DOCUMENT RESUME

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TITLE	Military Curricula for Vocational & Technical Education. Physical Therapy Specialist, 10-9.
INSTITUTION	Air Force Training Command, Sheppart AFB, Tex.: Ohio State Univ., Columbus. National Center for Research in Vocational Education.
SPONS AGENCY	Bureau of Occupational and Adult Education (DHEW/OE), Washington, D.C.
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NOTE	391p.: Sections containing small type will not reproduce well.
EDRS PRICE	MF01/PC16 Plus Postage.
DESCRIPTORS	*Allied Health Occupations Education: Anatomy: Behavioral Objectives: Competency Based Education: Course Descriptions: Curriculum Guides: Learning Activities: *Physical Therapy: *Physical Therapy Aides: Physiology: Postsecondary Education: Workbooks
IDENTIFIERS	Military Curriculum Project

ABSTRACT

This teaching guide and student study guides/workbooks are for a postsecondary course in the theory and practical application of physical therapy procedures and modalities needed to assist the physical therapist in administering physical therapy care. It is one of a number of military-developed curriculum packages selected for adaptation to vocational instructon and curriculum development in a civilian setting. The 197-hour course is divided into two blocks of instruction. Block I, Basic Sciences, contains three lessons covering 99 hours of instruction: Psychology of the Diseased and Injured (7 hours), Physiology (39 hours), and Anatomy (53 hours). Block II, Procedures and Modalities, contains three lessons covering 98 hours of instruction: Medical Conditions in Physical Therapy (18 hours), Physical Therapy Procedures (34 hours), and Physical Therapy Modalities (46 hours). Printed instructor materials include a course chart: a plan of instruction, criterion objectives, the duration of the lessons, and support materials needed: and a Specialty Training Standard for use in student performance evaluation. Student materials include three study guide/workbooks for Block I and four for Block II. The text suggested for use with the course, "The Physical and Occupational Therapy Technician," is not provided. Audiovisual aids suggested for use with this course include twenty-nine films, three transparency sets, and four mini-texts. (MEK)

Military Curricula for Vocational & Technical Education

PHYSICAL THERAPY SPECIALIST

10-9

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION
THE OHIO STATE UNIVERSITY

This military technical training course has been selected and adapted by The Center for Vocational Education for "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education," a project sponsored by the Bureau of Occupational and Adult Education, U.S. Department of Health, Education, and Welfare.

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL

Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION
The Ohio State University • 1960 Kenny Road • Columbus, Ohio 43210
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Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

Agriculture	Food Service
Aviation	Health
Building & Construction Trades	Heating & Air Conditioning
Clerical Occupations	Machine Shop
Communications	Management & Supervision
Drafting	Meteorology & Navigation
Electronics	Photography
Engine Mechanics	Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL Rebecca S. Douglass Director 100 North First Street Springfield, IL 62777 217/782-0759	NORTHWEST William Daniels Director Building 17 Airdustrial Park Olympia, WA 98504 206/753-0879
MIDWEST Robert Patton Director 1515 West Sixth Ave. Stillwater, OK 74704 405/377-2000	SOUTHEAST James F. Shill, Ph.D. Director Mississippi State University Drawer DX Mississippi State, MS 39762 601/325-2510
NORTHEAST Joseph F. Kelly, Ph.D. Director 225 West State Street Trenton, NJ 08625 609/292-6562	WESTERN Lawrence F. H. Zane, Ph.D. Director 1776 University Ave. Honolulu, HI 96822 808/948-7834

Developed by:
United States Air Force

Development and Review Dates
July 22, 1977

Occupational Area:
Health

Target Audiences:
Grades 13-adult

Print Pages:
369

Cost:
$7.50

Availability:
Military Curriculum Project, The Center for Vocational Education, 1960 Kenny Rd., Columbus, OH 43210

Contents:	Type of Materials: Lesson Plans	Programmed Text	Student Workbook (No. of pages)	Handouts	Text Materials	Audio-Visuals	Instructional Design: Performance Objectives	Tests	Review Exercises	Additional Materials Required	Type of Instruction: Group Instruction	Individualized
Block I — *Basic Sciences*								★				
Psychology of the Diseased and Injured	•		10		★	★	•		•		•	
Physiology	•		51		★	★	•		•		•	
Anatomy	•		86		★		•		•	★	•	
Block II — *Procedures and Modalities*								★				
Medical Conditions in Physical Therapy	•				★	★	•				•	
Physical Therapy Procedures	•		154		★	★	•			★	•	
Physical Therapy Modalities	•		97		★		•			★	•	
Physical Therapy Activities	•				★		•			★	•	

★ Materials are recommended but not provided.

Expires July 1, 1978

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Course Description

This course trains students in the theory and practical application of physical therapy procedures and modalities needed to assist the physical therapist in administering physical therapy care. Major areas of study are psychology of the diseased and injured, physiology, anatomy, medical conditions in physical therapy, physical therapy procedures and modalities. This course consists of two blocks of instruction covering 197 hours of instruction.

Block I — *Basic Sciences* contains three lessons covering 99 hours of instruction. Two lessons on orientation and the Air Force Physical Therapy Department were deleted. The included lesson topics and respective hours follow:

Psychology of the Diseased and Injured (7 hours)
Physiology (39 hours)
Anatomy (53 hours)

Block II — *Procedures and Modalities* contains four lessons covering 98 hours of instruction. A lesson on administration, communication, and ethics was deleted because it discusses specific military procedures and forms. The included lesson topics and respective hours follow:

Medical Conditions in Physical Therapy (18 hours)
Physical Therapy Procedures (34 hours)
Physical Therapy Modalities (46 hours)

This course contains both teacher and student materials. Printed instructor materials include a course chart; a plan of instruction detailing units of instruction, criterion objectives, the duration of the lessons, and support materials needed, and a Specialty Training Standard for use in student performance evaluation. Student materials include three study guide/workbooks for Block I and four study guide/workbooks for Block II.

The text recommended for this course is Air Force Manual 160-2, *The Physical and Occupational Therapy Technician.* The text is not provided. Audiovisual aids suggested for use with this course include 29 films, 3 transparency sets, and 4 mini-texts.

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COURSE CHART

NUMBER	PDS CODE	DATE
3ABR91330	FC2	24 November 1975

COURSE TITLE
Physical Therapy Specialist

ATC OPR AND APPROVAL DATE	CENTER OPR	SUPERSEDES COURSE CHART
SGHE, 25 March 1975	Sheppard/SHCS/MSDXC	3ABR91330, 25 March 1975

DEPARTMENT OPR Department of Biomedical Sciences	APPLICABLE TRAINING STANDARD STS 913X0, 25 March 1975
LOCATION OF TRAINING Sheppard AFB Texas 76311	COURSE SECURITY CLASSIFICATION UNCLASSIFIED
INSTRUCTIONAL DESIGN Group/Lock Step	TARGET READING GRADE LEVEL FOR PREPARATION OF TRAINING LITERATURE 11.4

LENGTH OF TRAINING (8 Weeks, 2 Days)

		Hours
Technical Training		314
Classroom/Laboratory (C/L)	252	
Complementary Technical Training (CTT)	62	
Related Training		22
Standard Traffic Safety (AFR 50-24)	14	
Commander's Call/Briefing	4	
End of Course Appointments; Predeparture Safety Briefing (ATCR 127-1)	4	
Total		336

REMARKS

Effective date: 23 January 1976 with class 760123

Applicable safety is integrated throughout the course.

TABLE I. MAJOR ITEMS OF EQUIPMENT

Microwave Diathermy Machine
Shortwave Diathermy Machine
Ultrasound Diathermy Machine
Infrared Lamp, 500 watt and 1000 watt
Ultraviolet Lamp
Hydrocollator
Paraffin Bath
Whirlpool, Leg and Arm
Traction Machine
Exercise Equipment
Medcollator

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COURSE CHART – TABLE II – TRAINING CONTENT

3ABR91330

NOTE: Include time spent on technical training (TT) (classroom/laboratory (C/L) and complementary technical training (CTT)) and related training (RT). Exclude time spent on individual assistance (remedial instruction). A single entry of time shown for a unit is C/L time. When a double entry is shown, the second entry is CTT time.

WK OF TNG / HRS PER DAY	1 2 3 4 5 6	7 8
1 2 3 4(3.6/5)	Course Material - UNCLASSIFIED 135 Hours TT BLOCK I - Basic Sciences Welcome and Orientation (2 hrs); USAF Physical Therapy Department (4 hrs); Psychology of the Diseased and Injured (7 hrs); Physiology (39/4 hrs); Anatomy (53/18 hrs); Measurement Test and Test Critique (8 hrs) 113 Hours C/L	14 Hours RT 22 Hours CTT
4(1.4/5) 5 6 7 8 9(2/5)	Course Material - UNCLASSIFIED 179 Hours TT BLOCK II - Procedures and Modalities Medical Conditions in Physical Therapy (18/4 hrs); Administration, Communication, and Ethics (9/4 hrs); Physical Therapy Procedures (34/12 hrs); Physical Therapy Modalities (46/16 hrs); Physical Therapy Activities (24/4 hrs); Measurement Test and Test Critique (6 hrs); Course Critique and Graduation (2 hrs) 139 Hours C/L	2 Hours RT 40 Hours CTT 6 Hours RT

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ATC FORM APR 73 449A PREVIOUS EDITION OBSOLETE.

PHYSICAL THERAPY SPECIALIST

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DEPARTMENT OF THE AIR FORCE
Headquarters US Air Force
Washington DC 20330

STS 913X0
(For AFSCs 91330/50/70)
25 March 1975

PHYSICAL THERAPY SPECIALIST AND PHYSICAL THERAPY TECHNICIAN

1. Purpose of this Specialty Training Standard (STS). As prescribed in AFR 8-13, this STS:

a. States in column 1 of attachment 1 the tasks, knowledges, and study references (SR) necessary for airmen to perform duties in the Physical Therapy ladder of the Airman Medical Career Field. These are based on the Specialty Description effective 1 March 1970 in AFM 39-1.

b. Indicates in columns 2A, 3A, and 4A of attachment 1 the minimum proficiency recommended for each task or knowledge for qualification at the 3, 5 and 7 skill level AFSCs. AFM 50-23 is the authority to change the proficiency level during JPM development when the local requirement is different from the level shown in this STS.

c. Shows in column 2A of attachment 1 the proficiency attained in Course 3ABR91330 (PDS Code FCL) described in AFM 50-5. Proficiency code for the minimum proficiency recommended for the 3 skill level AFSC and the proficiency attained in the course is the same except when dual codes are entered. When dual codes are entered the second code shows the proficiency attained in the course.

d. Provides basis for supervisors to plan and conduct individual OJT programs.

e. Provides a convenient record of on-the-job training completed when inserted in AF Form 623, "On-the-Job Training Record," and maintained in accordance with AFM 50-23.

f. Defines the knowledge requirements covered by Specialty Knowledge Tests in the Weighted Airman Promotion System.

2. Proficiency Code Key. Attachment 1 contains the Proficiency Code Key used to show proficiency level.

3. Career Development Channel of OJT. Personnel training to AFSCs 91350 and 91370 will obtain knowledge training by using applicable study references listed in this STS, and personnel training to AFSC 91370 must fulfill management training requirements specified in AFM 50-23. (See ECI Catalog and Guide, chapter 3, paragraph 3-5, for current CDC identification number for ordering purposes.)

4. Study Guidance for Weighted Airman Promotion System (WAPS). Specialty Knowledge Tests (SKTs) for promotion to E-5 are based on 5 skill level knowledge requirements. SKTs for promotion to E-6 and E-7 are based on 7 skill level knowledge requirements. SKT questions are based primarily on Career Development Courses (CDCs). However, some questions may be drawn from other references listed in this Specialty Training Standard. The CDCs for SKT study are maintained in the WAPS Study Reference Library. Other references listed should be available in the work area. Individual responsibilities are outlined in AFM 35-8, chapter 19, paragraph 19-3g.

5. Recommendations. Report to ATC/SG unsatisfactory performance of individual graduates or inadequacies of this STS. Refer to specific paragraphs of this STS. See AFR 50-38.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

DAVID C. JONES, General, USAF
Chief of Staff

JACK R. BENSON, Colonel, USAF
Director of Administration

2 Attachments
1. Qualitative Requirements
2. SKT Review Reference

Supersedes STS 913X0, 10 January 1974.

THIS BLOCK IS FOR IDENTIFICATION PURPOSES ONLY

TRAINEE		
NAME	INITIALS (In writing)	GRADE
ORGANIZATION		

IMMEDIATE SUPERVISOR'S NAME AND INITIALS (In writing)	
N I	N I
N I	N I

QUALITATIVE REQUIREMENTS

PROFICIENCY CODE KEY		
	SCALE VALUE	DEFINITION: The Individual
TASK PERFORMANCE LEVELS	1	Can do simple parts of the task. Needs to be told or shown how to do most of the task. (EXTREMELY LIMITED)
	2	Can do most parts of the task. Needs help only on hardest parts. May not meet local demands for speed or accuracy. (PARTIALLY PROFICIENT)
	3	Can do all parts of the task. Needs only a spot check of completed work. Meets minimum local demands for speed and accuracy. (COMPETENT)
	4	Can do the complete task quickly and accurately. Can tell or show others how to do the task. (HIGHLY PROFICIENT)
* TASK KNOWLEDGE LEVELS	a	Can name parts, tools, and simple facts about the task. (NOMENCLATURE)
	b	Can determine step by step procedures for doing the task. (PROCEDURES)
	c	Can explain why and when the task must be done and why each step is needed. (OPERATING PRINCIPLES)
	d	Can predict, identify, and resolve problems about the task. (COMPLETE THEORY)
** SUBJECT KNOWLEDGE LEVELS	A	Can identify basic facts and terms about the subject. (FACTS)
	B	Can explain relationship of basic facts and state general principles about the subject. (PRINCIPLES)
	C	Can analyze facts and principles and draw conclusions about the subject. (ANALYSIS)
	D	Can evaluate conditions and make proper decisions about the subject. (EVALUATION)

- EXPLANATIONS -

* A task knowledge scale value may be used alone or with a task performance scale value to define a level of knowledge for a specific task. (Examples: b and 1b)

** A subject knowledge scale value is used alone to define a level of knowledge for a subject not directly related to any specific task, or for a subject common to several tasks.

\- This mark is used alone instead of a scale value to show that no proficiency training is provided in the course, or that no proficiency is required at this skill level.

X This mark is used alone in course columns to show that training is not given due to limitations in resources.

1. TASKS, KNOWLEDGES AND STUDY REFERENCES	PROFICIENCY LEVEL, PROGRESS RECORD AND CERTIFICATION — 2. 3 Skill Level			3. 5 Skill Level			4. 7 Skill Level		
	A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
NOTE. Users may annotate lists of SRs to identify current references pending STS revision.									
1. CAREER LADDER PROGRESSION									
a. The Airman career ladder and Educational Opportunities	B			C			C		
SR: AFMs 39-1 (page A52-85 through A52-90). 50-5 (3ABR91330, 3AZR91370). 213-1 (chap 1. 3 and 4. para 6-1. 7-1. 7-2. 7-4. 7-5. 8-1. 8-2. 8-6. 9-1. 9-2. 9-6. 9-8): AFVA 39-1 (Medical 90 and 91)									
b. Progression career ladder 913X0	A			B			C		
SR: AFM 39-1 (page A52-85 through A52-90): AFR 35-1 (para 1-1. 1-2. 2-1. 2-2. 2-3c. 2-4. 3-1. 4-1 through 4-3. 5-3 through 5-9. 6-14 through 6-19. 6-21. 6-24 through 6-27. 6-31): AFVA 39-1 (Medical 90 and 91)									
c. Duties of AFSs 91330/50/70 (1) AFSC 91370. 91392	A			B			C		
SR: AFM 39-1 (page A52-85 through A52-88): AFR 160-12 (para 41)									
(2) AFSC 91330. 91350	B			C			C		
SR: AFM 39-1 (page A52-89. A52-90): AFR 160-12 (para 41)									
d. Mission. organization. development. and function of the Medical Service and the Physical Therapy Service	A			B			C	NO ADVANCE COURSE	
SR: AFMs 160-2 (chap 1): 168-4 (chap 1. para 7-39. 8-2. 9-3. 9-4. 9-10. 9-11. 9-15): AFR 20-28									
2. DISASTER PREPAREDNESS MEDICAL CARE AND FIRST AID PROCEDURES									
SR: AFMs 160-12 (chap 1). 160-34 (chap 5 and 9). 160-37 (chap 2 through 6)									
a. Manage shock	2b/-			3c			3c		
b. Maintain effective respiration	2b/-			3c			3c		
c. Control hemorrhage	2b/-			3c			3c		
d. Perform emergency treatment of wounds	2b/-			3c			3c		
e. Manage fractures. burns and injuries from chemical agents	2b/-			3c			3c		
f. Perform methods of hand and litter carries	2b/-			3c			3c		
g. Load and unload vehicles utilized for transportation of patients	2b/-			3c			3c		
h. Maintain military sanitation	a/-			1b			2b		

TASKS, KNOWLEDGES AND STUDY REFERENCES	2. 3 Skill Level A AFSC Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	3. 5 Skill Level A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	4. 7 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
3. COMMUNICATIONS SECURITY (TRANSMISSION SECURITY)									
SR: AFRs 205-1, 2c5-7									
a. Identify information as classified, unclassified, or of possible intelligence value	b			b			b		
b. Identify official information as Top Secret, Secret, Confidential, or For official use Only	b			b			b		
c. Select and recommend mode of transmission dictated by security and expediency required	b			b			b		
d. Observe security precautions involved in communications	b			b			b		
4. ENVIRONMENTAL SAFETY									
SR: AFM 160-2 (para 12-1b, 12-17c, 12-17d, chap 12, sec E); AFR 127-101 (para 2-6, 2-12, 2-14, 2-16, 2-17, 2-18, 2-21, 2-22, 2-23, 6-1, 6-10, 10-16 through 10-16b, 10-20c, 14-1 through 14-5, 14-13j, 14-1?n, 14-15?, 14-15m, 14-15o)									
a. Principles of general safety	B			C			D		
b. Exercise safety precautions during job performance	2c			4c			4d		
c. Accident reporting	A			B			C	NO ADVANCED COURSE	
5. PROFESSIONAL AND PATIENT RELATIONSHIPS									
SR: AFMs 160-2 (chap 12, sec B and C), 160-34 (chap 1)									
a. Promote professional relations with patients and medical personnel	2b/b			3c			4c		
b. Maintain professional standard of ethics	2b/b			3c			4c		
c. Perform duties with a high standard of conduct	2b/b			3c			4c		
6. PUBLICATIONS									
a. Use indexes to locate official publications	1a/a			3c			3c		
SR: AFRs 0-1, 0-2									
b. Locate required information in official and commercial publications	2b/b			3c			3c		
SR: AFMs 5-1 (chap 1, 2, 3 and 6), 168-4 (para 1-12); AFRs 0-1, 0-2									

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1. TASKS, KNOWLEDGES AND STUDY REFERENCES	2. 3 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	3. 5 Skill Level A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	4. 7 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
6c. Initiate requests for official and commercial publications	1a/a			2b			3c		
SR: AFM 168-4 (para 1-12)									
d. Maintain publication files	1a/a			2b			3c		
SR: AFM 168-4 (para 1-12); AFR 5-31 (para 1-1, 2-1, 2-3 through 2-8, 2-12)									
7. MEDICAL MATERIEL PROCEDURES									
a. Air Force accountability and responsibility	B			C			C		
SR: AFM 168-4 (para 1-16, 9-2, 9-3, 9-4, 9-15); AFR 67-10 (para 1, 2, 3, 4, 10 and 11)									
b. Prepare request for issue turn/in of supplies and equipment	1b/b			3c			4c		
SR: AFMs 67-1 (vol V, chap 1, atch 1; chap 16, atch 1, part III; chap 18, sec C); 167-240 (chap 10, fig 10-6)									
c. Report of survey system	A			B			C	NO ADVANCED COURSE	
SR: AFM 177-111 (chap 1, 2, 4, 7 and 9)									
8. SUPERVISION AND TRAINING									
a. Supervision									
(1) Evaluate performance of subordinate personnel	-			3c			4d		
SR: AFMs 39-1 (page A52-85 through A52-90), 39-62; AFRs 39-6, 40-451									
(2) Plan and schedule work assignments and priorities	-			3c			4c		
SR: AFM 50-20 (units 2 and 3); AFR 39-6									
(3) Prepare correspondence, reports, records, and schedules	1b			3c			4c		
SR: AFMs 10-1 (chap 1, 2, 4, 6 and 8, para 3-2, 3-3, 5-2, 5-5, 5-7), 160-2 (para 12-2 through 12-3.2), 168-420 (para 1-12a, 1-12d, 1-13d, 1-18)									
(4) Establish work methods, controls and performance standards	-			3c			4c		
SR: AFM 50-20 (units 2 and 3)									

1. TASKS, KNOWLEDGES AND STUDY REFERENCES	PROFICIENCY LEVEL, PROGRESS RECORD AND CERTIFICATION — 2. 3 Skill Level — A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	3. 5 Skill Level — A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	4. 7 Skill Level — A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
8a(5) Recommend policy changes on utilization of personnel and equipment	-			3c			4c		
SR: AFM 26-1 (para 8-2, chap 9)									
(6) Resolve technical problems encountered by subordinates	-			3c			4c		
SR: AFR 39-6									
(7) Counsel personnel and resolve individual problems	-			3c			4c		
SR: AFMs 39-12, 39-30 (sec A); AFRs 35-32 (para 2, 5, 6, 9 through 18), 39-6									
b. Training									
(1) Orient newly assigned personnel on standard operating procedures	-			3c			4c		
SR: AFMs 39-1 (page A52-85 through A52-89), 50-20 (unit 4), 50-23									
(2) Recommend personnel for training	-			3c			4c		
SR: AFMs 39-1 (page A52-86 through A52-90), 50-5 (3AZR91370), 50-23; AFRs 39-4 (chap 1, 2); 50-9 (para 8a, 17, 19, 20, 21, 28)									
(3) Plan and conduct OJT programs and refresher training	-			3c			4c		
SR: AFMs 39-1, 50-23, 50-62									
(4) Maintain OJT records	-			3c			4c		
SR: AFM 50-23									
9. PSYCHOLOGY OF THE DISEASED AND INJURED									
SR: AFM 160-2 (chap 2 and 8); F. H. Krusen (Ed), F. J. Kottke (Assoc. Ed) and P. M. Elwood (Assoc. Ed), <u>Handbook of Physical Medicine and Rehabilitation</u> (2nd ed) Philadelphia: W. B. Saunders Company, 1971 (page 762 through 767)									
a. Modes of reaction to physical disability	B			C			C		
b. Phases of adaptation to physical disability	B			C			C		
c. Techniques for managing the physically disabled	B			C			C		
d. Staff reactions to the physically disabled	B			C			C		

NO ADVANCED COURSE

1. TASKS, KNOWLEDGES AND STUDY REFERENCES	PROFICIENCY LEVEL, PROGRESS RECORD AND CERTIFICATION								
	2. 3 Skill Level			3. 5 Skill Level			4. 7 Skill Level		
	A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
10. ANATOMY AND PHYSIOLOGY									
SR: AFM 160-2 (chap 2 and 3); L. Daniels and C. Worthingham, Muscle Testing, Techniques of Manual Examination (3rd ed) Philadelphia, W. B. Saunders Company, 1972; C. M. Goss (ed) Gray's Anatomy (28th ed) Philadelphia, Lea Febiger, 1966 (page 57, 58, 61, 63, 67, 68, 70, 87 through 105), A. C. Guyton, Basic Human Physiology, Normal Function and Mechanisms of Disease, Philadelphia, W. B. Saunders Company, 1971 (chap 1, 2, 4, 7, page 186 through 190, 586 through 593)									
a. Nervous system	B			B			C		
b. Respiratory system	B			B			C		
c. Cardiovascular system	B			B			C		
d. Lymphatic system	B			B			C		
e. Renal system	A			A			B		
f. Endocrine system	-			A			B		
g. Integumentary system	B			B			C		
h. Digestive system	-			A			B		
i. Skeletal system	B			C			D		
j. Muscular system	B			C			D	NO ADVANCED COURSE	
11. PHYSICAL THERAPY PROCEDURES AND MODALITIES									
SR: AFM 160-2 (chap 2 and 9); AFP 160-14; F. H. Krusen (Ed), F. J. Kottke (Assoc Ed), P. M. Ellwood (Assoc Ed), Handbook of Physical Medicine and Rehabilitation (2nd ed) Philadelphia, W. B. Saunders Company, 1971 (chap 2, 3, 4, 9 through 17, 19); S. Licht (Ed) Therapeutic Exercise (2nd ed revised) Baltimore, Waverly Press Inc., 1965 (chap 2, 3, 4, 8, 15, 23, 24 and 32)									
a. Use physical therapy equipment	2c			3c			4d		
b. Use hospital aseptic techniques	2c			3c			4d		
c. Position patients for treatment	2c			3c			4d		
d. Physical therapy procedures									
(1) Therapeutic exercise									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Develop programs	2b/b			3c			4c		
(c) Instruct patients in programs	2b/b			3c			4c		
(d) Administer programs	2b			3c			4c		
(e) Use common types of equipment	2b			3c			4c		

1. TASKS, KNOWLEDGES AND STUDY REFERENCES	2. 3 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	3. 5 Skill Level A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	4. 7 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
11d(2) Perform joint range of motion, extremity girth, and leg length measurements	2b			3c			4c		
(3) Use transfer activities	2b			3c			4c		
(4) Crutch and cane ambulation									
(a) Gaits	B			B			C		
(b) Adjust, fit and instruct	2b			3c			4c		
(5) Massage									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply procedures	2b			3c			4c		
(6) Postural drainage									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply procedures	2b			3c			4c		
e. Physical therapy modalities									
(1) Infrared lamp									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(2) Moist heat packs									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(3) Paraffin bath									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(4) Whirlpool									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		

NO ADVANCED COURSE

1. TASKS, KNOWLEDGES AND STUDY REFERENCES	2. 3 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	3. 5 Skill Level A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	4. 7 Skill Level A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
11e(5) Microwave diathermy									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(6) Shortwave diathermy									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(7) Ultrasound diathermy									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(8) Ultrasound-electrical stimulation									
(a) Physiological effects, indications and contraindications	B			B			C	NO ADVANCED COURSE	
(b) Apply modality	2b/b			3c			4c		
(9) Electrical stimulation									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(10) Traction									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply cervical	2b			3c			4c		
(c) Apply pelvic	2b/b			3c			4c		
(11) Ultraviolet light									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		
(12) Cryotherapy									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b			3c			4c		

1. TASKS, KNOWLEDGES AND STUDY REFERENCES	PROFICIENCY LEVEL, PROGRESS RECORD AND CERTIFICATION								
	2. 3 Skill Level			3. 5 Skill Level			4. 7 Skill Level		
	A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	A AFSC	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials	A AFSC/Crs	B Date OJT Started	C Date Completed & Trainee's Supervisor's Initials
11e(13) Contrast packs and bath									
(a) Physiological effects, indications and contraindications	B			B			C		
(b) Apply modality	2b/b			3c			4c		
12. MEDICAL CONDITIONS IN PHYSICAL THERAPY									
SR: AFM 160-2 (chap 2, 4, 5 and 6); F. H. Krusen (Ed), F. J. Kottke (Assoc. Ed) and P. M. Elwood (Assoc. Ed), Handbook of Physical Medicine and Rehabilitation (2nd Ed) Philadelphia, W. B. Saunders Company, 1971 (chap 23, 24, 25, 26, 27, 29, 30, 32, 34, 35 and 36)									
a. Orthopedic conditions	A			B			C		
b. Neurological conditions	A			B			C		
c. Surgical conditions	A			B			C		
d. Internal medical conditions	A			B			C		
							NO ADVANCED COURSE		

SKT REVIEW REFERENCES

1. This attachment identifies review references for the Specialty Knowledge Test (SKT) under the Weighted Airman Promotion System (WAPS). The basic information needed for the SKT is covered in the Career Development Course (CDC). Other references are cited when the CDC requires supplementation to ensure currency and completeness of coverage or where no CDC exists. The attachment identifies the specific career field ladder by AFSCs and its associated Air Force Personnel Tests (AFPTs) by AFPT number.

2. Reference listings are limited to the basic reference. Amendments, revisions, and changes are considered a part of the basic reference. If publications are superseded or replaced by other publications, the latter should be regarded as part of the review references. If CDCs and other listed study references are in conflict, the later-dated reference takes precedence.

AFSCs: 91330/50/70 - Physical Therapy Specialist/Technician

AFPTs: 91350/60/70

REVIEW REFERENCES	FOR PROMOTION TO E-5	E-6	E-7
AFM 160-2			
Chapters 2, 3, 4, 5, 6, 8, 9, 11, and 12	X	X	X
Any basic text such as <u>Handbook of Physical Medicine and Rehabilitation</u>. Frank Krusen, F. J. Kottle, and P. M. Ellwood, W. B. Saunders Co., 1971:			
Chapters 2, 4, 10, 11, 13, 15, 16, 17, 19, 23, 24, 25, 27, and 35	X		
Chapters 2, 3, 4, 10, 11, 12, 13, 16, 23, 24, 29, 30, 34, and 36		X	
Chapters 2, 3, 4, 9, 11, 12, 14, 16, 23, 24, 26, 30, 35, and 36			X
Any basic text such as <u>Therapeutic Exercise</u>, 2nd Edition. Sidney Licht, Waverly Press, Incorporated, 1965:			
Chapters 8 and 24	X		
Chapters 8, 24, and 32		X	
Chapters 3, 6, 8, 15, 23, and 32			X

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PLAN OF INSTRUCTION

(Technical Training)

PHYSICAL THERAPY SPECIALIST

10-9

SHEPPARD TECHNICAL TRAINING CENTER

22 July 1975 - Effective 20 October 1975 with Class 751020

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DEPARTMENT OF THE AIR FORCE
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas 76311

PLAN OF INSTRUCTION 3ABR91330
(PDS Code FC2)
22 July 1975

FOREWORD

1. PURPOSE. This plan of instruction prescribes the qualitative requirements for Course Number 3ABR91330, Physical Therapy Specialist, in terms of criterion objectives presented by units/modules of instruction, and shows duration, correlation with the training standard, support materials, and instructional guidance. It was developed under the provisions of ATCR 50-5, Instructional System Development, and ATCR 52-7, Plans of Instruction.

2. COURSE DESCRIPTION. This 8 week, 2 day technical training course trains personnel to perform duties prescribed in AFM 39-1 for Physical Therapy Specialist, AFSC 91330. It trains the student in the theory and practical application of physical therapy procedures and modalities needed to assist the physical therapist in administering physical therapy care. Major areas of studies are (1) psychology of the diseased and injured; (2) physiology; (3) anatomy; (4) medical conditions in physical therapy; (5) administration, communication, and ethics; (6) physical therapy procedures and modalities. In addition, related training is provided on Commander's Call, Traffic Safety, Supplemental Military Training (SMT), End of Course Appointments, and Traffic Safety Predeparture Briefing.

3. EQUIPMENT ALLOWANCE AND AUTHORIZATION. Training equipment required to conduct this course, and for which accountability must be maintained, is found in the Report of Medical and Non-medical In-use Equipment, and is listed under custody account number 28558F.

NOTE: Group size is shown in parentheses after equipment listed in column 3 of numbered pages of this POI.

4. MULTIPLE INSTRUCTOR REQUIREMENTS. Units of instruction which require more than one instructor per instructional group are identified in the multiple instructor annex to this POI.

5. REFERENCES. This plan of instruction is based on SPECIALTY TRAINING STANDARD 913X0, 25 March 1975, and COURSE CHART 3ABR91330, 25 March 1975.

FOR THE COMMANDER

LORNE A. DAVIS
Chief, Training Operations Division

Supersedes Plan of Instruction 3ABR91330, 15 February 1974
OPR: Department of Biomedical Sciences
DISTRIBUTION: Listed on Page A

MODIFICATIONS

Lessons 1 + 2 of this publication has (have) been deleted in adapting this material for inclusion in the "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education." Deleted material involves extensive use of military forms, procedures, systems, etc. and was not considered appropriate for use in vocational and technical education.

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
2. USAF Physical Therapy Department a. Explain the mission, objectives and organization of the USAF Physical Therapy Department and the 913X0 career field.	4	Column 1 Reference: 2a STS Reference: 1a, 1b, 1c(1), 1c(2), 1d Instructional Materials AFM 160-2, The Physical and Occupational Therapy Technician, Chapter 1 Audio Visual Aids FLC 4/102, The Decision Training Methods Lecture and Discussion (4 hrs) Instructional Environment/Design Classroom (4 hrs) Group/Lock Step Instructional Guidance During the last hour tour the physical therapy department laboratory briefly explaining and showing the equipment students will be using during their training.
3. Psychology of the Diseased and Injured a. Explain the psychological theories and processes of the diseased and injured.	7	Column 1 Reference: 3a STS Reference: 9a, 9b, 9c, 9d Instructional Materials AFM 160-2, Chapters 2 and 8 SW 3ABR91330-I-3, Psychology of the Diseased and Injured Audio Visual Aids TF 5963, Atmosphere for Therapy Voice tape by Dr. Murry Banks Training Methods Lecture and Discussion (7 hrs)

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION [illegible]	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		<u>Instructional Environment/Design</u> Classroom (7 hrs) Group/Lock Step <u>Instructional Guidance</u> Administer measurement test and test critique, POI item 4, during the first two hours of the first training day following completion of unit 3 of the POI.
4. <u>Measurement Test and Test Critique</u>	2	
5. <u>Physiology</u>	39	<u>Column 1 Reference</u> — <u>STS Reference</u> 5a — 10a, 10j 5b — 10a 5c — 10b 5d — 10c 5e — 10d 5f — 10e 5g — 10g 5h — 10a, 10g 5i — 10j
a. Recognize the structures and explain the functions of the cell.	(6)	
b. Recognize the structures and explain the functions of the nervous system.	(12)	
c. Recognize the structures and explain the functions of the respiratory system.	(4)	
d. Recognize the structures and explain the functions of the cardiovascular system.	(4)	<u>Instructional Materials</u> AFM 160-2, Chapters 2 and 3 SW 3ABR91330-I-5, Physiology
e. Recognize the structures and explain the functions of the lymphatic system.	(2)	<u>Audio Visual Aids</u> FLC 3/78, The Cell Structure, Unit of Life TF 8227E, Human Body - Nervous System
f. Identify the structures and functions of the renal system.	(2)	FLC 16/100, Exam of Neurological Systems FLC 18/92, Respiration in Man TF 8227A, Human Body - Circulatory System
g. Recognize the structures and explain the functions of the integumentary system.	(2)	FLC 22/25, Varicose Veins FLC 23/91, The Work of the Heart
h. Recognize the structures and explain the functions of the body's heat regulatory system.	(4)	16mm Film, Title, Fundamentals of the Nervous System 16mm Film, Title, Endocrine Glands 16mm Film, Title, The Decubitus Ulcer FLC 13/180, Muscle: Dynamics of Contraction

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PLAN OF INSTRUCTION (Continued)

[illegible]	DURATION HOURS	SUPPORT MATERIALS AND GUIDANCE
i. Recognize the structures and explain the functions of the muscular system.	(3)	**Training Methods** Lecture and Discussion (39 hrs) **Instructional Environment/Design** Classroom (39 hrs) Group/Lock Step **Instructional Guidance** Administer measurement test and test critique, POI Item 6, during the first three hours of the training day following completion of unit 5 of the POI.
6. Measurement Test and Test Critique	3	
7. Anatomy	55 (53/2)	**Column 1 Reference** / **STS Reference** 7a — 10a, 10i, 10j 7b — 10a, 10i, 10j 7b — 10a, 10i, 10j
a. Recognize the axial skeleton structures and explain the functions of the bones and their selected parts, the joints and their selected parts, the nerves, and the muscles which are the prime movers for the axial skeleton.	(19)	**Instructional Materials** AFM 160-2, Chapters 2 and 3 SW 3ABR91330-I-7, Anatomy L. Daniels, M. Williams, and C. Worthington, Muscle Testing; Techniques for Manual Examination (2nd and 3rd Ed.), W. B. Saunders, Philadelphia, Pa.
b. Recognize the upper extremity structures and explain the functions of the bones and their selected parts, the joints and their selected parts, the nerves, and the muscles which are the prime movers for the upper extremity.	(18)	**Audio Visual Aids** Transparencies, Osteology Set Transparencies, Myology Set TF 82271, Human Body - Skeleton TF 1-4883, Surgical Approach to the Joints of the Spine and Sacroiliac TF 1-4884, Surgical Approach to the Sternoclavicular and Acromioclavicular Joint TF 1-4877, Surgical Approach to the Scapulohumeral Joint TF 1-4876, Surgical Approach to the Elbow Joint
c. Recognize the lower extremity structures and explain the functions of the bones and their selected parts, the joints and their selected parts, the nerves, and the muscles which are the prime movers for the lower extremity.	(16)	TF 1-4078, Surgical Approach to the Wrist Joint TF 1-4379, Surgical Approach to the Hip Joint

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PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
		Audio Visual Aids (Cont'd) TF 1-4880, Surgical Approach to the Knee Joint TF 1-4881, Surgical Approach to the Ankle Joint TF 1-4882, Surgical Approach to the Joints of the Foot **Training Equipment** Myology Model, Upper Extremity (12) Myology Model, Lower Extremity (12) Skeleton, Articulated (12) Skeleton, Disarticulated (6) **Training Methods** Lecture and Discussion (53 hrs) Outside Assignments (2 hrs) **Instructional Environment/Design** Classroom (53 hrs) Home Study (2 hrs) Group/Lock Step **Instructional Guidance** Administer measurement test and test critique, POI item 9, during the first three hours of the training day following the completion of unit 7 of the POI.
8. Related Training (identified in course chart)	34	
9. Measurement Test and Test Critique	3	

PLAN OF INSTRUCTION	COURSE TITLE Physical Therapy Specialist	
BLOCK TITLE Procedures and Modalities		
UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
1. Medical Conditions in Physical Therapy	22 (18/4)	Column 1 Reference — STS Reference 1a — 12a, 12b 1b — 12c, 12d
a. Identify orthopedic and neurological conditions which may be treated with physical therapy.	(15)	Instructional Materials AFM 160-2, The Physical and Occupational Therapy Technician, Chapters 2, 4, 5, and 6
b. Identify surgical and internal medical conditions which may be treated with physical therapy.	(3)	Audio Visual Aids FLC 18/115, Delta FR-1024, Surgical Repair of the Posteriorly Unstable Shoulder TF-6144, Patellectomy with Reconstruction of Quadriceps Tendon TF-8118, Sciatic Pain and Intervertebral Disc Mini-text #13 - Injections of 3 Commonly-Affected Arthritic Joints Mini-text #17 - Mechanisms of Lubrication in Joints Mini-text #18 - Pathology of Arthritic Joints Mini-text #19 - Treatment of Arthritic Joints Training Methods Lecture and Discussion (18 hrs) Outside Assignments (4 hrs) Instructional Environment/Design Classroom (18 hrs) Home Study (4 hrs) Group/Lock Step Instructional Guidance Stress that patient safety will be the responsibility of the student when he is assigned to a physical therapy clinic following graduation from this course.
2. ~~Administration,~~ Communication, and Ethics	13 (9/4)	Column 1 Reference — STS Reference 2a — 4c, 5a, 5b, 5c, 8a(3) 2b — ~~6a, 6b, 6c, 6d, 8a(3)~~ 2c — 7a, 7b, 7c
a. Explain professional and patient relationships and accident reporting.	(1)	

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PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3	
b. Identify procedures for securing and using official and commericial publications.	(1)	2d 2e	3a, 3b 3c, 3d
c. Explain Administrative and Medical Materiel Procedures.	(7)	Instructional Materials AFM 160-2, Chapter 12 SW 3ABR91330-II-2, Administration, Communication, and Ethics SW 3ABR9XXXX, Communication Security	
d. Identify information as classified, unclassified, of possible intelligence value, Top Secret, Secret, Confidential, or For Official Use Only.	(0/1)	Audio Visual Aids Transparencies, Administrative Set	
e. Select and recommend mode of transmission dictated by security and expediency required and observe security precautions involved in communications.	(0/1)	Training Methods Lecture and Discussion (9 hrs) Outside Assignments (4 hrs) Instructional Environment/Design Classroom (9 hrs) Home Study (4 hrs) Group/Lock Step Instructional Guidance Stress importance of keeping up-to-date patient progress notes. Administer measurement test and test critique, POI item 3, during the first two hours of the first training day following completion of unit 2 of the POI.	
3. Measurement Test and Test Critique	2		
4. Physical Therapy Procedures	46 (34/12)	Column 1 Reference	STS Reference
a. Explain the principles of aseptic technique required in the operation of a physical therapy department.	(2)	4a 4b 4c	4a, 4b, 11b 4a, 4b, 11a, 11c 4a, 4b, 11a, 11d(1)(a), 11d(1)(b), 11d(1)(c), 11d(1)(d), 11d(1)(e)
b. Explain the principles of positioning patients for physical therapy care.	(2)	4d 4e 4f	4a, 4b, 11a, 11d(2) 4a, 4b, 11a, 11d(3) 4a, 4b, 11d(4)(a), 11d(4)(b)
c. Recognize and explain the classification, physiological effects, indications, contraindications, and the principles of applying therapeutic exercise.	(4)	4g 4h 4i	4a, 4b, 11d(5)(a), 11d(5)(b) 4a, 4b, 11d(6)(a), 11d(6)(b) 4a, 4b, 8a(3), 11a, 11b, 11c, 11d(1)(d), 11d(1)(e), 11d(2), 11d(3), 11d(4)(b), 11d(5)(b), 11d(6)(b)
d. Recognize and explain the principles of joint range of motion, extremity girth, and leg length measurement.	(2)		

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PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
e. Recognize and explain the principles of transfer activities. f. Recognize and explain the principles of crutch and cane ambulation. g. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of massage. h. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of postural drainage. i. Given the necessary equipment in a simulated USAF Physical Therapy Department, administer therapeutic exercise, joint range of motion, extremity girth and leg length measurements, crutch and cane ambulation, massage, and postural drainage to student patients as prescribed on Standard Form 513, Consultation Sheet.	(1) (2) (2) (1) (18)	Instructional Materials AFM 160-2, Chapters 2 and 9 SW 3ABR91330-II-4b, Procedures and Modalities SW 3ABR91330-II-4c, Therapeutic Exercise SW 3ABR91330-II-4d, Therapeutic Tests and Measurements SW 3ABR91330-II-4e, Transfer Activities and Gait Training Audio Visual Aids FLC 18/90, Range of Motion Therapy Training Equipment N-K Table with Slotted Weights (12) Ankle Exerciser with Slotted Weights (12) Wheelchair (4) Axillary Crutches (1) Forearm Crutches (3) Cane (2) Exercise Weights (2) Goniometers (2) Tape Measure (4) Training Methods Lecture and Discussion (16 hrs) Performance (18 hrs) Outside Assignments (12) Instructional Environment/Design Classroom (16 hrs) Laboratory (18 hrs) Home Study (12 hrs) Group/Lock Step Instructional Guidance During the periods of performance the instructors will insure that all the required safety precautions are being practiced by the students. One instructor is required for each 6 students during the performance. Administer measurement test and test critique, POI item 5, during the first two hours of the first training day following completion of unit 4 of the POI.
5. Measurement Test and Test Critique	2	

PLAN OF INSTRUCTION (Continued)

1. UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2. DURATION (HOURS)
6. Physical Therapy Modalities	62 (46/16)
a. Explain the general principles of the physiological effects, indications, and contraindications for applying heat.	(2)
b. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of infrared light.	(1.5)
c. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of moist heat.	(1.5)
d. Recognize and explain the physiological effects, indications, contraindications and principles of the application of paraffin baths.	(1)
e. Recognize and explain the physiological effects, indications, contraindications and principles of the application of whirlpool.	(1)
f. Recognize and explain the physiological effects, indications, contraindications and principles of the application of microwave diathermy.	(3)
g. Recognize and explain the physiological effects, indications, contraindications and principles of the application of shortwave diathermy.	(3)

3. SUPPORT MATERIALS AND GUIDANCE

Column 1 Reference	STS Reference
6a	11e(1)(a), 11e(2)(a), 11e(3)(a), 11e(4)(a), 11e(5)(a), 11e(6)(a), 11e(7)(a)
6b	4a, 4b, 11a, 11e(1)(a), 11e(1)(b)
6c	4a, 4b, 11a, 11e(2)(a), 11e(2)(b)
6d	4a, 4b, 11a, 11e(3)(a), 11e(3)(b)
6e	4a, 4b, 11a, 11e(4)(a), 11e(4)(b)
6f	4a, 4b, 11a, 11e(5)(a), 11e(5)(b)
6g	4a, 4b, 11a, 11e(6)(a), 11e(6)(b)
6h	4a, 4b, 11a, 11e(7)(a), 11e(7)(b), 11e(8)(a), 11e(8)(b)
6i	4a, 4b, 11a, 11e(8)(a), 11e(8)(b), 11e(9)(a), 11e(9)(b)
6j	4a, 4b, 11a, 11e(10)(a), 11e(10)(b), 11e(10)(c)
6k	4a, 4b, 11a, 11e(11)(a), 11e(11)(b)
6l	4a, 4b, 11a, 11e(12)(a), 11e(12)(b), 11e(13)(a), 11e(13)(b)
6m	4a, 4b, 8a(3), 11a, 11b, 11c, 11e(1)(b), 11e(2)(b), 11e(3)(b), 11e(4)(b), 11e(5)(b), 11e(6)(b), 11e(7)(b), 11e(9)(b), 11e(10)(b), 11e(11)(b), 11e(12)(b)

Instructional Materials
AFM 160-2, Chapters 2 and 9
SW 3ABR91330-II-4b

Training Equipment
Ultraviolet Light (6)
Spot Quartz UV (6)
Infrared Light (3)
Moist Heat Packs (2)
Cold Pack (2)
Traction Machine (6)
Paraffin Bath (12)
Whirlpool (6)
Electrical Stimulator (6)
Microwave Diathermy (6)

PLAN OF INSTRUCTION (Continued)

UNITS OF INSTRUCTION AND CRITERION OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3
h. Recognize and explain the physiological effects, indications, contraindications and principles of the application of ultrasound diathermy.	(3)	Training Equipment (Cont'd) Shortwave Diathermy (6) Ultrasound Diathermy (12) Training Methods Lecture and Discussion (24 hrs) Performance (22 hrs) Outside Assignments (16 hrs)
i. Recognize and explain the physiological effects, indications, contraindications and principles of the application of electrical stimulation.	(2)	Instructional Environment/Design Classroom (24 hrs) Laboratory (22 hrs) Home Study (16 hrs) Group/Lock Step
j. Recognize and explain the physiological effects, indications, contraindi- tions and principles of the application of traction.	(2)	Instructional Guidance During the periods of performance the instructors will insure that all the required safety precautions are being practiced by the students. One instructor is required for each 6 students during performance hours.
k. Recognize and explain the physiological effects, indications, contraindications and principles of the application of ultraviolet light.	(2)	
l. Recognize and explain the physiological effects, indications, contraindications and principles of the application of cryotherapy, contrast baths, and contrast packs.	(2)	
m. Given the necessary equipment in a simulated USAF Physical Therapy Department, administer infrared light, moist heat, paraffin bath, whirlpool, microwave diathermy, shortwave diathermy, ultrasound diathermy, electrical stimulation, traction, ultraviolet light, and cryotherapy to student patients as prescribed on Standard Form 513, Consultation Sheet.	(22)	

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PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
7. Physical Therapy Activities a. Given the necessary equipment and supplies in a simulated USAF Physical Therapy Department, administer physical therapy care to student patients as prescribed on Standard Form 513, Consultation Sheet, and maintain proper cleanliness and order of the physical therapy department and equipment.	28 (24/4)	Column 1 Reference 7a STS Reference 4a, 4b, 8a(3), 11a, 11b, 11c, 11d(1)(d), 11d(1)(e), 11d(2), 11d(3), 11d(4)(b), 11d(5)(b), 11d(6)(b), 11e(1)(b), 11e(2)(b), 11e(3)(b), 11e(4)(b), 11e(5)(b), 11e(6)(b), 11e(7)(b), 11e(9)(b), 11e(10)(b), 11e(11)(b), 11e(12)(b) Instructional Materials AFM 160-2, Chapters 9 and 12 Training Equipment N-K Table with Slotted Weights (12) Ankle Exerciser with Slotted Weights (12) Wheelchair (4) Axillary Crutches Forearm Crutches (3) Cane (2) Exercise Weights (2) Goniometers (2) Tape Measure (4) Ultraviolet Light (6) Spot Quartz UV (6) Infrared Light (3) Moist Heat Packs (2) Cold Pack (2) Traction Machine (6) Paraffin Bath (12) Whirlpool (6) Electrical Stimulator (6) Microwave Diathermy (6) Shortwave Diathermy (6) Ultrasound Diathermy (12) Wringer Bucket and Mop (4) Broom (4)

PLAN OF INSTRUCTION NO. 3ABR91330	DATE 22 JUL 1975	BLOCK NO. II	PAGE NO. 11

PLAN OF INSTRUCTION (Continued)

1 UNITS OF INSTRUCTION AND CRITERION OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
		Training Methods Performance (24 hrs) Outside Assignments (4 hrs) **Instructional Environment/Design** Laboratory (24 hrs) Home Study (4 hrs) Group/Lock Step **Instructional Guidance** Reemphasize the importance of practicing safety precautions, maintaining safe environmental conditions, and performing equipment operational safety inspections. One instructor is required for each six students to maintain proper control and assure safety practices are observed.
8. Related Training (identified in course chart)	8	
9. Measurement Test and Test Critique	2	
10. Course Critique and Graduation	2	

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
10 OCT 1975 MAY 1974	
COURSE NUMBER 3ABR91330	**COURSE TITLE** Physical Therapy Specialist
BLOCK NUMBER I	**BLOCK TITLE** Basic Sciences

LESSON TITLE
Psychology of the Diseased and Injured

LESSON DURATION

CLASSROOM/~~Laboratory~~	Complementary	TOTAL
7 hrs /0 hrs	0 hrs	7 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
23	~~15 Feb 1974~~ 2 JUL 1975	3

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[illegible]	10 MAY [illegible]	Roy M. Conner	17 OCT [illegible]
[illegible]	25 OCT [illegible]		
[illegible]	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 7 & 8 SW 3ABR91330-I-3. Film: TF5963, Atmosphere for Therapy Voice Tape by Dr. Murray Banks Psychology of the Diseased and Injured

CRITERION OBJECTIVES AND TEACHING STEPS

3a. Explain the psychological theories and processes of the diseased and injured. (Teaching steps listed in Part II)

ATC FORM AUG 72 770

GPO: 1972 770-388/28

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MGDB 10 OCT 19 / 9 May 1974	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
I	Basic Sciences

LESSON TITLE
Cell

LESSON DURATION

CLASSROOM/Laboratory	Complimentary	TOTAL
6 hrs / 12 hrs	0 hrs	6 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
3	~~15 Feb 1974~~ 22 JUL 7	5a.

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	10 MAY 1974	Kay M. Conner	17 OCT 1975
Kay M. Conner	20 OCT 1974		
Kay M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 SW 3ABR91330-I-5, Physiology Film: FLC 3/78-The Cell Structure, Unit of Life; FLC 4-013 Diffusion and Osmosis; FLC 13-0222, Mitosis

CRITERION OBJECTIVES AND TEACHING STEPS

5a. Recognize the structures and explain the functions of the cell.

(Teaching steps listed in Part II)

ATC FORM 770

GPO 1972 779-380/30

32

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER I	BLOCK TITLE Basic Sciences

LESSON TITLE
Nervous System

LESSON DURATION

CLASSROOM/Laboratory	~~XXXXXXXX~~ Complementary	TOTAL
12 ~~11~~ hrs	0 hrs	12 ~~11~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
3	22 JUL 7? ~~15 Feb 1974~~	5b

STS/CTS REFERENCE

NUMBER	DATE
STS 915X0	10 ~~January 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	10 MAY 1974	[signature]	17 OCT 1975
[signature]	? 5 ? 1974		
[signature]	0 3 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 2 and 3 SW 3ABR91330-I-15 ~~Psychology of the Diseased and Injured~~ Films: TF8227E Human Body - Nervous System; FLC 16/100 Exam of Neurological Systems OVER

CRITERION OBJECTIVES AND TEACHING STEPS

5b. Recognize the structures and explain the functions of the nervous systems.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

33

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSTB MAY 1974	
COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	BLOCK TITLE
I	Basic Science

LESSON TITLE
Respiratory System

LESSON DURATION		
CLASSROOM/Laboratory	~~xxxxxxxxx~~ Complimentary	TOTAL
4 hrs/0 hrs	0 hrs	4 hrs

POI REFERENCE		
PAGE NUMBER	PAGE DATE	PARAGRAPH
3	15 Feb 1974 8 2 JUL 1975	5c

STS/CTS REFERENCE	
NUMBER	DATE
STS 913X0	10 Jan 1974 2 5 MAR 1975

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
[signature]	1 0 MAY 1974	[signature]	1 7 OCT 1975
[signature]			
[signature]	2 5 AUG 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 and SW 3ABR91330-I-5 Physiology Film: FLC 10/92 Respiration in Man

CRITERION OBJECTIVES AND TEACHING STEPS

5c. Recognize the structures and explain the functions of the respiratory system.

(Teaching steps listed in Part II)

ATC FORM 770

34

LESSON PLAN (Part I, General)

MSDB Wilson 10 OCT 6 May	
3ABR91330	Physical Therapy Specialist
I	Basic Sciences
Cardiovascular System	

LESSON DURATION

/Laboratory	~~xxxxxxxxx~~ Complementary	TOTAL
4~~7~~0 hrs	0 hrs	4 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
34	15 ~~Feb 1974~~ 2 2 JUL 1975	5d

STS CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	1 0 MAY 1974		
[signature]			
[signature]	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 2nd SW 3ABR91330-I-5 Physiology Films: TF8227A Human Body - Circulatory System; FLC 22/25, Varicose Veins; FLC 23/91 The Work of the Heart

OBJECTIVES AND TEACHING STEPS

5d. Recognize the structures and explain the functions of the cardiovascular system.

(Teaching steps listed in Part II)

ATC FORM 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR		
MSDB 10 OCT 1975			
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist		
BLOCK NUMBER I	BLOCK TITLE Basic Sciences		
LESSON TITLE Lymphatic System			
LESSON DURATION			
CLASSROOM/Laboratory 2hrs/0 hrs	~~XXXXXXXX~~ Complementary .5 hrs	TOTAL 2.5 hrs	
POI REFERENCE			
PAGE NUMBER 3 4	PAGE DATE ~~15 Feb 1974~~ 22 JUL 1975	PARAGRAPH 5e	
STS/CTS REFERENCE			
NUMBER STS 913X0	DATE ~~10 Jan 1974~~ 25 MAR 1975		
SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
Loy M. Conner	10 MAY 1974	Loy M Conner	17 OCT 1975
Loy M. Conner			
Loy M. Conner	25 APR 1975		
PRECLASS PREPARATION			
EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 2 and 3 SW 3ABR91330-I-5 Physiology

CRITERION OBJECTIVES AND TEACHING STEPS

5e. Recognize the structures and explain the functions of the lymphatic system.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE: KSDII 10 OCT 1975 / MAY 1974	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: I	BLOCK TITLE: Basic Sciences
LESSON TITLE: Renal System	

LESSON DURATION

CLASSROOM /Laboratory	~~xxxxxxxx~~ Complimentary	TOTAL
2 hrs/0 hrs	.50 hrs	2.50 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
34	~~15 Feb 1974~~ 22 JUL 1975	5f

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~19 Jun 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Connor	10 MAY 1974	Kay M Connor	17 OCT 1975
Kay M Connor			
Kay M. Connor	1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 Sect SW 3ABR91330-I-5 Physiology

CRITERION OBJECTIVES AND TEACHING STEPS

5f. Recognize the structures and explain the functions of the renal system.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

37

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB 10 OCT 5 MAY 1974	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist

BLOCK NUMBER	BLOCK TITLE
I	Basic Sciences

LESSON TITLE

Integumentary System

LESSON DURATION

CLASSROOM/Laboratory	~~XXXXXXXX~~ Complimentary	TOTAL
2/Chrs	.5 Hr	2.5 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
3	~~15 Feb 1974~~ 2 JUL 1975	59

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	10 MAY 1974	[signature]	17 OCT 1975
[signature]			
[signature]	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 SW 3ABR91330-I-5 Physiology, SNES-006 ~~Film:~~, The Decubitus Ulcer

CRITERION OBJECTIVES AND TEACHING STEPS

59. Recognize the structures and explain the functions of the integumentary system. (Teaching steps listed in Part II)

ATC FORM 770 AUG 72

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE MSDB 8 MAY 1974	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER I	BLOCK TITLE Basic Sciences
LESSON TITLE Body's Heat Regulatory System	

LESSON DURATION

CLASSROOM/Laboratory	~~xxxxxxxxxx~~ Complimentary	TOTAL
4 hrs/0 hrs	1.5 ~~0~~ hrs	5.5 ~~4~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
3 ~~4~~	~~15 Feb 1974~~ JUL 75	5 h

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Gary M. Conner	10 MAY 1974	Gary M. Conner	17 OCT 1975
Gary M. Conner	25 OCT 1974		
Gary M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 SW 3ABR91330-I-5 Physiology. 2nd ~~Ed~~ Film: FLC 19-0127, Regulating Body Temperature

CRITERION OBJECTIVES AND TEACHING STEPS

5h. Recognize the structures and explain the functions of the body's heat regulatory system

(Teaching steps listed in Part II)

ATC FORM 770

GPO: 1972 779-300/23

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB 6 MAY 1974	
COURSE NUMBER	**COURSE TITLE**
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
I	Basic Sciences

LESSON TITLE

Muscular System

LESSON DURATION

CLASSROOM/Laboratory	~~Classroom~~ Complimentary	TOTAL
3 4/0 hrs	1 ~~8~~ hr	4 ~~2~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
4	~~15 Feb 1974~~ 2 2 JUL 1975	5i

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	1 0 MAY 1974	Kay M. Conner	1 7 OCT 1975
Kay M. Conner	[illegible]		
Kay M. Conner	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 3 and 3 SW 3ABR91330-I-5 Physiology FLC 13/170 Film: ~~Title~~ Muscle: Dynamics of Contraction, FLC 13-0223 Muscle: Electrical Activity of Contraction.

CRITERION OBJECTIVES AND TEACHING STEPS

5i. Recognize the structures and explain the functions of the muscular system.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

GPO : 1972 779-398/23

40

LESSON PLAN (Part I, General)

MSDB [illegible] 19 Oct 197[illegible]	INSTRUCTOR
3ABR91330	Physical Therapy Specialist
I	TITLE: Basic Sciences

Osteology, Arthrology, Myology and Neurology of Axial Skeleton

LESSON DURATION

Classroom/Laboratory	~~XXXXXXXXX~~ Complementary	TOTAL
19 hrs/0 hrs	6 ~~6~~ 6 hrs	25 ~~25~~ 25 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
4.5	~~15 Feb 74~~ 2 JUL 1975	7a

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jun 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	1 0 MAY 1974	[signature]	1 7 OCT 1975
[signature]			
[signature]	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Skeleton, Articulated (1) Skeleton, Disarticulated (6)	N/A	N/A	AFM 160-2, Chap 3 21 SW 3ABR91330-I-7 Daniels, L., Williams, M., and Worthington, C., Muscle Testing: Techniques for Manual Examination (2nd and 3rd Ed), W.B. Sanders, (see back)

CRITERION OBJECTIVES AND TEACHING STEPS

7a. Recognize the axial skeleton structures and explain the functions of the bones and their selected parts, the joints and their selected parts, the nerves, and muscles which are the prime movers for the axial skeleton.

(Teaching steps listed in Part II)

ATC FORM 770

GPO 1972 779-398 23

LESSON PLAN (Part I, General)

41

MSIR Wilson DP OCT 1974	INSTRUCTOR
3ABR91330	Physical Therapy Specialist
I	Basic Sciences

Osteology, Arthrology, Myology and Neurology of the Upper Extremity

LESSON DURATION

/Laboratory 18 19 hrs. 0 hrs.	~~xxxxxxxxx~~ Complimentary 6 4 6 hrs	TOTAL ~~24 18 22~~ 25 hrs

POI REFERENCE

PAGE NUMBER 4 5	PAGE DATE ~~15 Feb 1974~~ 2 2 JUL	PARAGRAPH 7 b

STS CTS REFERENCE

STS 913X0	DATE ~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

	DATE	SIGNATURE	DATE
Lloyd M. Conner	1 0 MAY 1974	Lloyd M Conner	1 7 OCT 1975
Lloyd M. Conner			
Lloyd M. Conner	2 3 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Skeleton, Articulated (12) Skeleton, Disarticulated (6) Myology Model, Upper Extremity (12)	N/A	N/A	AFM 160-2, Chap 3 SW 3ABR91330-I-7 Daniels, L., Williams M., and Worthington, C., Muscle Testing: Techniques for Manual Examination (2nd and 3rd Ed.) W.B. Sanders (see back)

LESSON OBJECTIVES AND TEACHING STEPS

7b. Recognize the upper extremity structures and explain the functions of the bones and their selected parts, the joints and their selected parts, the nerves and the muscles which are the prime movers for the upper extremity.

(Teaching steps listed in Part II)

ATC FORM 770

42

LESSON PLAN (Part I, General)

INSTRUCTOR'S OFFICE AND DATE: MSDB	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: I	BLOCK TITLE: Basic Sciences

LESSON TITLE

Osteology, Arthrology, Myology and Neurology of the Lower Extremity

LESSON DURATION

CLASSROOM /Laboratory	Complementary	TOTAL
16	6	22 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
45	~~15 Feb 1974~~ 2 JUL 1975	7c

STS/CTS REFERENCE

NUMBER	DATE
~~STS 913X0~~	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	10 MAY 1974	[signature]	17 OCT 1975
[signature]	25 OCT 1974		
[signature]	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Skeleton, Articulated (12) Skeleton, Disarticulated (6) Myology Model, Lower Extremity (12)	N/A	N/A	AFM 160-2, Chap ~~3~~ 2 and SW 3ABR 91330-I-7 Daniels, L., Williams, M, and Worthington, C., Muscle Testing: Techniques for Manual Examination (2nd and 3rd Ed) W.B. Sanders (see back)

CRITERION OBJECTIVES AND TEACHING STEPS

7c. Recognize the lower extremity structures and explain the functions of bones and their selected parts, the joints and their selected parts, the nerves, and the muscles which are the prime movers for the lower extremity.

(Teaching steps listed in Part II)

ATC FORM 770

GPO 1972 779-384/89

43

DEPARTMENT OF BIOMEDICAL SCIENCES

PHYSICAL THERAPY SPECIALIST

PSYCHOLOGY OF THE DISEASED AND INJURED

September 1975

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

DO NOT USE ON THE JOB

Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas 76311

SW 3ABR913--
September 1?

PSYCHOLOGY OF THE DISEASED AND INJURED

OBJECTIVES

After completing this study guide and workbook you will be able to explain the psychological theories and processes of the diseased and injured.

INTRODUCTION

You, as a physical therapy specialist, are going to be dealing with patients with many and varied diseases and injuries. In working with these patients you are going to be dealing with people who are from varying backgrounds and who will react differently to their disease or injury. You will have to cope with the attitudes of these patients and how you cope with them will affect how well the patient responds to the treatment program that has been established for him.

INFORMATION

PSYCHOLOGICAL REHABILITATION OF THE PHYSICALLY DISABLED

Body Symptoms Which May be Affected by Disease or Injury

LOSS OF VOLUNTARY MUSCLE CONTROL. This may endanger the patient's means for manipulating and controlling his own environment. He may not be able to walk normally, his activities of daily living may not be normal, i.e., eating, dressing, bathing. He must depend on others temporarily, if not permanently. This causes the patient to regress to more of a childlike relationship with others.

LOSS OF SENSATION, PERCEPTION, AND AWARENESS. These critical avenues of contact may be lost or compromised at the time when alertness and reception of these stimuli need to be at their very best. This patient will frequently be seen with a blank, masked face and his behavior factors will not be as noticeable. Voluntary muscle control may return or be compensated for by some type of brace. Yet, the individual may not be able to function effectively because of a partial or complete perceptual loss. This perceptual loss may be hearing, touch, or position-sense.

LOSS OF SPEECH (APHASIA). One of baby's first approval experiences is the way his parents react to his first attempts at talking; especially his first word. The baby soon realizes that speech can be used to get the things he wants and get people to do the things which he wants them to do. One of our most powerful methods for relating to people is removed when we lose our speech. When a patient loses his speech he may revert to more primitive techniques for controlling his surroundings. Not being able to speak, the individual may regress to childish insistence and infantile temper tantrums. Having lost his speech the patient may retreat to a state of depressed dependency and will demand that we take care of him as if he were a baby. Some patients react with gross anxiety. They are not able to understand their impairment and are afraid they have lost their mind and wonder if anyone realizes their problem and will provide for their needs. Some are so troubled that they will withdraw into a state of encapsulated apathy which is a defensive attempt at avoiding all stress.

This supersedes SW 3ABR91330-I-3, September 1974

LOSS OF BOWEL AND BLADDER CONTROL (INCONTINENCE). Developing control of bowel and bladder activities is another early approval experience which the child learns to use to extract approval from his parents or punish them. A child's attitude toward cleanliness, shame, and maturity are closely involved in the development of continence and if this vital function is impaired in adult life, he may return to his former attitudes. When a patient returns to his former attitudes it results in shame, feelings of uncleanliness and not being adult, or fear of displeasing others. The reactions of those who are responsible for the bodily care of the impaired person are important in approving or not approving his self doubt.

INTELLECTUAL RESOURCES AFFECTED. Some of the following intellectual resources may be affected and are seen in persons having a chronic brain syndrome. Poor judgment, disorientation to the external environment, not able to remember newly learned material, not able to plan for the future, and defective abstract conceptualization. The patient may consciously or unconsciously be aware of his deficiencies and resort to different compensatory mechanisms such as withdrawal, denial, and confabulation.

LOSS OF ESTEEM. Physical strength, speech, independence, and vocational skills are the functions through which values are established. If any of these functions become impaired, the sense of value is lessened and results in a fall in esteem. The patient is viewed by others and himself as inadequate, incompetent, infantile, and even insane.

DECREASE OF RELATENESS. When the channel of contact with other people is partially or completely lost it results in a breaking off of previously meaningful and supportive ties with family, friends, and co-workers.

CHANGE IN BODY IMAGE. Since babyhood an individual has developed a psychic conceptualization of his body. When psychic conceptualization is altered by a change in the body's function or structure a vast readjustment and adaptation is required. Facial paralysis, limp arm, awkward walk or limp, and the loss of a body part presents a severe threat to one's body image.

SEPARATION AND ROLE CHANGE. Being admitted to a hospital or rehabilitation center separates the patient from home, family, work, and the social roles he has played in these areas. This results in the temporary loss of valuable sources of gratification, esteem, security, and identity.

Different Ways of Responding to Disease or Injury

REGRESSION. When a patient cannot use his usual physical and personality resources to face physical and intellectual harm, he will regress or revert to techniques he has used in the past which may be quite primitive. He may remember the childhood rivalry with his brothers or sisters. He may try to control, manipulate, or punish medical staff members by being obstinate. A patient will show severe regression by being extremely dependent and depressed. Two different types of personalities are seen in excessive dependency. One is the individual who has always been dependent and his medical condition gives him a good sound reason to continue his dependency. The other is the compulsively independent person who has never been allowed to express his dependency needs. His medical condition opens wide the doors to a lot of previously repressed ideas.

DENIAL. This is rather a severe departure from reality and is usually seen when some degree of organic brain dysfunction is present. The patient may deny his impairment and his behavior will express the thought, "I am disabled; so what, it doesn't bother me

ANXIETY. The greatest source of anxiety is being aware of the fact that one's continuance is threatened. Having been close to death and not knowing when it will happen again.

HOSTILITY. There are two ways in which hostility may be expressed, inwardly or outwardly. Inwardly is putting the blame on self. Outwardly is putting the blame on somebody else.

DEPRESSION. This is a reaction to having lost something and the patient who has some medical condition may have lost several things. Depression should become apparent at some point during the period of impairment. If depression does not become apparent, he may be undergoing denial.

WITHDRAWAL. The patient may choose not to deal actively with the challenge of reality and will consciously retreat into deep passivity or apathy.

PSYCHOSIS. This is a major break from reality which may result from several factors. There are several different types of psychotic reactions. Acute confusional or delirious states, such as fearfulness, agitation, and disorientation. Psychotic depression, such as mutism, refusal to eat, suicidal behavior. Schizophrenic reactions, such as delusions, hallucinations, catatonic withdrawal or excitement.

HEALTHY ADAPTATION. The patient accepts reality and works in constructive, purposeful activities to regain his normal function.

Phases of Adapting to Disease or Injury

SHOCK. This is the time that the patient is not sure of his body and its functions and is not sure that life itself will continue for him.

DENIAL. Shortly after the time of shock, restitution by denial takes place. This gives the personality resources a period of time to recover.

TURBULENT AWARENESS. This phase is most frequently experienced by the younger patient who has not learned to control his aggressiveness. The individual will be quick to perceive any intra-staff conflicts and he will use these to project his hostilities away from himself.

WORKING THROUGH. This phase is longer than the others. If the previous phases have been handled properly the patient's faith and thrust in the empathy and understanding of the medical staff will have been developed. This is the phase in which the patient enters into a therapeutic alliance with the members of the medical staff to overcome his medical condition and dependence. During this time the patient gets to explore reality and continues probing the avenues of hope even though he may, at times, retreat into areas of frustration.

SEPARATION ANXIETY. Just before the patient is discharged from treatment he may realize that he will have to face the outside world and that he may have to do it before he has fully recovered from his medical condition. This may result in a short period of emotional turbulence similar to the turbulent awareness phase. To help the patient make an easy transition from the protective, accepting treatment environment to the outside world, it will be necessary to increase support and environmental manipulation such as:

1. Vocational planning

2. Family counseling

3. Physical modification of the home environment

ADAPTATION. After being released from the medical environment the patient will gradually test out his home environment and the way the community accepts him. The reaction of the patient to his home environment and community depends on the confidence and self-esteem he has developed during the period of his treatment. The acceptance of his family, employer, and society plays an equally important part in his reaction.

Management of the Diseased or Injured

TIME. During this period the patient must come face-to-face with the meaning of his medical condition to himself. This is an internal struggle which requires support from his family and the medical staff. This period begins when the patient first realizes what losses have occurred because of his medical condition and the period ends when he enters the working-through phase.

PATIENCE, TOLERANCE, AND UNDERSTANDING. During the early phases of adapting to disease or injury, the patient feels very helpless and has very little self-confidence. It is very important that the medical staff use patience, tolerance, and understanding when dealing with the patient at this time.

When the patient is in the turbulent awareness phase these three qualities must be used to the maximum.

The use of these three qualities is very important in establishing the coordination of the treatment activities between the patient and the medical staff.

EDUCATION AND ORIENTATION. Giving the patient information about his medical condition enables him to confront reality in gradual steps and recognize the areas in which recovery can or cannot be expected. This information may be given in various ways; such as, doctor-patient bedside charts, team conferences to which the patient has been invited, or lecture/discussions to groups of patients.

Establishing trust and confidence in the medical staff's ability to aid in the patient's recovery can be done by informing the patient that there is a predictable and structured course for his recovery.

ALLOWING CONTROL. The patient needs to progress from dependence to control of self and sometimes control of others as he improves. In any decisions affecting his treatment program, his ideas and feelings need to be considered.

THERAPY MODALITIES. At this time the patient is reoriented to activity instead of passivity, success instead of failure. The restoring of function is emphasized and the loss of function is deemphasized. The pent-up aggressive impulses are released instead of being suppressed through bedrest and inactivity.

ATMOSPHERE OF HOPE, OPTIMISM, AND RESPECT. If complete recovery is not obtained from the treatment program the patient should be encouraged to return home and give the natural healing process a chance to work, with the hope that future treatment efforts will be possible.

MILIEU. The patient's need for solitude must be respected as resocialization is started. Activities for the patient should be provided which use his remaining functions. Avoid long periods of unscheduled time.

To avoid confusion from frequent changes of room, personnel, or procedures, a well-structured, constant environment is needed. This is especially true when working with elderly patients.

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KEEPING THE PATIENT INFORMED. The inactivity which the patient's medical condition forces upon him should not be made worse by the medical staff treating him as a completely passive recipient of his treatment program. It is not necessary to obtain permission from the patient for every detail of his treatment program. The reasons for the treatment program need to be explained very clearly to add meaning to his participation in the treatment program

PSYCHOTHERAPY AND PSYCHO-ACTIVE DRUGS. To help the patient accept his medical condition and dependency at the beginning, it is frequently necessary to use some supportive measures temporarily. This permits some regression while the patient's weakened ego repairs its defenses and gets ready for the strenuous phases ahead.

Some supportive techniques which may be used are: reassurance, opportunity for open discussion of grievances, opportunity for suggestion, persuasion, and environmental manipulation such as change of roommate, change of room, and presentation of limited goals.

During the later part of the treatment program insight-directed psychotherapy may be indicated to aid the patient in understanding the meaning of his medical condition and his reaction. This will also provide the psychological environment for self-appraisal and revision of coping techniques.

Reactions of the Medical Staff to the Diseased or Injured

SOME WAYS IN WHICH THE MEDICAL STAFF VIEW THE PATIENT. The patient is a dependent person and dependency may not be tolerated by some members of the medical staff. The medical staff member may be struggling with his own feelings of dependency on his spouse or parents. The "Rescue Fantasies" of the medical staff member may be jeopardized by a chronic incurable disease. The medical condition of the patient may arouse a fear of old age to some members of the medical staff. The conflicts involving the medical staff members' parents may be transferred to the patient. If the medical staff member can interpret the patient's medical condition as partial death, he will be bringing himself face-to-face with the ultimate victor in the struggle against disease. The preceding factors and the feeling they stimulate may either challenge or threaten the medical staff member and he will consciously or unconsciously retreat to anxiety-control mechanisms taken from his past life experiences and habit formations.

FREQUENTLY SEEN MEDICAL STAFF REACTIONS

1. Some medical staff members exhibit omnipotence and omniscience in which an aura of power and intellectual pseudomastery substitute for empathy and involvement with the patient.

2. Other medical staff members may retreat into feelings of inadequacy resulting in impotence of medical care.

3. Still other members of the medical staff will react with hostility, rejection, and ultimately withdraw from the patient who threatens him.

MEDICAL STAFF ADAPTATION. If the members of the medical staff are aware of the feelings and as they develop comfort and experience in working with patients they will be able to use the techniques of healthy adaptation and reality-confrontation which they expect the patient to use.

10. When a channel of contact with other people is partially or completely lost, person will suffer from a decrease of ______________________.

11. When a patient cannot use his usual physical and personality resources to face physical and intellectual harm he will tend to ______________________.

12. A severe departure from reality is called ______________________ and is usually seen when some degree of ______________________ is present.

13. The greatest source of anxiety is being aware of the fact that one's ______________________ is threatened.

14. Hostility may be expressed in two ways ______________________ and ______________________.

15. If depression does not become apparent in the patient it may be due to several reasons.

a. ______________________

b. ______________________

16. When the patient does not choose to deal actively with the challenge of reality and will consciously or unconsciously retreat into deep passivity, this is referred to as ______________________.

17. Psychosis is a ______________________.

18. List three types of psychotic reactions.

a. ______________________

b. ______________________

c. ______________________

19. List the phases of adapting to disease or injury.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

f. ______________________

REVIEW EXERCISES

1. List the body symptoms which may be affected by disease or injury.

a. ______

b. ______

c. ______

d. ______

e. ______

f. ______

g. ______

h. ______

i. ______

2. Which symptom may endanger the patient's means for manipulating and controlling his own environment?

______

3. If the patient is frequently seen with a blank, masked face, it may be said he is suffering from loss of ______.

4. When a patient has a loss of speech it is called ______.

5. One of a baby's first approval experiences is ______.

6. One of our most powerful methods for relating to people is removed when we lose ______.

7. If the patient loses bowel and bladder control he may be ______.

8. List the intellectual resources that may be affected in persons having a chronic brain syndrome.

a. ______

b. ______

c. ______

d. ______

e. ______

9. Physical strength, speech, independence, and vocational skills are the functions through which values are established, if any of these functions are impaired a person will suffer from ______.

20. The shock phase of adapting is the time that the patient is not sure of ____.

21. The phase of adaptation that is longer than the others is ______________________ ____.

22. The phase of adaptation the patient may realize just before discharge from treatment is ____ ______________________.

23. Information about his condition and his future prospects may be given to the patient in various ways, including:

a. ____

b. ____

c. ____

24. A well structured, constant environment is needed to avoid ______________________ ____.

25. The inactivity which the patient's medical condition forces upon him should not be made worse by the medical staff treating him as a ______________________ ______________________.

26. If complete recovery is not obtained from the treatment program, the patient should be encouraged to ____ ____.

27. The rescue fantasies of the medical staff member may be jeopardized by __________ ____.

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STUDY GUIDE AND WORKBOOK

3ABR91330-I-5

Technical Training

Physical Therapy Specialist

PHYSIOLOGY

October 1975

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
Department of Biomedical Sciences
SHEPPARD AIR FORCE BASE, TEXAS 76311

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Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas 76311

SW 3ABR91330-I-5
October 1975

PHYSIOLOGY

OBJECTIVE

After completing this study guide and workbook you will be able to recognize the structures and explain the functions of specific body systems. Specifically, you will be able to recognize the structures and explain the functions of the cell, nervous system, respiratory system, cardiovascular system, lymphatic system, renal system, integumentory system, body's heat regulatory syste, and the muscular system.

INTRODUCTION

In physical therapy the treatments that we administer to our patients have important effects on the various physiological systems of the body. It is essential that you have an understanding of the structures and functions of these systems so that you will be able to understand the ways in which different treatments affect the systems and the body as a whole.

INFORMATION

THE CELL

Functional Organization of the Human Body

The cell is the basic living unit of the body. There are approximately 100 trillion cells in the human body. Each organ of the body is made up from many different cells. All of the cells which make up an organ are held together by intercellular supporting structures. There are several types of cells. Each type has a special job. For example, the red blood cells which carry oxygen from the lungs to the tissues of the body.

The cells are automatons. They can live, grow, and provide their own special functions. Cells must have the correct mixture of oxygen, glucose, amino acids, fatty substances, and different electrolytes available in the tissue fluids of the body.

Almost all cells can reproduce themselves. If a certain type of cell is destroyed the remaining cells of that type will keep dividing until the right number of cells is present again.

This supersedes SW 3ABR91330-I-5, September 1974

The adult human body is about 56 percent fluid. Within the body there are two types of fluid.

1. Intracellular fluid which is the fluid inside of the cells. It contains large amounts of potassium, magnesium, and phosphate ions.

2. Extracellular fluid is the fluid which is located in the spaces outside of the cells. It contains large amounts of sodium, chloride, and bicarbonate ions. Nutrients for the cells such as oxygen, glucose, fatty acids, and amino acids, are also contained in the extracellular fluid, along with carbon dioxide and other waste products from the cells. It is in constant motion throughout the body and is mixed by the circulation of the blood and by diffusion between the blood and the tissue spaces. The extracellular fluid also provides the environment in which the cells live and for that reason is often called the internal environment of the body.

Homeostasis in physiology means the maintenance of constant conditions in the internal environment. Basically all the organs and tissues of the body work to maintain these constant conditions.

1. The lungs provide oxygen for the cells.

2. The kidneys maintain a constant electrolyte concentration.

3. The gastrointestinal tract provides the nutrients.

Function of the Cell

We must first understand the basic organization of the cell and the functions of its component parts before we can understand the function of the organs and other structures of the body. The cell is more than just a minute bag of fluid, chemicals, and enzymes. There are some very highly organized physical structures present in the cell. These highly organized physical structures are called organelles. The organelles are just as important to the activity of the cell as other components of the cell. The major organelles which will be briefly discussed are the cell membrane, nuclear membrane, mitochondria and lysosomes.

All the physical structures of the cell are lined with membranes which are similar in structure and this common type of structure is called the unit membrane. The unit membrane is composed primarily of a thin layer of proteins, a thicker layer of lipids, and another thin layer of proteins. The cell membrane is the outer covering for the cell. It holds all the other cell structures and constituents. It is thin and elastic, approximately 75 to 100 Angstroms thick (one Angstrom equals one ten millionth of a millimeter or one 254 millionth of an inch.

The outside of the cell membrane is covered with a thin layer of mucopolysaccharide. This makes the outside of the cell different from the inside so that the cell membrane is polarized. When the membrane is polarized the chemical reaction of the inner surface of the cell is different from that of the outer surface. There are pores in the membrane which permit water and urea molecules to pass between the interior and exterior of the cell.

Cytoplasm

This is a fluid like substance which is in the space between the cell membrane and the nuclear membrane. The cytoplasm contains mostly dissolved proteins, glucose, and electrolytes (potassium, magnesium, and phosphate ions). Frequently the cytoplasm immediately beneath the cell membrane is jelled and is called the cortex or ectoplasm. The cytoplasm between the cortex and the nuclear membrane is liquefied and is called the endoplasm. Two important organelles are located in the cytoplasm - mitochondria and lysosomes.

Mitochondria

They are present in the cytoplasm of all cells. They are responsible for the release of energy used to form adenosine triphosphate (ATP). ATP is used to supply the energy needed during muscle contractions.

Lysosomes

nese are the digestive organs of the cells.

Nuclear Membrane

It separates the cytoplasm from the nucleus and its constituents. It forms the little bag which contains the nucleus, nuclear sap, and chromatin material. The nuclear membrane is actually a double membrane with a space between them. There are pores in the nuclear membrane which permit the movement of substances between the nuclear sap and the cytoplasm.

Nucleus

This is the control center of the cell. It controls the chemical reaction of the cells. It controls the reproduction of the cell. The nucleus contains large amounts of deoxyribonucleic acid which has been called genes for years. The genes control reproduction. During reproduction the cell splits by a special process called mitosis. This forms two daughter cells and each receives one of the two sets of genes.

Ingestion by the Cell

For the cell to live and grow it must have food. It gets its food from the fluids which are around it which are the extracellular fluids. There are three methods which the cell uses.

DIFFUSION. The food substances pass through the pores in the cell membrane.

ACTIVE TRANSPORT. These are special carrier substances which carry the food substances through the cell membrane.

PINOCYTOSIS. In this method of getting food substances, the cell actually engulfs some of the extracellular fluid. Pinocytosis occurs when certain substances come in contact with the cell membrane (proteins and strong electrolyte solutions are attracted to the cell membrane). When protein molecules or electrolyte molecules come in contact with the cell membrane they become attached to it. This causes the surface tension properties of the membrane to change in such a way that the membrane invaginates (the infolding of one part within another). Immediately after this the invaginated portions break away from the surface of the membrane and forms a pinocytic vesicle which penetrates deep into the cytoplasm. Pinocytosis is the only way which the protein molecules can pass through the cell membrane.

Movement of the Cell

The most important type of cell movement occurs in the specialized muscle cells. These cells make up almost one half of the body mass. This type of cell movement will be discussed in more detail later in the course. There are two other types of cell movement which will be discussed here.

AMEBOID MOVEMENT. This is the movement of the entire cell in relation to its surroundings. An example is the movement of the white blood cells through the body tissues. Ameboid movement begins with the protrusion of a pseudopodium from one end of the cell. The pseudopodium projects out away from the body of the cell and then the remainder of the cell just moves toward the pseudopodium.

CILIARY MOVEMENT. Cilia are sharp, pointed, hair-like structures which project 3 to 4 microns from the surface of the cell. Ciliary movement occurs along the surface of the cells in the respiratory tract and in some areas of the reproductive tract. In ciliary movement the cilium moves forward with a very quick stroke and bends sharply at its projection from the surface of the cell. It then moves backward with a slow, whiplike movement to its starting position. The quick forward stroke pushes fluid in the direction of the ciliary movement. The slow, whiplike movement to its starting position has very little effect on the fluid. As a result, the fluid is constantly pushed in the direction of the forward stroke. The ciliated cells are placed so that movement will be in the same direction. This is a good way for moving fluids from one part of a surface to another. Ciliary movement provides a good method for moving mucous out of the lungs or moving the ovum along the fallopian tube.

Reproduction of the Cell

Most cells are continually growing and reproducing. The newly reproduced cells take the place of those that have died. This maintains a complete complement of cells in the body. The reproduction steps, as with almost all the other events of the cell, begin in the nucleus.

1. The first step is the duplication of all genes and all the chromosomes of the cell.

2. The next step is to divide the two sets of genes between two separate nuclei.

3. The final step is the splitting of the cell itself to form two new daughter cells and this process is mitosis. Mitosis lasts about 30 minutes.

Reproductive Inhibition

The complete life cycle of a cell which is not inhibited in some way is about 10 to 30 hours from reproduction to reproduction. There are almost always inhibitory controls which slow or stop the uninhibited life cycle of the cell to vary from about 10 hours for the stimulated bone marrow cells to an entire lifetime of the human body for nerve cells.

For the normal human body the regulation of cell growth and reproduction is mostly a mystery. Some types of cells grow and reproduce all the time, for example, the blood forming cells of the bone marrow, the germinal layers of the skin, and the epithelium of the gastrointestinal tract.

Some types of cells do not reproduce for many years, for example, muscle cells. Some types of cells do not reproduce during the entire life of the person, such as the neurons. Most cells of the human body can reproduce continually but the rate of reproduction usually remains slowed down. However, if there are not enough cells of a particular type in the body, this type of cell will grow and reproduce very rapidly until the correct number of cells is available. For example, seven-eighths of the liver may be surgically removed and the cells of the remaining one-eighth will grow and reproduce until the liver mass returns almost to normal. This same effect occurs for almost all the other cells of the body, the exception being the highly differentiated cells such as the nerve cells.

Transport Through the Cell Membrane

The intracellular fluid, the fluid inside the cells, is very different from the extracellular fluid, the fluid outside the cells. The extracellular fluid contains large amounts of Sodium (Na+), 142 mEq/l and Chloride (Cl-), 103 mEq/l. The intracellular fluid contains large amounts of Potassium (K+), 141 mEq/l and Phosphates 75 mEq/l. The extracellular fluid contains small amounts of Potassium (K+), 5 mEq/l and Phosphates, 4 mEq/l. The intracellular fluid contains small amounts of Sodium (Na+), 10 mEq/l and Chloride (Cl-), 4 mEq/l.

Constituent	Extracellular Fluid	Intracellular Fluid
Sodium (Na+)	142 mEq/l	10 mEq/l
Chloride (Cl^-)	103 mEq/l	4 mEq/l
Potassium (K^+)	5 mEq/l	141 mEq/l
Phosphates	4 mEq/l	75 mEq/l

There are several other constituents in the extracellular and intracellular fluids. These four are used just to show the difference between the two fluids.

The extracellular fluid circulates in the spaces between the cells and mixes with the blood through the capillary walls. Because of this, the extracellular fluid supplies the cells with the nutrients and other substances which they need to perform their functions. Before the cell can use these nutrients and other substances which are in the extracellular fluid they have to be transported through the cell membrane.

There are two major processes used for transporting substances through the cell membrane.

DIFFUSION. This is the movement of substances in a random fashion caused by normal kinetic motion or the continual movement of molecules among each other in liquids or gases. There are two ways in which substances can diffuse through the cell membrane: (1) The substances become dissolved in the lipid and diffuse through it, the same way that diffusion occurs in water. (2) The substances will diffuse through the minute pores that pass directly through the cell membrane.

ACTIVE TRANSPORT. There are no substances which can diffuse against a concentration difference or "uphill." The process of moving molecules uphill against a concentration difference is called active transport. Very small quantities of sodium and potassium can diffuse through the pores of the cell membrane and eventually the concentration of the two ions would become equal inside and outside the cell unless a system is provided to remove the sodium ions from inside the cell and putting the potassium ions inside the cell.

The system for active transport of sodium and potassium in all the cells of the body is called the sodium pump. It works like this:

1. The sodium (Na) inside the cell combines with the carrier Y at the membrane to form NaY.

2. The NaY moves to the outer surface of the membranes where the sodium (Na) is released.

3. Carrier Y then changes its chemical composition to become carrier X.

4. Carrier X then combines with potassium (K) to form KX.

5. KX then moves to the inner surface of the membrane.

6. K is split from X.

7. X changes its chemical composition slightly to become Y and the cycle repeats itself.

The sodium pump is very important to many different functioning systems of the body. The nerve and muscle fibers use the sodium pump for transmission of impulses. The sodium pump prevents cellular swelling of all cells of the body.

Cell Membrane Potentials

Essentially all the cells of the body have electrical potentials existing across their membranes. Some cells such as the nerve and muscle cells are excitable. Cells which are excitable are able to transmit electrochemical impulses along their membranes.

DEVELOPMENT OF MEMBRANE POTENTIALS. Both the extracellular and intracellular fluids are electrolytic solutions containing the same concentrations of negative ions (anions) and positive ions (cations). Generally an unusually large number of negative ions accumulate along the inner surface of the cell membrane and the same number of positive ions accumulate along the outer surface of the cell membrane. This results in the development of a membrane potential with an average electrical value of 85 millivolts.

There are two basic means by which membrane potentials can be developed.

a. Active transport of ions through the cell membrane which causes an imbalance of positive and negative charges on the two sides of the cell membrane. The action of the sodium pump can develop a membrane potential.

b. Diffusion of ions through the cell membrane resulting in a concentration difference between the two sides of the membrane causing an imbalance of the charges.

DEVELOPMENT OF ACTION POTENTIALS. When the permeability of the cell membrane to sodium is suddenly increased it may cause a series of rapid changes in the membrane potential which lasts only a fraction of a second and is followed by an immediate return of the membrane to its resting potential. These series of rapid changes are called the action potential.

Some factors which may cause an action potential are:

- Electrical stimulation of the membrane.
- Application of chemicals to the membrane causing an increased permeability to sodium.
- Mechanical damage to the membrane.
- Heat or cold of sufficient intensity to alter the normal resting state of the membrane.
- Any factor which alters the membrane's resting potential.

The action potential starts the transmission of the impulse along the nerve or muscle fiber and is called the nerve or muscle impulse. The impulse does not travel in just one direction. The impulse travels in all directions away from the point of stimulation. Once an action potential starts the transmission of an impulse it will travel over the entire membrane. This is called the all-or-nothing law and applies to all normal excitable tissue.

EXERCISE

1. The basic living unit of the body is the ______________________.

2. Cells are automatons, which means they can ______________________

______________________.

3. There are two types of fluid in the body ______________________ and ______________________.

4. The fluid in the spaces outside the cells is called ______________________.

5. The maintenance of constant conditions in the internal environment is called

______________________.

6. The cell has some very highly organized physical structures called ____________

______________________.

7. The major organelles of the cell are ____________ ____________

____________ ____________ ____________.

8. The membrane that lines the physical structures of the cell is called the

______________________.

9. The outer covering of the cell is called the ______________________.

10. The outside of the cell membrane is covered with a thin layer of ____________

____________ which makes the outside of the cell different from the inside, so that the cell membrane is polarized.

11. Cytoplasm is found in the space between the ____________ and the

______________________.

12. Mitochondria are present in the ______________________ of all cells.

13. ATP (adenosine triphosphate) is used to supply the energy needed during

______________________.

14. Lysosomes are the ______________________ of the cells.

15. The nuclear membrane separates the ______________________ from the ______________________.

16. There are ______________________ in the nuclear membrane which permit the movement of substances between the ______________________ and the ______________________.

17. The control center of the cell is the ________________ and it controls the ________________ and ________________ of the cells.

18. Another name for deoxyribonucleic acid is ________________.

19. The cell gets its food from the fluid around it which is called ________________ fluid.

20. When food substances pass through the pores in the cell membrane this is called ________________.

21. The process by which the cell actually engulfs food substances is called ________________.

22. Two types of cell movements are ________________ and ________________.

23. In cell reproduction when the cell splits into two new daughter cells the process is called ________________.

24. An example of a type of cell that grows and reproduces all the time is ________________.

25. An example of a cell that does not reproduce for many years ________________.

26. The type of cell that would not reproduce at all is ________________.

27. The two major processes used for transporting substances through the cell membrane are ________________ and ________________.

28. The process of moving molecules uphill against a concentration difference is called ________________.

29. The system for active transport of sodium and potassium in all the cells of the body is called the ________________.

30. The two basic means by which membrane potentials can be developed are ________________ and ________________.

31. List five factors which may cause an action potential.

a.

b.

c.

d.

e.

32. Once an action potential starts the transmission of an impulse it will travel over the entire membrane and this is called ________________.

THE NERVOUS SYSTEM

Divisions and Sheath of a Neuron

A neuron is a nerve cell. It contains a cell body which has protoplasmic processes or extensions. Since the neuron is a cell, it is the functional and structural unit of the nervous system. Therefore, you must learn how it functions if you are to understand the physiology and pathology of the nervous system.

A neuron has three main divisions: cell body, dendrite, and axon. The cell body or main portion of the neuron is responsible for the life processes of the neuron. If this area is destroyed, the entire neuron dies. It should be noted here that neurons lack the ability to reproduce which is a characteristic of other cells. The dendrites are protoplasmic processes, or extensions of the cell body, which carry messages (impulses) toward the cell body. There may be one or many dendrites on a neuron depending on its function. The axon is also a protoplasmic process of the neuron. There is always just one axon and it always carries the impulse away from the cell body.

Label the three main parts of the neuron on the following diagram and indicate the pathway of the impulse across the neuron by arrows.

There are two sheaths or coats which are found on certain areas of the neuron. They have separate and specific effects upon the neuron and are located in certain areas of the nervous system.

MYELIN. Myelin, the inner coat, is a white fatty material which acts as an insulator. It is found in the central nervous system (CNS) and the peripheral nervous system (PNS).

NEUROLEMMA. Neurolemma, the outer coat, is a type of connective tissue. This coat is found <u>only</u> in the peripheral nervous system and is responsible for nerve regeneration. Now, you will say, "But nerves do not regenerate or reproduce." If you care to look back to the first paragraph, you will see we were talking about neurons, not nerves. We will define the term "nerve" and describe the process of nerve regeneration in a later section.

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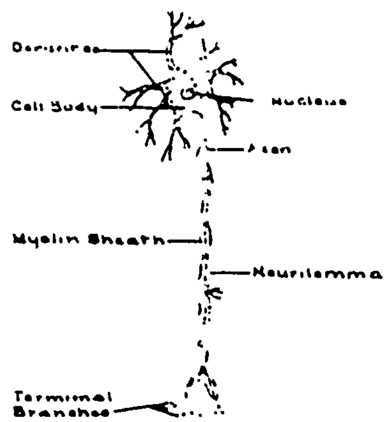
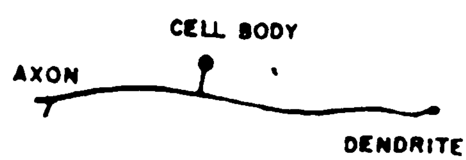


Types of Neurons and Their Functions

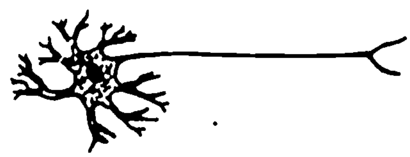
Neurons or nerve cells are named according to their function. What are the functions of neurons? To carry messages, right? But what type of messages? Can you think of any? How about the message of sight, sound, taste, pain, or pressure. All of these messages are classified as ______________________________. Sensory neurons carry sensations. Sensory neurons are unique in their structure since they have only one dendrite and the usual one axon.



A Typical Sensory Neuron

Sensory neurons always carry their messages toward the central nervous system from the periphery. Why? Well, within the brain there are definite areas which are associated with the different sensations. You could say this is where the sensations are interpreted. Now you know the messages do not go to the brain and stay there, so the next question is, "How does a body part react?" In the human body all action or reaction is in the form of movement and muscles are the only structures capable of producing movement. You might say muscles are the motors for the body. The neurons which carry the messages to the muscles are then termed

____ neurons.



A Typical Motor Neuron

Sensory neurons carry impulses toward the CNS while motor neurons carry the messages away from the CNS. That leaves only one type of neuron, one that carries the impulses between sensory and motor neurons. These are called internuncial neurons; you could call them connecting neurons. Inter (between) nuncial (neurons) are similar in shape to motor neurons. Draw in the appropriate space below a sensory, internuncial and motor neuron. Arrange them so the message will flow in the proper direction from neuron to neuron.

Motor   Internuncial   Sensory

Basic Neuroanatomy Terms

NERVE. A nerve is a bundle of protoplasmic processes with all their sheaths. The common tendency is to confuse neurons and nerves or to think of them as the same structure. Can you list the definition for a neuron?

____

____

The difference between a nerve and a neuron would be nerves are only made up of the protoplasmic processes of the neuron. If you examine the definition of a nerve you will find it to limit nerves to a specific region of the nervous system. The key to the location of nerves is correlating the definition of the sheaths. Myelin, the ______________ coat, is found in both the CNS and the PNS; while neurolemma, the outer coat, is found only in the ______________. Therefore, nerves are found only in the peripheral nervous system or outside of the brain and spinal cord. Remember we said neurolemma is responsible for nerve regeneration. If you cut a nerve and the surgeon sutures the ends of the neurolemma together, the protoplasmic processes and myelin will grow distally from the cut toward the insertion of the nerve into the muscle and skin. The nerve or processes will grow back or regenerate at about one inch per month.

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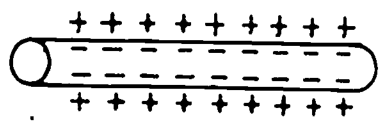
IMPULSE. An impulse is an electrochemical change conducted along neuron. The message we have been describing which neurons carry or transmit is really an impulse. To understand how the impulse could be conducted along the neuron let's go back to some information on basic physics. Electrically charged atoms or groups of atoms are known as ____________________. Ions can carry either a ____________________ or ____________________ charge. The basic law of electrophysics states that ____________________ charges repel while unlike charges ____________________. With this brief background let's look at a schematic of a process of a neuron.



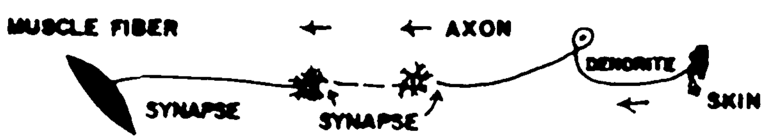
You should recognize the negative charges inside of the membrane of the neuron and the positive charges on the outside of the membrane. Obviously, the membrane must be impermeable or capable of holding the opposite charges apart. Now if some outside force alters the membrane so the charges can be joined you have a minute or extremely small electrical charge sweeping across the surface of the neuron.

STIMULUS. The stimulus is defined as any change in the environment of a neuron which initiates an impulse. How many types of stimuli can you list:

____________________, ____________________, ____________________, ____________________,

____________________, ____________________, and ____________________.

SYNAPSE. The synapse is a chemical junction between axons and dendrites of neurons, and axons of neurons and muscle fibers.



The Path of an Impulse from the Skin to a Skeletal Muscle

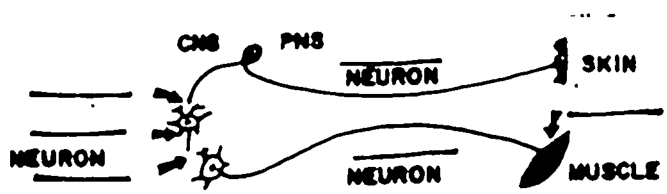
To complete this objective all you have to do is review the previous material. However, we will review the steps and then have you label the appropriate diagrams.

S5

1. We should mention first that all impulses must travel from the skin to the spinal cord, through the spinal cord, and then out to the muscle. In this cycle the skin contains the receptor for the sensory neuron; it converts the stimulus into an impulse which is carried by the ____________________ neuron to the spinal cord.

2. Within the spinal cord the impulses are transmitted to an internuncial neuron at the ________________________. At the synapse the impulse may travel to other neurons going to the brain or to the internuncial neuron and directly to a motor neuron via a second synapse.

3. The motor neuron then carries the impulse from the ________________________ to the muscle and transmits the impulse by synapse to the muscle fiber which responds by contraction. Label the following neurons and areas on the diagram below.



You can see from the diagram above that sensory and motor neurons run in close proximity in the peripheral nervous system. In the following paragraph we will discuss the types of neurons found in the nerves of the PNS.

Types and Classifications of Nerves

There are three types of nerves found within the peripheral nervous system. They derive their names from the type of neurons which make them up and from their functions.

SENSORY NERVES. These nerves carry only sensory impulses and consist only of sensory neurons. Examples of pure sensory nerves are: the optic nerve which carries ____________________ impulses, the olfactory nerve which carries the sensation of ______________________, and the auditory nerve which is associated with the sense of sound and __________________________.

MOTOR NERVES. Pure motor nerves are made up only of ____________________ neurons and carry only ____________________ impulses. The oculomotor nerve, which innervates the muscles that move the eye, is an example of a pure motor nerve.

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MIXED NERVES. Most of the nerves in the body carry both sensory and motor messages. These nerves consist of both sensory and motor ________________.

Nerves are classified according to their origin within the central nervous system. The main divisions of the CNS are the ________________________ and ________________________________. The brain is located within the cranial vault of the skull while the spinal cord is located in the vertebral or spinal column.

- Cranial nerves are one classification of nerves. They arise from different areas within the brain. There are 12 pairs of cranial nerves, some of which are sensory, motor and ________________________ nerves.

- Spinal nerves are the other classification of nerves. They arise from the spinal column and all of them carry both __________________________ and __________________________________ messages. There are 31 pairs of spinal nerves.

ANATOMY AND PHYSIOLOGY OF THE CENTRAL AND AUTONOMIC NERVOUS SYSTEMS

The Peripheral Nervous System

Every nerve in the body enters or leaves the central nervous system. All nerves are outside this system and are termed peripheral nerves. These nerves are divided into the cranial nerves or the spinal nerves, according to their origin. The PNS is divided into two systems - the voluntary and the involuntary.

CRANIAL NERVES. The cranial nerves are sensory, motor, or a combination of these two types (mixed nerves), and are adapted to special functions. They are attached to the brain and pass through specific foramina of the skull to the periphery.

- The trigeminal nerve forms the ophthalmic nerve, the maxillary nerve, and mandibular nerve, which innervate the teeth, jaws, and skin of the face.

- The facial nerve controls the muscles of the face that are concerned with facial expressions.

- The acoustic nerve is the combination of two nerve roots - the cochlear and vestibular. The cochlear for hearing and vestibular for equilibrium or balance.

- The vagus nerve extends through the neck to the pharynx, larynx, trachea, and esophagus. It has wide distribution in the thoracic and abdominal viscera.

- The spinal accessory nerve supplies two muscles of the neck - the trapezius and the sternocleidomastoidus.

SPINAL NERVES AND PLEXUSES. The spinal nerves, which arise from the spinal cord and pass through the intervertebral foramina, consist of 31 pairs - 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal. Each nerve has an anterior and a posterior root. A collection of nerve cells (spinal ganglia) are located on the posterior root. Sensory nerve impulses enter the central nervous system from the fibers from the periphery of the body by passing through the posterior root. Motor nerve impulses pass from the spinal cord through the anterior root. In some parts of the body, the roots of the spinal nerves form an interlacing network called a plexus. These networks are the brachial plexus from the neck which innervate the upper extremity and the lumbar and sacral plexuses associated with the nerves of the lower extremities.

REFLEXES. In physical therapy we are vitally concerned with the patient's reflexes. If the reflexes are abnormal they may well affect how we treat the patient. The physician uses the presence or absence of the different typas of reflexes as clinical evidence for making certain diagnoses. The physical therapist may position the patient to facilitate certain reflexes as part of an exercise program. You should be familiar with the types of reflexes and be able to describe them.

Superficial Reflexes. These are reflexes initiated by light pressure to the skin and mucous membrane. You might think of this as tickling. The physician would use it in the abdominal region to see the reaction of the umbilicus.

Deep Reflexes. Stretching of a muscle, tendon or joint capsule initiates this reflex.

Visceral Reflexes. Visceral refers to internal organ. You might recall the Bainbridge Reflex; it dealt with increasing the rate and depth of the heartbeat. However, this is of little clinical significance. There are certain visceral reflexes which the physician may test, among these the pupillary is the most common. You can try this out in a modified form on your buddy by moving your finger in toward his eye and away from it. While doing this, watch the pupil constrict and dilate.

Pathological Reflexes: These are primitive defense reflexes found in infants. When certain pathological changes are present in the mature CNS, these reflexes once again are found in the body.

INVOLUNTARY NERVOUS SYSTEM. The involuntary nervous system is more often called the autonomic nervous system (ANS). The ANS exercises control over reactions not under the conscious control of the individual. It is divided into sympathetic and parasympathetic divisions.

Sympathetic Division. The sympathetic division enables the body to react defensively by increasing the activity of the body organs, enabling them to meet danger and to perform strenuous physical activities. During periods of danger, attack, fear, or severe muscular exercise this system assumes control. It is stimulated by fear, excitement, anger and certain other situations. It causes acceleration of the heart rate, dilation of the pupils of the eyes, erection of the hairs on the skin (goose pimples), secretion of sweat, dilation of the bronchioles in the lungs and of arteries of the heart, secretion of the epinephrine from the suprarenal glands, and a release of glycogen from the liver to form glucose for the blood.

Parasympathetic Division: The parasympathetic division has a more conservative function than the sympathetic division - it dominates when the body is at rest, or during periods of relative calm and quiet. Mood music, dim lights, and a pleasant atmosphere stimulate this division. It slows down, or regulates, the normal pace of the heart rate; controls the constrictions of the pupils of the eyes as a protection against intense light; and controls such activities of the digestive system as peristalsis and chemical digestion of food and elimination of waste products.

THE RESPIRATORY SYSTEM

Structures and Functions of the Respiratory Passageways

THE NOSE. As air enters the body through the nose, there are three functions that are performed by the nasal cavities. First, the air is warmed by the extensive surfaces of the turbinates and septum. Second, the air is moistened considerably before it passes beyond the nose. Third, the air is filtered. All of these functions together are called the air conditioning function of the upper respiratory system.

THE PHARYNX (Throat). Transmits air from the naso-oral passageway to the larynx.

THE LARYNX (Voice Box). Located in the upper and front part of the neck, between the root of the tongue and the trachea. It is shaped somewhat like a triangular box, with flat sides and a prominent ridge in front (the Adams apple). Below it is narrow and rounded where it blends with the trachea. It is made up of nine fibrocartilages united by extrinsic and intrinsic ligaments and moved by numerous muscles. The larynx is lined throughout with mucous membrane, which is continuous above with that lining the pharynx and below with that lining the trachea. The cavity of the larynx is divided into two parts by two folds of mucous membrane stretching from front to back but not quite meeting in the middle. By not meeting they leave an elongated fissure called the glottis, which is the narrowest segment of the air passages. The glottis is protected by a lid of fibrocartilage called the epiglottis.

TRACHEA (Windpipe). This is a cartilaginous and membranous tube, cylindrical, about 11.2 cm (4.4 inches) in length and about 2 to 2.5 cm (2 inches) from side to side. It is located in front of the esophagus and extends from the larynx on the level of the sixth cervical vertebra to the upper level of the thoracic vertebra, where it divides into the two bronchi, one for each lung. The trachea is so placed in the chest cavity that the upper portion is more anterior than the lower. Because of this, when a person is lying prone, secretions in the bronchi and trachea tend to flow upward - making drainage of fluid in lung infections easier. The walls of the trachea are strengthened by C-shaped rings of hyaline cartilage placed so that the open portion is toward the esophagus. It is lined with mucous membrane and has ciliated epithelium on its inner surface. The mucous membrane, which extends into the bronchial tubes, keeps the internal surface of the air passages free from dust particles, the mucus entangles the inhaled particles, and the movements of the cilia continually sweep this dust-laden mucus upward into the pharynx.

THE BRONCHI. The trachea divides (bifurcates) into two primary branches which are called primary bronchi. The two primary bronchi are only slightly different, the right one being shorter, wider, and more vertical in direction than the left one. The primary bronchi after they enter the lungs, subdivide into secondary bronchi with one going to each of the lobes of the lung.

BRONCHIOLES. Following after the bronchi is the next order in the subdivision which are the bronchioles. To this point, the bronchi and their subdivisions are composed of fibrous tissue and resemble the C-shaped cartilaginous rings of the trachea and the primary bronchi. But when the bronchi become bronchioles their diameter is decreased to 1 mm or less and the cartilage is no longer seen. The bronchioles are composed only of muscle and elastic tissue and are lined with ciliated epithelium. They regulate the amount of air entering the lung by dilating and contracting.

ALVEOLAR DUCTS. Each bronchiole penetrates deeper into the lung tissue where it divides into several ducts called the alveolar ducts.

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ATRIA. These are irregularly shaped elongated, air sacs continuous with the alveolar ducts.

ALVEOLI. These are minute, cup-shaped air cells which project from the walls of the atria. They consist of a very delicate, thin layer of epithelial tissue and are surrounded by a network of capillaries. It is here, where the alveoli are close to the bloodstream, that the gases are exchanged through diffusion. The alveoli are the functional units of the lung.

LUNGS. Cone-shaped organs which fill the two lateral chambers of the thoracic cavity. They are separated from each other by the heart and other contents of the mediastinum. Each lung extends from about 1 - 1 1/2 inches above the sternal end of the first rib to the superior border of the diaphragm. The arteries, veins, and nerves that supply the lungs enter and leave the lung at a point called the hilum, which is a triangular depression on the inner or medial surface of each lung.

The lungs are composed of a light, porous, and spongy material. Each lung resembles an inverted cone in shape and consists of an apex, base, lobes, and a bronchial tree. The apex is rounded and extends about 1 - 1 1/2 inches above the first rib. The base of the lung or the diaphragmatic surface, consists of a broad, concaved, inferior part that rests on the convex superior surface of the diaphragm. Because it covers the liver, the right lung is shorter than the left. The mediastinal surface has a deep concavity called the cardiac impression. This impression, which makes room for the heart, is greater on the left lung than on the right. The hilum is also on the mediastinal surface. The left lung is divided into two parts - a superior or upper lobe, and an inferior or lower lobe. The right lung is composed of three lobes, with the middle lobe situated between the superior and inferior lobes.

Each lung is enclosed in a serous sac, one layer of which is closely adherent to the inner chest wall and superior surface of the diaphragm and is called the parietal pleura. The other layer closely covers the lungs and is called the visceral pleura. Between the two layers is a potential space called the pleural cavity since the layers are in intimate contact. The pleura is a thin, transparent, moist membrane which forms serous fluid. The two layers move easily upon each other with respiratory movements of the chest wall. If the chest wall becomes inflamed (pleurisy) friction results, and the sounds which are produced by this rubbing can be heard through a stethoscope. Any collection of fluid, as with inflammation, in the pleural cavities will cause compression and possible collapse of portions of the lung.

Physiology of Respiration

The primary purpose of the respiratory process is to supply oxygen to the body cells and to rid them of excess carbon dioxide. To gain a good general understanding of this process, you should consider it in these three stages: (1) the process of breathing, (2) external respiration, and (3) internal respiration. There are two phases of the breathing process - inspiration and expiration.

INSPIRATION. The inflation of the lungs with air occurs when the diaphragm and external intercostal muscles contract. When the diaphragm contracts it drops to a lower level, increasing the vertical dimension of the thorax. Upon contraction of the external intercostal muscles, the ribs are expanded and the anteroposterior and lateral dimensions of the thorax are increased. The expansion of the lungs, then, is in proportion to the increased dimension of the thorax. During inspiration, the air pressure in the lungs (intrapulmonic pressure) is decreased because of the increased size of the thorax and lungs. Consequently, air rushes in until the intrapulmonic pressure in the lungs is equal to the outside pressure. When the two pressures are equalized, the lungs are quiet for an instant.

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EXPIRATION. The deflation of air from the lungs occurs this way: When the external and internal pressures have been equalized, the diaphragmatic and external intercostal muscles relax. Then, the natural recoil action of the elastic lung tissue occurs and, aided by the force of gravity, the lungs retract. Thus, expiration forces the air from the lungs in order that inspiration can recur. Forced expiration may occur through the contraction of the internal intercostal muscles and through the abdominal muscles compressing the viscera against the diaphragm.

RESPIRATORY CONTROL. Although the rate and depth of respiration can be voluntarily controlled to some extent, the respiratory function is controlled by the nervous system. This control comes from the respiratory center located in the medulla oblongata of the brain. These centers react to the amount of CO_2 in the blood; the more CO_2, the faster and deeper the respiratory movements. Nerve impulses from these centers travel down the spinal cord to the diaphragmatic muscles, causing them to contract. In the normal adult, the respiratory rate is usually about 14 to 20 per minute. Emotional stresses, illnesses, exercise, and other conditions can affect this rate.

EXTERNAL RESPIRATION. All processes that occur from the time air first enters the nasal cavity until the gases are exchanged are part of external respiration and diffusion. If the concentration of gas in two solutions differ and are separated by a membrane which can be penetrated, the molecules of both gases will pass through that membrane, in both directions, until the concentrations are equalized. This is true in the process of diffusion in which oxygen is liberated into the blood and carbon dioxide is liberated from the blood. The alveoli are surrounded by numerous capillaries, branches of the pulmonary artery. This artery brings blood from the right ventricle of the heart to receive oxygen and then returns it to the heart by the pulmonary vein. Because the oxygen in the alveoli is separated from the capillaries by a layer of thin epithelium, the molecules of both oxygen and carbon dioxide penetrate the layer and make the exchange. All the blood in the body passes through the capillaries of the lungs once or twice a minute; the process of diffusion occurs in about one or two seconds.

INTERNAL RESPIRATION. Internal respiration, which is the continuation of external respiration, consists of the processes by which oxygen, carried by the blood, is delivered to the body tissues in exchange for excess carbon dioxide given up by the tissue cells. These four processes of diffusion take place in internal respiration: (1) oxygen carried by the blood passes into the tissue cells; (2) from this fluid the oxygen diffuses into the tissue cells; (3) through diffusion, the tissue cells exchange excess carbon dioxide for the oxygen in the tissue fluid then passes into the bloodstream through diffusion. It is believed that under normal conditions, the body tissues use about 350 cc of oxygen per minute. However, exercise, emotional stresses, and other conditions can increase this amount. It should be remembered that the blood never gives up all of its oxygen content to the tissue, nor does the tissue give up all of its carbon dioxide content to the blood.

Two Methods of Breathing

Two methods of breathing that will be discussed at this point are diaphragmatic and chest. Diaphragmatic breathing is the use of the abdominal muscles to breathe, using only minimal chest muscles, this is a very deep type breathing. Chest breathing is the use of the intercostal muscles, with minimal diaphragm and abdominal movements. This is a very shallow type breathing.

Breath Sounds

With each intake of air there is an accompanying low rustling sound, which can be heard if the ear is applied to the chest wall. It is thought that the dilation of the alveoli produces this sound, and the absence of it indicates that the air is not entering the alveoli over which no sound is heard or that the lung is separated from the chest wall by effused fluid. The air passing in and out of the larynx, trachea, and bronchial tubes produces a louder sound, which is called a bronchial murmur. In diseased conditions the normal sounds are modified in various ways and are then spoken of as <u>rales</u>.

EUPNEA. This term is applied to ordinary quiet respiration made without obvious effort.

DYSPNEA. This term is usually reserved for painful breathing, in which the expirations are active and forced. Dyspnea may be caused by (1) stimulation of the sensory nerves, particularly the pain nerves, (2) an increase in the hydrogen ion concentration of the blood, and (3) any condition that interferes with the normal rate of the respirations or of the heart action or prevents the passage of air in or out of the lungs.

HYPERPNEA. The word hyperpnea is applied to an increased rate and/or depth of respirations.

APNEA. Basically this word means lack of breathing. Physiologically it is used to describe the cessation of breathing movements due to lack of stimulation of the respiratory center, brought about by rapid and prolonged ventilation of the lungs. This term is sometimes used to mean the same as asphyxia or suffocation.

Cheyne-Stokes Respiration

This is an exaggeration of the type of respiration which is often seen during sleep in normal people. The respirations increase in force and frequency up to a certain point and then gradually decrease until they cease altogether; there is a short period of apnea, then the respirations recommence and the cycle is repeated. This type of respiration is associated with conditions that depress the respiratory center, especially in brain, heart, and kidney diseases.

EDEMATOUS RESPIRATION. When the air cells become infiltrated with fluid from the blood, the breathing becomes edematous and is recognized by the moist, rattling sounds, or rales, caused by the passage of the air through the fluid. It is a serious condition because it interferes with aeration of the blood and often results in asphyxia.

COUGH. The cough reflex is a critically essential one, because it prevents obstruction of the airway. Foreign material, such as particles of irritating chemicals, stimulate nerve endings and the impulses are transmitted to the respiratory center by the vagus nerves. This results in the inspiration of a large volume of air; the epiglottis closes tightly; the abdominal muscles and other expiratory muscles contract fully. When the epiglottis opens there is a rapid, strong expulsion of air from the lungs which carries the foreign material outward.

ASPHYXIA. This is produced by any condition that causes prolonged interference with the aeration of the blood, which may be caused by obstruction to the entrance of air to the lungs, depression of the respiratory center, an insufficient supply of oxygen, or lack of hemoglobin in the blood.

QUESTIONS

1. The three functions that are performed by the nasal cavities are:

   a. ____________________

   b. ____________________

   c. ____________________

2. Another name for the larynx is the ____________________.

3. The larynx is lined throughout by ____________________.

4. The glottis is protected by a lid of fibrocartilage called the ____________________.

5. Another name for the windpipe is the ____________________.

6. The upper portion of the trachea is more ____________________ than the lower portion, and because of this, when a person is lying prone ____________________.

7. The walls of the trachea are strengthened by ____________________ of ____________________.

8. The trachea is lined with ____________________ and has ____________________ epithelium.

9. The primary bronchi after they enter the lung subdivide into ____________________ bronchi.

10. The bronchioles are composed of ____________________ and ____________________ tissue and are lined with ____________________.

11. The bronchioles regulate ____________________ by dilating and contracting.

12. The functional unit of the lung is the ____________________.

13. The point where the arteries, veins, and nerves enter the lung is called the ____________________.

14. The right lung has ____________________ lobes and the left lung has ____________________ lobes.

15. The hilum is located on the ______ surface of the lung.

16. The lung is located in a serous sac that has two layers and they are called the ______ and the ______.

17. The ______ pleura is the outermost layer and the ______ pleura is the innermost layer.

18. The primary purpose of the respiratory process is to ______.

19. During inspiration the diaphragm ______ increasing the vertical dimension of the thorax.

20. The ______ expand the ribs during inspiration.

21. Forced expiration may occur through the contraction of the ______ and the ______.

22. The respiratory centers are located in the ______ of the brain, and react to the amount of ______ in the blood.

23. All the processes that occur from the time air first enters the nasal cavity until the gases are exchanged are part of ______ and ______.

24. List the four processes of diffusion that take place during internal respiration.

a. ______ ______

b. ______ ______

c. ______ ______

d. ______

25. Two methods of breathing are ______ and ______.

6. Ordinary quiet respiration is called ______.

27. The term dyspnea usually refers to ______.

28. An increase in the rate and/or depth of respiration is referred to as ______.

29. Cessation of breathing movements due to lack of stimulation of the respiratory centers is called ______________________.

30. Describe Cheyne-Stokes respiration.

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31. Respiration becomes edematous when the ______________________ becomes infiltrated with fluid from the ______________________.

32. Why is the cough reflex an essential one?

____

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THE CARDIOVASCULAR SYSTEM

Structures of the Heart

The heart is a hollow, muscular organ which is situated in the thorax between the lungs and above the center depression of the diaphragm. It is approximately the same size as a closed fist and is shaped like a blunt cone.

TISSUE LAYERS OF THE HEART. The wall of the heart is made up of three layers: (1) an outer layer, the epicardium, (2) a middle layer, the myocardium, and (3) an inner layer, the endocardium.

The heart is covered by a serous membrane called the pericardium. It consists of two parts: (1) an external fibrous portion and (2) an internal serous portion. The external fibrous pericardium is composed of fibrous tissue and is attached by its upper surface to the large blood vessels which emerge from the heart. The internal, or serous portion of the pericardium, which is also called the epicardium, is a completely closed sac; it envelops the heart and lines the fibrous pericardium. The heart, however, is not within the cavity of the closed sac. The portion of the serous pericardium which lines it and is closely adherent to the heart is called the visceral portion; the remaining part of the serous pericardium, that which lines the fibrous pericardium, is known as the parietal portion.

The inner surface of the cavities of the heart is lined by a thin membrane called the endocardium. It is a smooth surface, composed of endothelial cells. It covers the valves and is continuous with the lining membrane of the large blood vessels.

The main portion of the heart is made up of cardiac muscle called myocardium. This tissue includes the muscle bundles of the atria and the ventricles. The myocardium is the portion of the heart that is responsible for the pumping of the blood.

COMPONENT PARTS OF THE HEART. The heart is divided into two halves, a right half and a left half. These two halves are frequently referred to as the right and left heart and are divided by a muscular partition called the ventricular septum which extends from the base of the ventricles to the apex of the heart. The atrial septum is inconspicuous. After birth the two sides have no communication with each other. The right side of the heart contains venous blood and the left side contains arterial blood. Each half is subdivided into two cavities, the upper called the atrium, and the lower called the ventricles. Both the right and left sides of the heart contract and relax simultaneously.

Between each atrium and ventricle there is a somewhat constricted opening that is protected by valves. The openings into the aorta and pulmonary artery are also guarded by valves.

The right atrioventricular valve, also called the tricuspid valve, is composed of three irregular shaped flaps or cusps. The flaps are formed mainly of fibrous tissue covered by endocardium. The tricuspid valve allows blood to flow from the right atrium into the right ventricle and prohibits the backflow of blood from the right ventricle into the right atrium. The left atrioventricular valve, also called the bicuspid valve, is composed of two flaps or cusps. The bicuspid valve is sometimes referred to as the mitral valve. Its structure and function are similar to the tricuspid valve.

The opening between the right ventricle and the pulmonary artery is guarded by the pulmonary valve, and the opening between the left ventricle and the aorta is guarded by the aortic valve. These two valves are called the semilunar valves and consist of three semilunar cusps.

BLOOD SUPPLY TO THE MYOCARDIUM. Since the heart cannot use blood directly from the chambers, it must have its own source of blood supply. Blood is carried through the muscle layers of the heart by means of two coronary arteries. These small vessels are branches off the aorta just after it leaves the heart. These arteries fill during myocardial relaxation and empty during contraction. The veins that carry the blood from the heart muscle, empty into a channel about 1 inch long called the coronary sinus. The coronary sinus opens into the right atrium between the inferior vena cava and the atrioventricular opening. There is a valve at the point where the coronary sinus empties into the right atrium. This valve is a single semicircular fold of the lining of the atrium.

NERVE SUPPLY TO THE HEART. Located in the right atrium is a strip of specialized muscle fibers called the sino-atrial node (S-A node), often referred to as the pacemaker. The fibers of the S-A node are self-excitatory, contracting rhythmically at a normal rate of 70 to 80 times per minute and under normal conditions are independent of the CNS. The stimulus sent out by the S-A node spreads across both atria, like a ripple across a pond, causing the atrial muscle to contract. The contraction of the atrial muscle forces the blood into the ventricles. As the impulse travels across the atria toward the ventricle, it stimulates a strip of specialized conductive fibers called the atrio-ventricular node (A-V node). The impulse then spreads out across the ventricles conducted along the way by specialized fibers called Purkinje fibers.

As was stated previously, the cardiac rhythm is normally independent of the CNS. It receives its control from the autonomic nervous system (vagal nerve). The parasympathetic fibers slow the heart rate by decreasing the rate of the S-A node and decreasing the excitability of the A-V node, thereby slowing impulses to the ventricles. The sympathetic fibers have the opposite function of the parasympathetic fibers, in that they increase the heart rate.

Cardiac Cycle

The cardiac cycle consists of three phases: (1) a period of contraction called systole, (2) a period of relaxation called diastole, and (3) a period of rest. The average heart rate of man at rest is 70 to 72 beats per minute. If we assume a pulse rate of 70 to 72, the time required for a cardiac cycle is 0.8 second, and half of this or 0.4 second, represents the length of the rest period.

BLOOD VESSELS. Arteries - The arteries are thick-walled, elastic tubes that usually carry oxygenated blood from the heart to the body tissues. Since they consist mostly of muscle and elastic tissues, they can contract or expand in proportion to the amount of blood that is pumped into them, which in turn forces the blood through them.

The arteries are composed of three layers or coats. The inner layer or coat is called the tunica intima, and is composed of endothelial cells and a membrane or network of elastic fibers. In larger vessels there may also be a delicate layer of connective tissue. The middle layer or coat is called the tunica media and consists mainly of smooth-muscle fibers and is the thickest of the three layers. The external layer or coat is called the tunica externa or adventitia and consists primarily of loose connective tissue.

The strength of an artery depends to a large extent on the outer coat. The arteries do not collapse when empty, and when the artery is severed, the orifice remains open.

The largest arteries in the body are the aorta and pulmonary arteries. They have a diameter of more than 3 cm at their connection with the heart. These large arteries give off branches which divide and subdivide into smaller branches. The smallest of these branches are called arterioles, and at their distal ends where only the internal coat remains, the capillaries begin. The walls of the arterioles contain a great portion of smooth muscle in relation to elastic tissue, and they are thought of as muscular rather than elastic. They have the ability to constrict and dilate several times their normal size.

CAPILLARIES. The capillaries are very small vessels, that connect arterioles (smallest arteries) and venules (smallest veins). The walls of the capillaries are composed of one layer of endothelial cells, which is continuous with the layer that lines the arteries, veins, and the heart.

The capillaries communicate freely with one another and form interlacing networks of variable size and form in the different tissues. All the tissues, with the exception of cartilage, hair, nails, cuticle, and the cornea of the eye, have networks of capillaries. The diameter of the capillaries is so small that on many occasions the blood cells have to pass through them in single file, and frequently the cell is larger than the diameter of the vessel and becomes distorted as it passes through them. Capillaries are most numerous and form the finest networks in the organs, where the blood is needed for purposes other than local nutrition, such as secretion or absorption.

It is in the capillaries that the main work of the blood is accomplished, and the purpose of the vascular mechanism is to cause the blood to flow through these vessels in a steady stream. It is in the capillaries that the exchange of fluids and nutrients between the blood and the interstitial (intercellular) spaces takes place. We can break down the work done by the capillaries into five areas: (1) supplies the organs with the necessary materials for secretion; (2) takes up some of the elements of digested food through the digestive system; (3) takes up secreted products from the ductless glands; (4) absorbs oxygen and gives off carbon dioxide in the lungs; and (5) discharges waste products of metabolism in the kidneys.

Veins

Veins are the blood vessels that carry blood from the capillaries to the heart. The structure of the veins is similar to that of the arteries. They have three coats: (1) an inner endothelial lining; (2) a middle muscular lining, and (3) an external layer of connective tissue. The primary differences between arteries and veins are: (1) veins usually carry blood toward the heart; (2) the walls of the veins are thinner than the walls of the arteries; (3) veins are not as elastic as arteries; (4) the middle coat is not as well developed in the veins; and (5) many of the veins have valves which function to keep the blood flowing toward the heart and prevent a backflowing of blood.

Blood Circulation

PULMONARY CIRCULATION. Pulmonary circulation, sometimes called lesser circulation, is the circulation of blood through the lungs for the purpose of oxygenation. All venous blood returning from the body enters the right atrium through the superior and inferior vena cava and then enters the right ventricle through the tricuspid valve. As the right ventricle contracts, venous blood is forced through the pulmonary valve to the pulmonary artery which carries the blood to the lungs. In the capillary network of the alveoli of the lungs, the blood, through diffusion, exchanges waste carbon dioxide for oxygen. The oxygenated blood is then returned to the left atrium by way of the pulmonary veins.

SYSTEMIC CIRCULATION. Systemic circulation involves the circulation of the blood from the left ventricle to all parts of the body and then back to the right atrium. The oxygenated blood enters the left ventricle from the left atrium by way of the bicuspid valve. When the left ventricle contracts, blood is forced through the aortic valve into the aorta. From here it takes different courses to all parts of the body through arteries, arterioles, and capillaries and then returns by way of the veins to the right atrium. Systemic circulation includes coronary and portal circulation. Coronary circulation involves circulation of blood through the muscular tissue of the heart, by way of the coronary arteries. Portal circulation involves the passage of venous blood from the gastrointestinal tract and spleen, through the liver and out to the inferior vena cava through the hepatic veins.

Blood Pathway Through Heart and Lungs

In concluding the cardiovascular system it may be helpful to briefly trace the route that the blood takes through the body.

Deoxygenated blood is returned to the right atrium of the heart mainly by the superior and inferior vena cava and the coronary sinus. From the right atrium the blood is pumped into the right ventricle through the tricuspid valve. From the right ventricle the blood is pumped through the pulmonary valve into the pulmonary artery which carries the blood to the lungs. In the lungs the process of diffusion occurs, by which carbon dioxide is exchanged for oxygen. Upon leaving the lungs the oxygenated blood flows back to the left atrium through the pulmonary vein. From the left atrium the blood is pumped through the bicuspid (mitral) valve into the left ventricle. The blood is then pumped through the aortic valve into the aorta and from there to the various parts of the body.

QUESTIONS

1. The heart is situated in the ____________ between the ____________ and above the center depression of the ____________.

2. The wall of the heart is made up of three layers.

   a. ____________

   b. ____________

   c. ____________

3. The heart is covered by a ____________ membrane called the ____________.

4. The inner surface of the cavities of the heart is lined by a thin membrane called the ____________.

5. The main portion of the heart is made up of ____________ called ____________.

6. The right and left heart are divided by a muscular partition called the ____________.

7. Another name for the right atrioventricular valve is the ____________.

8. The left atrioventricular valve is called the ____________.

9. The pulmonary and aortic valves are the ____________ valves.

10. The heart receives its blood supply by means of the ____________.

11. The coronary sinus opens into the ____________.

12. A strip of specialized muscle fiber located in the right atrium is the ____________ and is often referred to as the ____________.

13. Cardiac rhythm receives its control from the ____________, in particular the ____________ nerve.

14. The parasympathetic fibers ____________ the heart rate, by decreasing the rate of the ____________.

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15. In the cardiac cycle, a period of contraction is called ______________ and a period of relaxation is called ______________.

16. Arteries can ______________ or ______________ in proportion to the amount of blood pumped into them.

17. Arteries have three coats or layers, the inner layer or ______________, the middle layer or ______________, and the outer layer or ______________.

18. The largest arteries in the body are the ______________ and ______________.

19. The smallest arteries are called ______________ and contain a great portion of ______________.

20. The smallest veins are called ______________ and are connected with the smallest arteries by ______________.

21. Walls of capillaries are composed of one layer of ______________.

22. In the capillaries is where the exchange between the blood and the ______________ takes place.

23. The difference between the walls of arteries and the wall of veins is that the ______________ is more developed in the ______________.

24. In pulmonary circulation, the process of ______________ takes place in the lung. During this process ______________ is given up for ______________.

25. Portal circulation involves the passage of ______________ blood from the ______________ tract and ______________ through the liver and out to the inferior vena cava through the ______________.

THE LYMPHATIC SYSTEM

Structures and Functions of the Lymphatic System

LYMPH FLUID. Lymph fluid is usually a clear, transparent, colorless fluid. It is interstitial (intercellular) fluid that enters the lymphatic system through the terminal lymphatic capillaries. Generally it is similar in composition to the blood plasma in the part of the body from which it flows, with one exception. The protein content of the lymph is much lower than that of the blood plasma.

TERMINAL LYMPHATIC CAPILLARIES. The basis upon which the lymphatic system is built is similar to that of the blood vascular system, if the heart and arteries are left out. In the tissues are located the closed ends of minute microscopic vessels, called terminal lymphatic capillaries, which are similar to, and often larger and more permeable than, the blood capillaries. The terminal lymphatic capillaries do not have pores like the typical blood capillaries. They are composed of a single layer of endothelial cells.

There are no connections at the junctions between the cells. The edge of one endothelial cell overlaps the edge of the adjacent cell forming a flap. The flap that is formed by the overlaping cells forms a valve which opens to the inside of the capillary. Interstitial fluid pushes the flap valves open and flows into the lymph capillary. Once the interstitial fluids enters the capillary it cannot leave, because any backflow will close the flap valve.

The endothelial cells of the terminal lymphatic capillaries are attached to the connective tissue of the surrounding tissue cells by anchoring filaments. These anchoring filaments permit the flap valve of the capillary to work and helps prevent the capillary from collapsing.

The terminal lymphatic capillaries arise from the intercellular spaces and are the beginning of the lymphatic vessels.

LYMPHATIC VESSELS. The lymphatic vessels are transparent and of very delicate construction. They are composed of three coats or layers. The internal coat is composed of a layer of elongated endothelial cells supported on an elastic membrane. The middle coat is composed of smooth muscle and fine elastic fibers. The external coat is composed of connective tissue intermixed with smooth muscle fibers. This forms a protective covering to the other coats and serves to connect the vessel to its neighboring structures. The lymphatic vessels also contain valves that are similar to those that are found in the veins. These valves are composed of thin layers of fibrous tissue covered on both surfaces by endothelium. The valves perform the same type of function that the valves of the veins perform.

LYMPH NODES. Lymph nodes can be compared to a sewage treatment plant or filtering system. The nodes consist of enormous numbers of lymphocytes, which are lymph cells or white blood corpuscles without cytoplasmic granules. The

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nodes are situated along the course of the lymphatic vessels. They filter the lymph fluid as it passes through them and they form antibodies. They aid in preventing the spread of infection and toxins in the body.

LYMPHATIC DUCTS. As the lymphatic vessels continue to unite and form larger and larger vessels they finally converge into two main channels, (1) the thoracic duct and (2) the right lymphatic duct.

The thoracic duct conveys lymph from the greater part of the body into the blood. It conveys lymph from the right lower half of the body and all of the left side of the body. It empties into the junction of the left subclavian and the internal jugular vein.

The right lymphatic duct conveys lymph from areas of the body not emptied by the thoracic duct. The right side of the head, neck, thorax, and the right upper extremity are served by the right lymphatic duct. It empties into the junction of the right subclavian vein and the internal jugular vein.

LYMPHATIC PUMP. Whenever the lymph vessel is compressed by pressure the lymph is moved. The direction of the lymph movement is controlled by the valves.

There are certain factors which frequently compress the lymphatic vessels. These factors will be listed in the order of their importance:

a. Contraction of muscles

b. Passive movements of the parts of the body

c. Arterial pulsation

d. Compression of the tissues

The lymphatic pump becomes very active during exercise and very sluggish under resting conditions. During exercise the lymph flow may be increased three to 14 times above its normal flow.

EDEMA. There is always a small amount of protein filtering from the arterial capillaries into the tissue spaces. This protein cannot be reabsorbed into the blood stream through the venous capillaries because of pores of the capillaries are too small to permit the protein molecules to pass through. The only way in which the protein can be returned to the blood circulatory system is through the lymphatic vessels. If the lymphatic vessels from any area of the body becomes plugged there will be a continual increase of protein in the tissue spaces. This causes more fluid to collect in the tissues and results in a very severe edema.

EXERCISE

1. Lymph fluid is ______________________ fluid that enters the lymphatic system through the ______________________________.

2. Lymph fluid is similar in composition to the ____________________ in the part of the body from which it flows.

3. The ______________________ content of the lymph is much lower than that of the blood plasma.

4. The lymphatic system is similar to the __________________________.

5. Terminal lymphatic capillaries do not have ____________________ like typical blood capillaries.

6. Interstitial fluid flows into the lymph capillary through a ______________.

7. The endothelial cells of the terminal lymphatic capillaries are attached to the connective tissue of the surrounding tissue cells by ____________________.

8. The terminal lymphatic capillaries arise from the ____________________ and are the beginning of the ________________________.

9. The lymphatic vessels are composed of ______________ layers, the most internal being composed of ______________________________________

____.

____.

10. The middle coat of the lymphatic vessels is composed of ______________ and ______________________.

11. The lymphatic vessels contain ____________________ similar to those found in the veins.

12. Lymph nodes consist of enormous numbers of ________________________.

13. The lymph nodes ______________________ the lymph fluid and they form ______________________________.

14. The two lymphatic ducts are the ______________________________ and ________________________.

15. The right lower half of the body and all of the left side of the body are drained by the ____________________________ duct.

16. The factors which frequently compress the lymphatic vessels are:

a.

b.

c.

d.

17. The lymphatic pump becomes very active during ____________________ and sluggish during ______________________________.

18. The only way that protein may be returned to the blood circulatory system is through the ____________________________.

RENAL SYSTEM

Physiological Anatomy of the Kidney

MAJOR FUNCTIONS OF THE KIDNEYS. There are two major functions that the kidneys perform for the body. First, most of the end products of bodily metabolism are excreted by the kidneys. Second, the concentrations of most of the elements of the extracellular and intracellular fluids are controlled by the kidneys.

Nephron. The nephron might be called the functional unit of the kidney. There are about 1,000,000 in each kidney and each of these nephrons has two basic components. The glomerulus, where the fluid is filtered out of the blood, and the tubules, where the filtered fluid is converted into urine as it goes to the pelvis of the kidneys.

The basic function of the nephron is to clean the blood plasma of unwanted substances. Some of these unwanted substances, such as urea, creatinine, uric acid, sulphates, and phenols are the end products of body metabolism. Besides these end products there are several nonmetabolic substances which accumulate in the body in excessive amounts, among these substances are sodium, potassium, and chloride ions. The nephron cleans the plasma of these substances.

The mechanism used by the nephron for removing these substances has two steps. First, about one-fifth of the plasma filters through the glomerular membrane into the tubules. Second, as the filtered fluid passes through the tubules, the unwanted substances are separated from the wanted substances. The wanted substances are returned to the blood and the unwanted substances go into the urine.

Blood Flow Through the Nephron. The blood enters the glomerulus through the afferent arteriole. The glomerulus is a network of about 50 parallel capillaries encased in Bowman's capsule. An average pressure of about 70 mmHg on the blood causes the plasma to filter into Bowman's capsule. The glomerulus is a high pressure bed of capillaries. Because of the high pressure the glomerulus functions about the same way as the arterial ends of the tissue capillaries by continually filtering fluid out.

The blood leaves the glomerulus by passing through the efferent arteriole. The efferent arteriole offers a lot of resistance to the blood flow between the glomerulus and the peritubular capillary network. The peritubular capillary network surrounds the tubules and is a low pressure bed of capillaries having a pressure of about 13 mmHg. The low pressure permits the peritubular capillary network to function about the same way as the venous ends of the tissue capillaries by continually absorbing fluid from the tubules. From the peritubular capillary network most of the blood passes through the vasa recta. The vasa recta are straight capillary loops which go down into the medulla and then loop back up to empty into the cortical vein of the kidney. From the cortical veins the blood begins its return to the heart.

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Bowman's capsule collects the fluid which has filtered through the capillaries of the glomerulus. From Bowman's capsule the filtered fluid (glomerular filtrate) flows into the proximal tubule. The proximal tubule lies in the cortex of the kidneys along with the glomerulus. From the proximal tubule the fluid enters the loop of Henle, which may go deep into the medulla of the kidney. From the loop of Henle the fluid goes into the distal tubule which is located in the cortex of the kidney. As the fluid goes through the tubules the wanted substances, water and varying amounts of other elements, are reabsorbed, and that which is not reabsorbed becomes urine.

From the distal tubule fluid goes into the collecting duct which collects fluid from several nephrons. The collecting duct passes from the cortex down to the medulla. From the collecting duct the fluid goes into the pelvis of the kidney, which is a basin like cavity. From the pelvis of the kidney the fluid goes into the ureters, which carry the urine to the urinary bladder which is a reservoir for the urine. From the urinary bladder the fluid goes into the urethra and is eliminated from the body.

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EXERCISE

1. The kidneys have ______ major functions. First, ______ ; Second, ______ . ______ .

2. The ______ might be called the functional unit of the kidney.

3. There are about ______ nephrons in each kidney.

4. The nephron has two basic components the ______, where fluid is filtered out of the blood, and the ______, where the filtered fluid is converted into ______.

5. The basic function of the nephron is to ______ .

6. Some of the unwanted substances found in blood plasma which are end products of bodily metabolism are ______.

7. The mechanism used by the nephron for removing unwanted substances has two steps.

a. ______

b. ______

8. The blood enters the glomerulus through the ______.

9. An average pressure of about ______ on the blood causes ______ to filter into Bowman's capsule.

10. Because of the high pressure the glomerulus functions about the same way as ______ .

11. Blood leaves the glomerulus by passing through the ______.

12. The ______ surrounds the tubules and is a ______ bed of capillaries.

13. The ______________________________ are straight capillary loops which go down into the medulla and loop back up to empty into the ______________.

14. Bowman's capsule collects the fluid which has filtered through ______________

____.

15. From the proximal tubule the fluid enters ______________________ which may go deep into the medulla of the kidney.

16. The distal tubule is located in the ______________________________ of the kidney.

17. The collecting duct collects fluid from several ______________________.

18. The reservoir for the urine is the ______________________________.

THE INTEGUMENTARY SYSTEM

Function

The skin not only covers most visible parts of the body, but is also associated with several other functions. It protects the deeper tissues of the body from injury and dehydration, and (unless the skin is broken) it prevents the entrance of bacteria-producing organisms. The skin, along with some of its appendages, helps to regulate body temperature through the dilation and constriction of its blood vessels. Another important function, which is attributable to the sweat glands, is the elimination of certain waste products.

Skin Layers and Appendages

THE EPIDERMIS. The skin consists of an outer layer called the epidermis and an inner layer called the dermis. The epidermis consists of squamous epithelium tissue in four layers. The outer layer (surface skin) is often called the horny layer or stratum corneum and it forms a protective layer of dry, clear, overlapping scales over the true skin (dermis). The epidermis varies in thickness in different places. It is the thickest on the soles of the feet and the palms of the hands. As the cells from the deeper areas multiply, they are pushed outward until they finally become part of the first layer of the epidermis. Located within the epidermis is a substance known as melanin which is responsible for the pigmentation of the skin. The more melanin present the darker the pigmentation.

THE DERMIS. The dermis consists of two layers of highly vascular and sensitive connective tissue. The most superficial layer or papillary layer of the dermis is located just beneath the deepest layer of the epidermis. In the papillary layer are located the grooves, pores, capillaries and nerve endings. The deepest layer of the dermis or reticular layer consists of interlacing fibrous and elastic tissues and is richly supplied with blood capillaries and nerves. The interlacing network of these tissues also contains sweat glands and adipose tissue.

NAILS. Since the fingernails and toenails are composed of horny cells of the superficial layer of the epidermis, they are considered to be a modified type of epidermis. When the outer layer of the epidermis becomes scaly, the epidermis that forms the nails becomes hardened.

HAIR. The hair is considered a modification of the epidermis. Each hair consists of a root, which is below the surface, and a shaft which is visible above the skin. The hair follicle is a small canal extending from the dermis to the skin surface. It provides a passageway for the hair and contains the cuticle, the cortex and the medulla. At the bottom of each hair follicle is an enlargement called a bulb, where hair grows in much the same manner that skin layers develop. The hair follicle forms a sheath around the formative germinal cells, thus creating the rodlike projections known as hair.

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EXERCISE

1. The skin protects the deeper tissues of the body from ____.

2. The skin, along with some of the appendages helps to regulate ____________________.

3. Sweat glands function to ____________________.

4. There are two main layers of skin, the ____________________ and ____________________.

5. The outer layer of skin consists of ____________________ tissue and is often called ____________________.

6. The substance that is responsible for the pigmentation of the skin is ____________________.

7. The two layers of the dermis are the ____________________ and ____________________.

8. Nails are a modified type of ____________________.

9. At the bottom of each hair follicle is an enlargement called a ____________________.

10. The sweat glands are located in the ____________________ layer of the dermis.

THE BODY'S HEAT REGULATORY SYSTEM

Body Temperature

The internal body temperature remains fairly constant, within plus or minus 1°F day in and day out unless a person has a febrile illness (illness with a fever). A nude person can be exposed to temperatures as low as 55° to 60°F and still maintain an almost constant temperature. A nude person can also be exposed to temperatures as high as 150° and still maintain an almost constant temperature. The mechanism which the body uses to control body temperature is a nicely designed control system.

There is not a single temperature level which can be considered the normal temperature level for all people. Temperature measurements for many normal people have been taken and these have ranged from 97°F to over 99°F. The average normal temperature is generally considered to be 98.6°F when measured orally and about 1°F higher when measured rectally.

The body temperature will vary with exercise and with the temperature of the surroundings because the temperature regulatory mechanism is not always 100% effective. During strenuous exercise an excessive amount of heat is produced in the body and the rectal temperature can go as high as 101°F to 104°F. The body may be exposed to extreme cold and the rectal temperature can fall below 98°F.

HEAT PRODUCTION. Heat is always being produced in the body as a by-product of metabolism. And heat from the body is always being lost to the surroundings. A person is said to be in heat balance when the rate of heat production is exactly equal to heat loss. When the rate of heat production and the rate of heat loss are not in equilibrium the body temperature will either be increasing or decreasing. The following are some major factors which are important in determining the rate of heat production:

- The basal rate of metabolism of all the cells of the body.
- An increase in the rate of metabolism caused by muscle activity.
- An increase in metabolism caused by an increased temperature of the body.

HEAT LOSS. There are many different methods by which heat is lost from the body and the amount of heat loss by each of these methods will vary with atmospheric conditions.

Radiation. This is the loss of heat in the form of infrared heat rays (a type of electromagnetic wave). The usual situation is this. The temperature of the body is greater than the temperature of the surroundings, so more heat is radiated from the body than is radiated to the body. At times the surroundings may be hotter than the body. Under these circumstances more heat would be radiated to the body than from the body.

The human body absorbs heat rays very easily. About 97% of the rays that hit the body are absorbed. The absorption rate is almost equal for people with either white or black skin. The different colors of the skin have no effect on the absorption at infrared wavelengths.

Energy from the sun is transmitted by light rays rather than infrared rays. White skin will reflect about 35% of the light rays while only a small amount will be reflected by dark skin. In sunlight the dark skin can absorb more heat than white skin. A nude person loses about 60% of his heat by radiation when in a room at normal temperature.

Conduction. This is the transfer of heat by direct contact from the surface of the body to the surface of another object or to a liquid or gas. Only a small amount of body heat is lost from the surface of the body by direct conduction to the surface of another object such as a chair, bed, or water. A large amount of body heat is lost by conduction to air even under normal conditions. After the temperature of the air adjacent to the skin of the body equals the temperature of the skin, no more heat will be lost by conduction to the air. Body heat loss by conduction to the air is self-limiting unless the heated air is moved away from the skin so that unheated air can be moved in next to the skin.

Convection. This is the transmission of heat in liquids and gases by a circulation carried on by the heated particles. When heat is removed from the body by convection air currents, it is commonly called heat loss by convection. Actually the heat is first conducted to the air and then carried away by the convection air currents. Almost always a small amount of convection is occurring around the body since the air adjacent to the skin has a tendency to rise as it is heated. A nude person seated in a room with minimal air movement will lose about 12% of his body heat by conduction to the air and then by convection away from the body.

Evaporation. This is body heat loss resulting from changing a liquid to a vapor. When the temperature of the surroundings is higher than the body temperature, the body gains heat by radiation and conduction from the surroundings. In this situation the only way the body can get rid of heat is by evaporation. If anything prevents evaporation when the surrounding's temperature is higher than the body temperature, the body temperature will rise. The continual heat loss by insensible water evaporation from the skin is 12 to 18 calories per hour.

The Body's Insulator System

The heat insulators for the body are the skin, the subcutaneous tissues and the fat of the subcutaneous tissues. The fat is very important because it conducts heat only one-fourth as fast as the other tissues.

The Body's Radiator System

There is a continuous venous plexus which is supplied by an inflow of arterial blood. The venous plexus is located immediately beneath the skin. In the hands, feet and ears the blood will go directly to the venous plexuses from the small arteries through the atriovenous shunts. The rate of blood flow in the venous plexus varies from just above zero to about 30% of the total cardiac output. A high rate of flow will cause heat to be conducted from the deep areas of the body to the skin efficiently. A low rate of flow will decrease the efficiency of the heat conduction from the deep areas of the body. Because of this the skin is a very effective radiator system for the body.

The flow of the blood to the skin is the primary method of heat transfer from the deep areas of the body to the skin. If something should happen to this radiator system of the body the only way that heat from the deep areas of the body could be lost to the exterior would be by heat diffusion through the heat insulator of the body. The heat conduction to the skin is controlled by the sympathetic division of the autonomic nervous system. Normally sympathetic impulses cause continual constriction of the arterioles supplying the skin. Stimulation of the sympathetic centers will cause further constriction of the arteries, which will cause the blood flow to the skin to almost stop. When the sympathetic centers are inhibited a decrease in sympathetic impulses to the periphery reuslts and the arteries dilate.

Body Temperature Regulation

In general the nude body is able to maintain indefinitely a normal body core temperature between 98°F to 100°F when it is placed in dry air at a temperature of 60°F to 130°F. The body temperature is almost entirely regulated by nervous feedback mechanisms which are operated through a temperature regulating center located in the hypothalamus. For the temperature regulating center to function, temperature detectors are used to determine if the body temperature is too hot or too cold. These temperature detectors are located in the preoptic area of the anterior hypothalamus and are heat sensitive neurons. This small preoptic area of the anterior hypothalamus is called the thermostatic center. When the body temperature rises above 98.4°F the heat sensitive neurons increase their output to activate the mechanisms to lower the body temperature. The sweat glands are activated to cause evaporative heat loss from the body. The sympathetic centers are inhibited which permits vasodilation and loss of heat from the body.

When the body temperature goes down below 98.4°F the heat sensitive neurons decrease their impulse output so that mechanisms can be activated to raise the body temperature. The sympathetic centers are exicted which results in vasoconstriction and a decrease in the flow of heat by the blood to the skin.

Sweating is stopped. Shivering is started to increase heat production by the muscles.

Besides the heat sensitive neurons in the thermostatic center there are skin temperature receptors. The skin temperature receptors include both warmth and cold receptors. These receptors send impulses into the spinal cord and on to the hypothalamic region to help control body temperature. The skin temperature receptors help in controlling body temperature in three different ways. First, they cause a psychic desire for warmer surroundings and make the person seek appropriate clothing and shelter. Second, they cause nerve impulses to be sent into the central nervous system to alter the setting of the thermostatic centers. Third, they elicit local cord reflexes which affect skin blood flow or sweating that help maintain normal body temperature.

Harmful Effects of High Temperature

The parenchyma (general term for the essential elements or parts) of many cells usually begins to be damaged when the body temperature rises above 106°F. The brain may suffer since neural cells can never be replaced once they are destroyed. A person usually only has a few hours to live when the body temperature reaches 110°F unless it is rapidly lowered to its normal range.

EXERCISE

1. The internal body temperature remains fairly constant unless a person has a ______________________.

2. A nude person can be exposed to temperatures as low as ______________ or as high as ______________ and still maintain an almost constant temperature.

3. The average normal temperature is generally considered to be ______________.

4. Heat is always being produced in the body as a by-product of ______________.

5. A person is said to be in heat balance when ______________________________.

6. Name one major factor which is important in determining the rate of heat production ______________________________

7. List the four methods by which heat is lost from the body. ______________________________

8. When heat is lost from the body in the form of infrared rays this is called heat loss by ______________________.

9. The human body will absorb about ______________________ of the heat rays that hit it.

10. A nude person loses about ______________________ of his heat by radiation.

11. Transfer of heat from the surface of the body by direct contact with another object is called ______________________.

12. Transmission of heat in liquids and gases by circulation carried on by the heated particles is called ______________________________.

13. Body heat loss resulting from changing liquid to a vapor is called ______________________.

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14. The skin, the subcutaneous tissues, and the fat of the subcutaneous tissues are the ______________________________.

15. In the hands, feet, and ears the blood will go directly to the venous plexuses from the small arteries through the ______________________________.

16. A ______________________________ of blood flow will decrease the efficiency of the heat conduction from the deep areas of the body.

17. The heat conduction to the skin from the deeper parts of the body is controlled by ______________________________.

18. When the ______________________________ centers are inhibited a decrease in the sympathetic impulses in the periphery results and the arteries ______________________________.

19. The temperature regulating center is located in the ______________________________.

20. For the temperature regulating center to function ______________________________ are used to determine if the body temperature is too hot or cold.

21. A small preoptic area of the anterior hypothalamus is called the ______________________________.

22. Name one of the ways in which the skin temperature receptors help in controlling body temperature ______________________________.

23. The parenchyma of many cells usually begins to be damaged when the body temperature rises above ______________________________.

24. If the body temperature reaches ______________________________ a person usually only has a few hours to live.

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THE MUSCULAR SYSTEM

Skeletal Muscle Anatomy

There are numerous muscle fibers that make up all of the skeletal muscles of the body. Each of these muscle fibers vary in size from 10 to 100 microns in diameter. One micron is equal to 1,000,000th of a meter. Each muscle fiber contains several hundred to several thousand myofibrils, which are tiny fibers found in muscular tissue. Each myofibril is composed of about 1500 myosin filaments, which are thick filaments, and about 300 actin filaments, which are thin filaments. Both myosin and actin are protein molecules which are found in muscle fibers and are responsible for muscle contraction. The actin and myosin filaments are lying side by side and are interdigitated. The interdigitations result in the alternate dark and light bands that are found in the myofibril. The dark bands contain the myosin and are called the A bands, while the light bands contain actin and are called I bands. The combination of an A band and an I band is called a sarcomere. In the middle of the I band there is a structure called the Z line or Z membrane. At the Z line the actin filaments are attached to each other. The Z line passes from one myofibril to another all the way across the muscle fibers. This causes the sarcomeres of adjacent myofibrils to be side by side. The myofibrils are suspended in a matrix called sarcoplasm. The sarcoplasm is composed of the usual intracellular constituents such as potassium, magnesium, phosphate, and protein enzymes. There are large numbers of mitochondria (granular and filamentous structures in cell cytoplasm) which lie very close to the actin filaments of the I bands. This suggests that the actin filaments play a major role in using the adenosine-triphosphate (ATP) which is formed by the mitochondria.

SKELETAL MUSCLE CONTRACTION. All the muscle fibers innervated by a single motor nerve fiber make up a motor unit. The muscles which react quickly and whose control is accurate have a small number of muscle fibers in a motor unit. There will be a large number of nerve fibers going to these muscles. An example is the ocular muscles which have only 10 to 15 muscle fibers in a unit. The postural muscles, which are slow acting and do not require a fine degree of control, will have a very large number of muscle fibers in each motor unit. There will be a small number of nerve fibers going to these muscles. There may be as many as 300 to 800 muscle fibers in a motor unit. On the average all of the muscles of the body have about 180 muscle fibers in each motor unit.

To make the muscle fiber contract these basic steps will be followed: (1) An impulse travels down the neuron to the motor end plate. (2) At the motor end plate acetylcholine is released. (3) The acetylcholine affects the muscle fiber membrane making it permeable to sodium ions. (4) There is an influx of sodium ions which causes the impulse to travel along the muscle fibers. (5) Just a few milliseconds after the release of acetylcholine it is destroyed by cholinesterase. (6) The impulse will go deep into the muscle fiber to cause the deep myofibrils to contract also. (7) When the myofibrils contract the actin filaments just slide inward toward each other until they overlap and the Z membrane approaches the ends of the myosin filaments. (8) Following this the muscle fiber will return to its original state.

SPECIAL FEATURES OF MUSCLE FUNCTION.

Muscle Hypertrophy. This is the result of forceful muscular activity which causes the muscle to increase in size. The diameter of the individual muscle fibers increase. The total number of myofibrils increase. The nutrient mechanisms are increased. When resistive or isometric exercise is used, muscle strength can be developed more quickly than when using prolonged mild exercise. For new myofibrils to develop the muscle has to contract to at least 75% of its maximum tension.

Muscular Atrophy. This is the reverse of muscular hypertrophy. Atrophy results when the muscle is not used or when it is used only for very weak contractions. It frequently occurs when an extremity is placed in a cast which prevents muscular contractions. Sometimes muscular size will decrease by one-half in as little as one to two months of disuse.

Reaction of Muscle to Denervation. A muscle immediately begins to atrophy when it becomes denervated. The muscle will continue to decrease in size for several years. If the muscle becomes re-innervated during the first three or four months the muscle usually regains all functions. After four months of denervation some of the muscle fibers usually have degenerated. After two years, re-innervation of the muscle rarely results in any return of function. Pathological studies have shown that the muscle fibers have been replaced by fat and fibrous tissue by this time.

REVIEW EXERCISE

1. Each myofibril is composed of ______ filaments and ______ filaments, which are both ______ molecules.

2. The interdigitation of ______ and ______ results in alternate dark and light bands.

3. The dark bands contain ______ and are called ______, while the light bands contain ______ and are called ______.

4. The combination of the two bands is called a ______.

5. At the "Z" line, the actin filaments are ______.

6. The myofibrils are suspended in a matrix called ______.

7. All muscle fibers innervated by a single motor nerve fiber make up a ______.

8. Muscles which react quickly and have accurate control have a ______ in a motor unit.

9. Postural muscles, which are slow acting have a ______ in a motor unit.

10. On the average all of the muscles of the body have about ______ in each motor unit.

11. What substance is released at the motor end plate that affects the permeability of the muscle f'ber membrane? ______

12. What substance destroys the substance listed in question 11? ______

13. The result of forceful muscular activity which causes the muscle to increase in size is called ______.

14. Muscular atrophy results when ______ or ______.

15. Sometimes muscular size will decrease by one-half in as little as ______.

16. A muscle immediately begins to atrophy when it becomes ______.

17. Pathological studies have shown that after two years of denervation muscle fibers have been replaced by ______.

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DEPARTMENT OF BIOMEDICAL SCIENCES

PHYSICAL THERAPY SPECIALIST

ANATOMY

May 1975

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

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Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

SW 3ABR91330-I-7
May 1975

ANATOMY

OBJECTIVES

1. Classification and functions of bones.

2. Parts of a long bone.

3. Basic osteology terms.

4. Tissue structure of a typical joint.

5. Arthrology terms.

6. Types of joints.

INTRODUCTION

This study guide and workbook is designed to acquaint you with osteology (the sutdy of the skeletal system) and certain joint motions and structures.

All essential information is included in this sutdy guide. Additional notes are not necessary. Label structures on anatomical diagrams as they are explained by the instructor. Complete each exercise as directed by the instructor.

INFORMATION

1. Classifications and functions of bones.

a. Long bones are found in the extremities. They provide support and leverage. Examples: humerus, radius, ulna, femur, tibia, fibula.

b. Short bones are found in the wrist and ankle. Becauseeof their multiarticulations, they provide a greater degree of movement.

c. Flat bones are located where protection is needed. They protect the brain and other visceral organs, Examples: cranial bones, ribs, sternum.

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d. Irregular bones are not a true type but a combination of the others. Example: vertebrae

e. Sesamoid bones develop within a tendon. The only sesamoid bone we'll discuss is the patella.

2. Parts of a long bone.

a. Shaft - the elongated tubular part of a long bone.

b. Epiphyseal line - A cartilage plate called the growth line. It regulates the linear growth of a long bone.

c. Epiphysis - That smaller portion of the bone which is separated from the larger portion of the bone by the epiphyseal plate.

d. Medullary cavity - the hollow, which contains bone marrow and blood vessels.

e. Periosteum - A membrane which covers bone except at the articular ends.

f. Articular cartilage - smooth cartilage covering articular surfaces of bone.

3. Basic Osteology terms.

a. Processes - marked bone prominences.

b. Head - ball shaped process for articulation.

c. Condyle - a knuckle like process for articulation.

d. Spine - a sharp, slender process.

e. Crest - narrow ridge

f. Tubercle - small, round process

g. Tuberosity - medium, round process

h. Trochanter - large, round process

i. Fossa - large depression

j. Foramen - hole

k. Sinus - cavity or pocket within a bone.

4. Tissue structures of a typical joint.

a. Bone

b. Articular cartilage - forms a smooth joint surface to reduce friction during movement.

c. Fibrous cartilage - found around the edges of certain joints to deepen the joint.

d. Joint capsule

(1) Synovial membrane. The inner lining of the joint capsule. This membrane secretes synovial fluid which lubricates the joint.

(2) Fibrous coat. The tough, outer layer of the capsule which protects the joint and offers passive support.

e. Ligaments. Tough, elastic connective tissue which attaches bone to bone and gives passive support to the joint.

f. Tendon. Tough, white cord-like connective tissue which attaches muscle to bone. Tendons give active support to a joint during muscle contraction.

5. -Arthrology terms

a. Bursa - a saclike structure, containing a viscous fluid, placed between tissues at points where friction is likely to develop. Typically found between muscles or tendons and the periosteum of the bone.

b. Tendon sheath - a connective tissue tube-like structure lined with synovial membrane, which affords a common passageway and lubrication.

c. Joint motions

(1) Flexion - shortening the angle of a joint. Bending.

(2) Extension - lengthening the angle of a joint or returning from flexion to the anatomical position.

(3) Hyperextension - extension beyond the normal anatomical position.

(4) Abduction - movement away from the midline of the body.

(5) Adduction - movement toward the midline.

(6) Rotation - movement around the long axis of a bone. Qualified:

(a) internal

(b) external

(7) Circumduction - circular, cone-like movement around a constantly changing axis.

(8) Pronation - turning the palm down

(9) Supination - turning the palm up

(10) Inversion - turning the sole of the foot inward

(11) Eversion - turning the sole of the foot outward

6. Types of joints

a. Synathroses - immovable joints found in the skull.

b. Amphiarthroses - partially movable joints - found in vetebral column and pelvis.

c. Diarthroses - freely movable joints. Found in the extremities.

d. Types of freely movable joints

(1) Hinge - permits motion in only one plane. Example: elbow

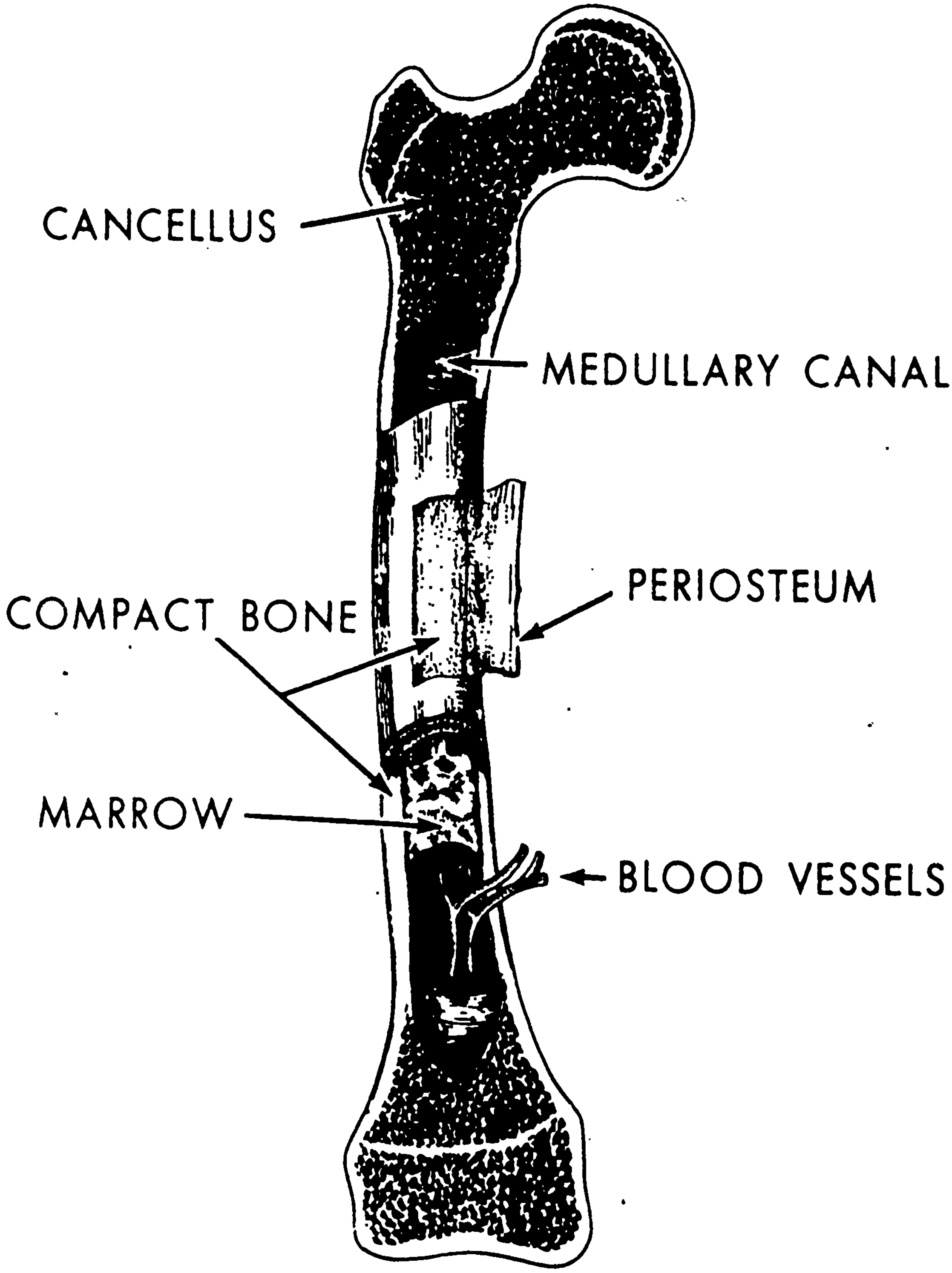
(2) Gliding - permits linear and rotary motions. Example: carpals

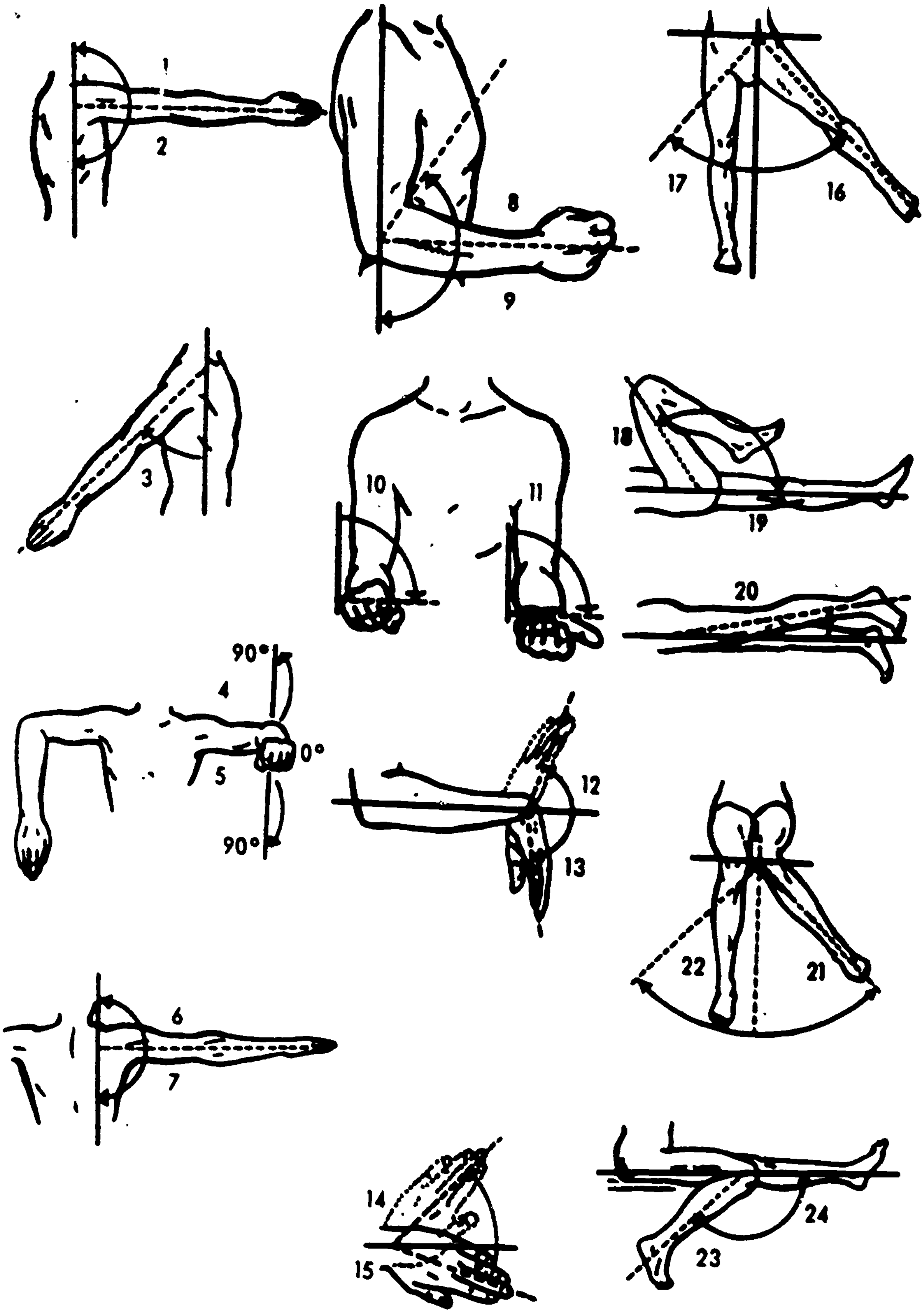
(3) Condyloid - permits linear and circumduction motions, no rotation. Example: wrist and M. P. joints

(4) Ball and socket - permits all forms of motion. Example: shoulder and hip joints

(5) Saddle - permits all motions except rotation. Example: carpometacarpal joint of the thumb

(6) Pivot - permits rotation. Example: radio-ulnar joints


CANCELLUS
MEDULLARY CANAL
PERIOSTEUM
COMPACT BONE
MARROW
BLOOD VESSELS



6

JOINT MOTION EXERCISE

The line drawings on the preceding page illustrate 24 joint motions. In the spaces below, supply the appropriate name for each motion. Be sure to designate the joint. Examples: Should abduction, hip flexion, etc.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________
19. ____________________
20. ____________________
21. ____________________
22. ____________________
23. ____________________
24. ____________________

OSTEOLOGY SCHEMATICS

OBJECTIVE

Given anatomical schematics, each student will correctly identify 70% of the bones of the axial skeleton and their selected parts.

INSTRUCTIONS

1. The following schematics have been supplied for your use during classroom discussion. Label all bones and their parts as they are discussed by the instructor. If you wish to complete a section before the lecture, use AFM 160-2 as a reference.

2. In order to satisfactorily complete the criterion objectives for osteology, each student will be required to label these schematics without instructor assistance or reference material.

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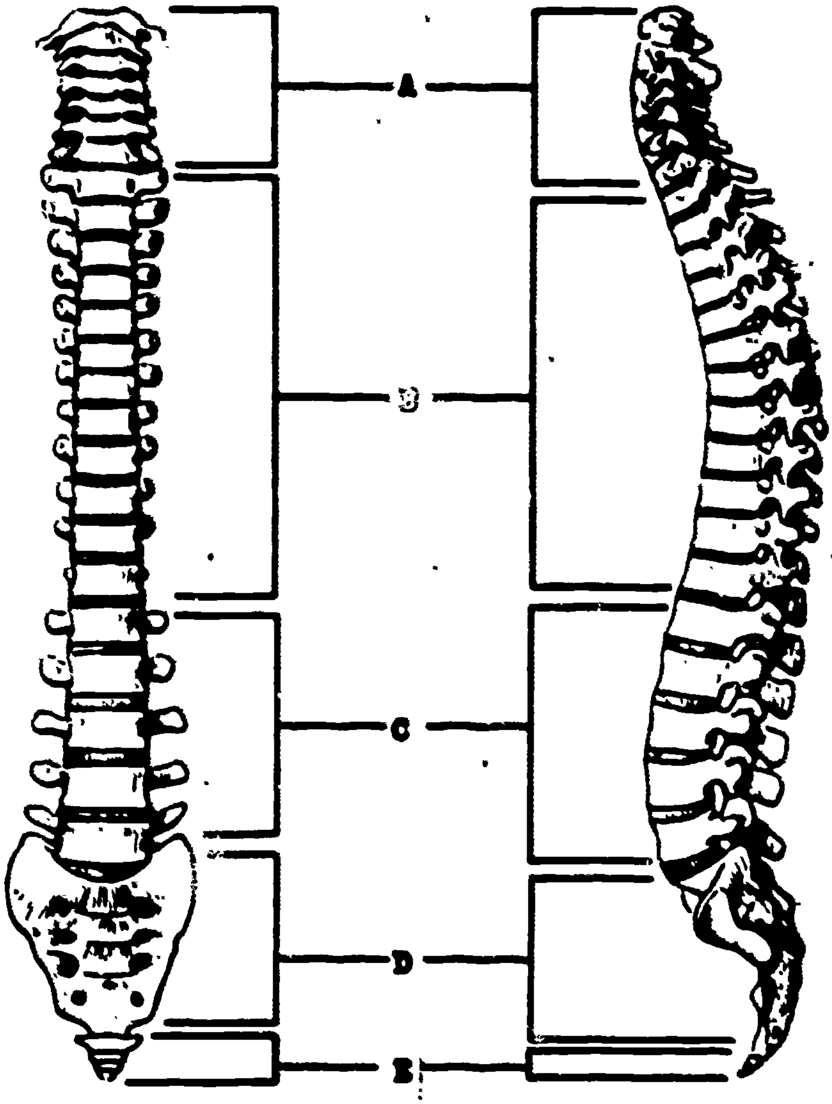
1. In your own words, list the three functions of the vertebral column.

a. ______

b. ______

c. ______

2. Below are two views of the vertebral column with its major sections indicated. Identify each by placing the correct answer in the lettered blank.



A. ______

B. ______

C. ______

D. ______

E. ______

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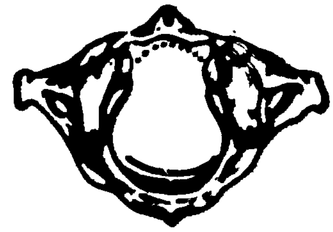
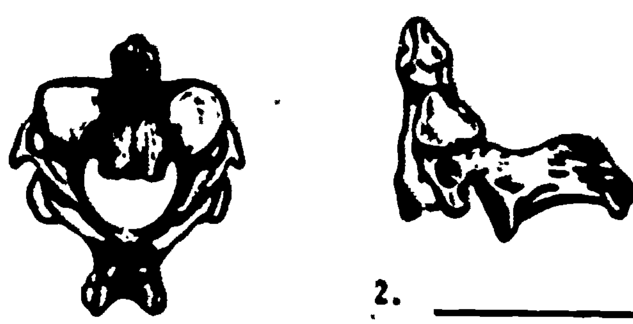
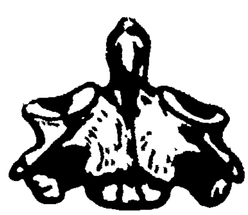


1. ________________



2. ________________



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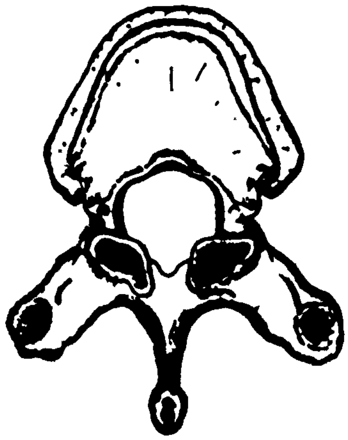
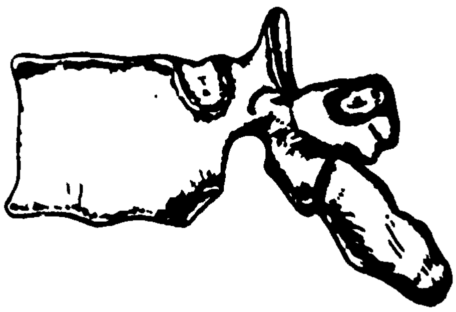
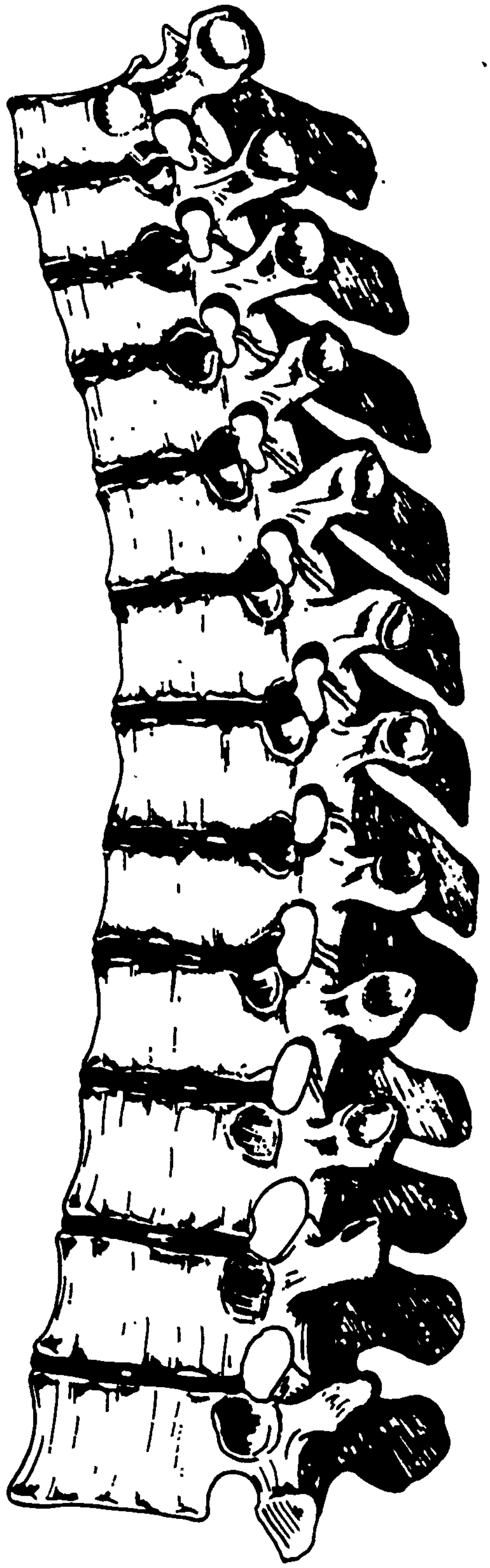
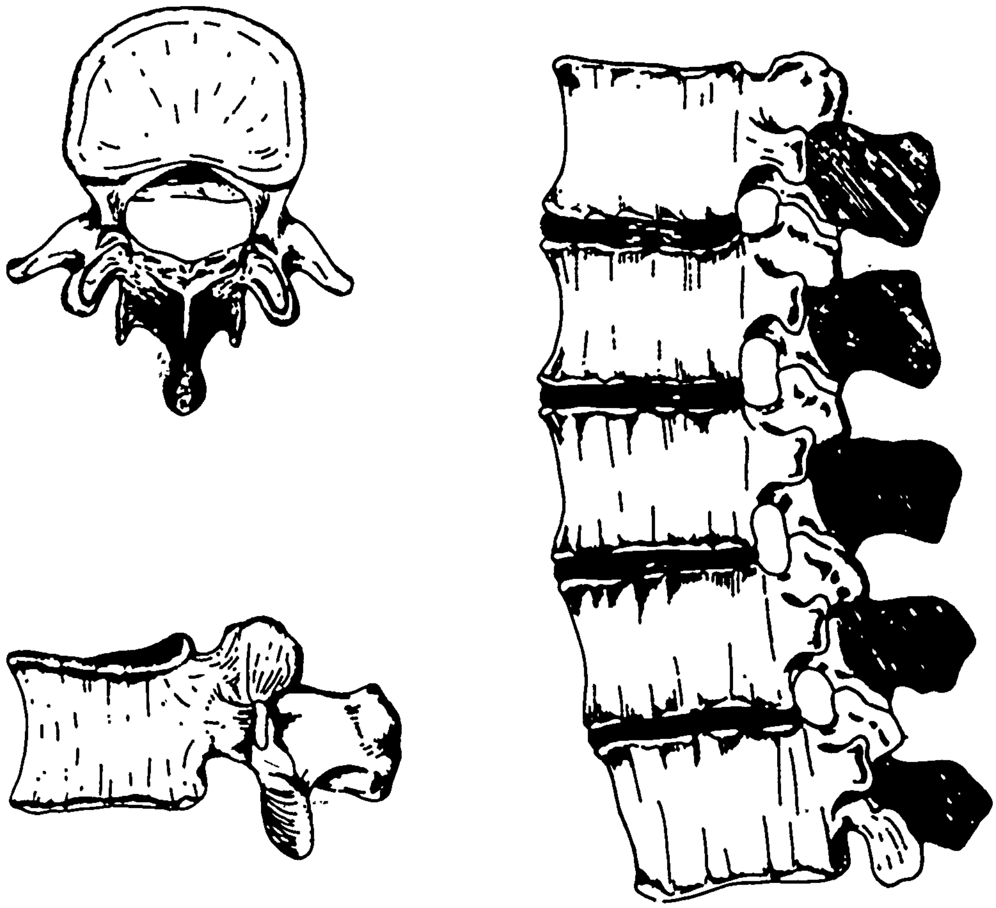






_______________ region



_______________ region

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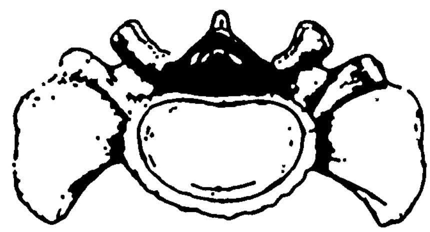
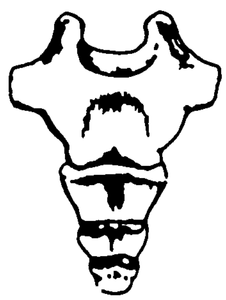
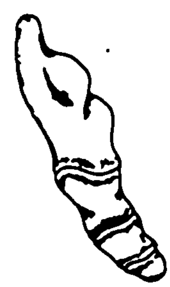
1. ____________

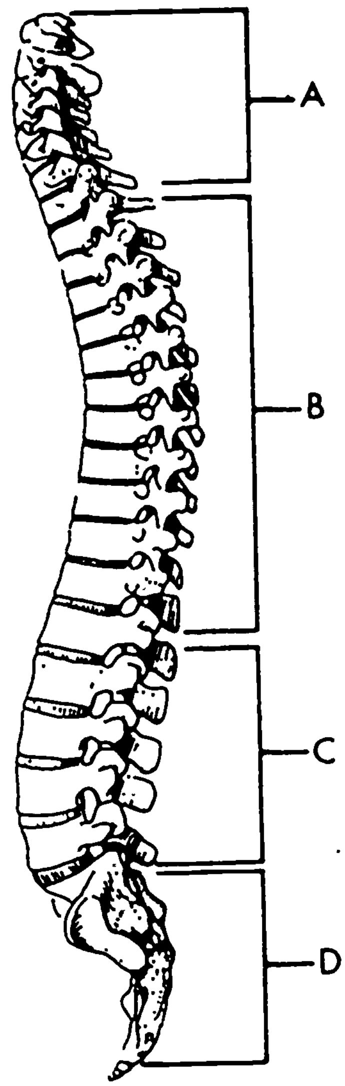






2. ____________

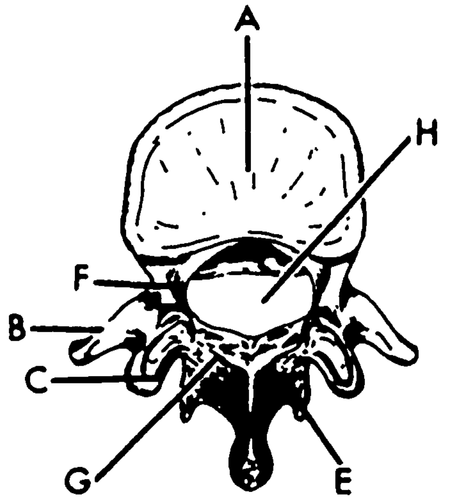
Below is an illustration of the vertebral column. Identify the primary and secondary curves by placing the correct answer in the blank lettered to correspond with the letter on the illustration.

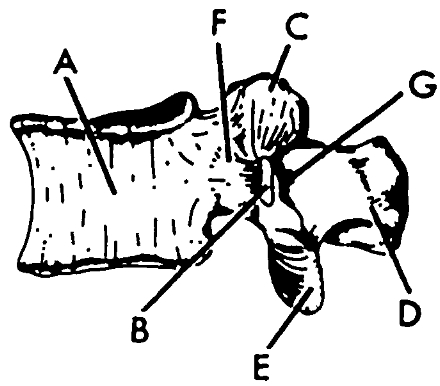


A. ______________________ C. ______________________

B. ______________________ D. ______________________

Below are views of a vertebra with its major parts indicated. Identify each by placing the correct answer in the blank lettered to correspond with the letter on the illustrations.



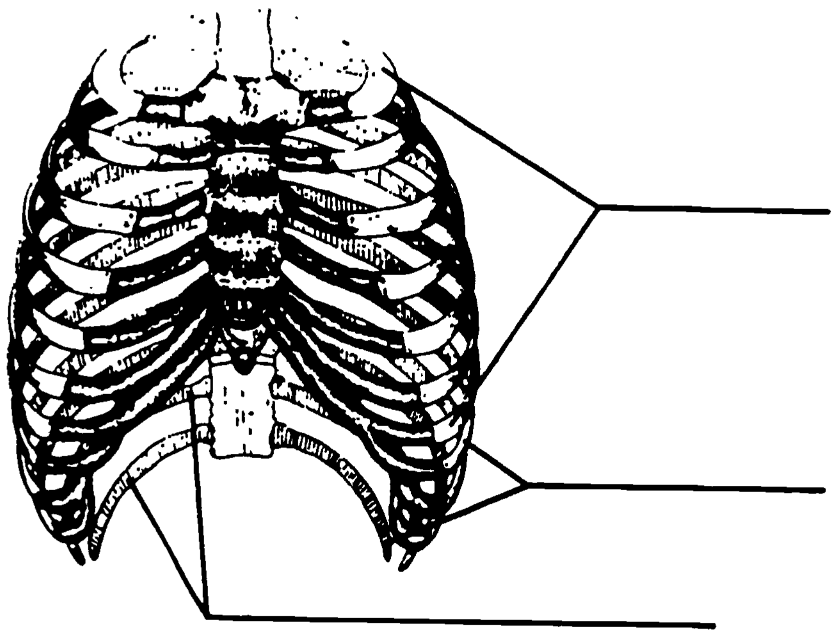


A. ______________________ E. ______________________

B. ______________________ F. ______________________

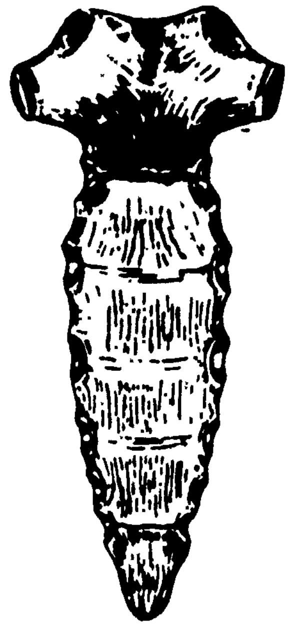
C. ______________________ G. ______________________

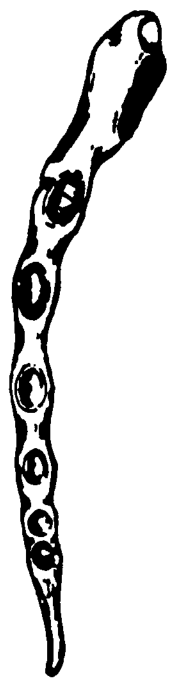
D. ______________________ H. ______________________



________________ end

________________ end





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INTRODUCTION TO MYOLOGY

OBJECTIVES

1. Parts of a muscle.

2. Functions of skeletal muscles.

3. Basic myological terms.

INTRODUCTION

This study guide is designed to acquaint you with the parts and function of skeletal muscles.

INSTRUCTIONS

1. All essential material is included in this study guide and in the muscle testing manual you will be issued as a text. Additional notes should not be necessary.

2. Complete exercises as directed by the instructor.

INFORMATION

1. Parts of a muscle.

a. Muscle belly - The main, fleshy portion of a muscle.

b. Attachments - The ends of a muscle are connective tissue called tendon. The tendon at both ends usually attach to the periosteum of bone. However, you will study a few facial muscles which attach to skin.

(1) Origin - This is the less movable end of a muscle. It is usually proximal to the joint it moves.

(2) Insertion - The more movable end, usually distal to the joint it moves.

c. Tendons - This is the tough, white connective tissue found at each end of a muscle. The function of tendon is to:

(1) Connect muscle to bone

(2) Concentrate the area of pull of a muscle or group of muscles.

(3) Allows the muscle belly to be located some distance away from the joint being moved.

d. Irregular bones are not a true type but a combination of the others. Example: vertebrae

e. Sesamoid bones develop within a tendon. The only sesamoid bone we'll discuss is the patella.

2. Parts of a long bone.

a. Shaft - the elongated tubular part of a long bone.

b. Epiphyseal line - A cartilage plate called the growth line. It regulates the linear growth of a long bone.

c. Epiphysis - That smaller portion of the bone which is separated from the larger portion of the bone by the epiphyseal plate.

d. Medullary cavity - the hollow, which contains bone marrow and blood vessels.

e. Periosteum - A membrane which covers bone except at the articular ends.

f. Articular cartilage - smooth cartilage covering articular surfaces of bone.

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b. Head - ball shaped process for articulation.

c. Condyle - a knuckle like process for articulation.

d. Spine - a sharp, slender process.

e. Crest - narrow ridge

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g. Tuberosity - medium, round process

h. Trochanter - large, round process

i. Fossa - large depression

j. Foramen - hole

k. Sinus - cavity or pocket within a bone.

4. Tissue structures of a typical joint.

a. Bone

b. Articular cartilage - forms a smooth joint surface to reduce friction during movement.

c. Fibrous cartilage - found around the edges of certain joints to deepen the joint.

d. Joint capsule

(1) Synovial membrane. The inner lining of the joint capsule. This membrane secretes synovial fluid which lubricates the joint.

(2) Fibrous coat. The tough, outer layer of the capsule which protects the joint and offers passive support.

e. Ligaments. Tough, elastic connective tissue which attaches bone to bone and gives passive support to the joint.

f. Tendon. Tough, white cord-like connective tissue which attaches muscle to bone. Tendons give active support to a joint during muscle contraction.

5. Arthrology terms

a. Bursa - a saclike structure, containing a viscous fluid, placed between tissues at points where friction is likely to develop. Typically found between muscles or tendons and the periosteum of the bone.

b. Tendon sheath - a connective tissue tube-like structure lined with synovial membrane, which affords a common passageway and lubrication.

c. Joint motions

(1) Flexion - shortening the angle of a joint. Bending.

(2) Extension - lengthening the angle of a joint or returning from flexion to the anatomical position.

(3) Hyperextension - extension beyond the normal anatomical position.

(4) Abduction - movement away from the midline of the body.

(5) Adduction - movement toward the midline.

An example is, the long tendons which cross the wrists and joints of the hand. The resulting lack of muscle bulk in this area allows a degree of movement which would otherwise be impossible.

(4) Permits additional leverage - The straight course of a tendon may be deflected by a bone or bony prominence. This may give a mechanical advantage to the muscle by lifting the tendon away from the axis of the joint. Example: The leverage for knee extension is improved by the patella within the quadriceps tendon.

2. Functions of Skeletal Muscles

a. Provide motion

(1) Locomotion - This term describes movement of an individual from one place to another; crawling, walking, running, etc.

(2) Dexterity - Fine purposeful movement. This term is usually reserved for finger movements. It involves a high degree of coordination and precision. It is greatly enhanced by thumb opposition.

(3) Mastication - The craniomandibular motions necessary for breaking down food with the teeth. This includes elevation, protraction, retraction and lateral movements of the mandible.

(4) Speech - Muscles of the tongue, lips, vocal cords, etc.

(5) Circulation - Venous circulation is improved by the mechanical compression of skeletal muscles. This is especially significant in the deeper veins of the lower extremities. When movement of the legs is restricted for long periods of time, decreased circulation is demonstrated by edema or swelling of soft tissue around the ankles.

b. Fixation - Immobilizing a skeletal part through muscle contraction. Examples of fixation include:

(1) Posture - varying attitudes of posture are due to an ever changing tone maintained in the antigravity muscles which keep the body in an upright but flexible position.

(2) Stabilization - Holding a body part in a fixed position to enhance the movement of another part. Example: The serratus anterior stabilizes the scapula during push-up exercises. Without the fixation the scapula would wing making the exercise extremely difficult and painful.

(3) Protection - Certain muscles protect internal organs by forming a wall around the body cavities. The abdominal muscles perform this function by protecting the viscera of the abdominal cavity. Some joints are protected by muscular contraction, for example the knee and shoulder joints.

3. Basic Myological Terms

a. Muscle coordination. The united action of groups of muscles to produce a well adjusted muscular action.

b. Prime mover. The main muscle or muscle group acting directly to produce a movement.

c. Agonist - A muscle or muscle group which helps the prime mover.

d. Antagonist. Muscles which oppose the prime mover. They function to:

(1) Regulate the rate of movement

(2) Smooth the muscular action

(3) Stop the motion

e. Synergist. These are guiding muscles which rule out unwanted action.

f. Types of contraction:

(1) Isotonic - a muscle contraction which produces joint motion. There are two types:

(a) Concentric - a contraction with the muscle fibers shortening.

(b) Eccentric - contraction with the muscle fibers lengthening.

Example: Flexing the elbow with a weight in the hand requires concentric contraction of the biceps. Eccentric contraction of the biceps allows you to slowly return the elbow to the extended position.

(2) Isometric - The muscle develops tension but does not produce joint motion.

Types of muscle contraction will be covered again in the introduction of therapeutic exercise. However, we feel that it deserves mention before we begin discussing the prime movers.

g. Characteristics of muscles.

(1) Irritability. The ability to respond to stimuli.

(2) Contractility. The ability to shorten.

(3) Extensibility. Property of being stretched.

(4) Elasticity. The ability to return to the normal or original length.

(5) Tonus (Muscle tone). Condition in which a muscle is in a steady state of contraction; the ability of a muscle to resist a force for a considerable period of time without change in length.

(6) Fascia. This is the connective tissue which covers muscle.

MYOLOGY EXERCISE # 1

Fill in the blanks in the sentences below.

1. Connective tissue which attaches muscle to bone is called ______________________.

2. Movement from one place to another is ______________________.

3. Speech is one of the functions of ______________________.

4. The tissue which covers a muscle is known as ______________________.

5. Fine purposeful movement is the definition of ______________________.

6. Venous compression is improved by ______________ ______________ exerted by skeletal muscle contraction.

7. The more movable end of a muscle is called the ______________________.

8. The fleshy part of a muscle is the ______________________.

9. ______________________ allows the muscle belly to be located some distance away from the joint being moved.

10. United action of groups of muscles to produce a well adjusted muscular action defines ______________ ______________.

11. Muscles which oppose the prime mover are called ______________________.

12. Little or no joint motion takes place during ______________________ contraction.

13. Eccentric and concentric are types of ______________________ contraction.

14. Rate of movement is regulated by ______________________ muscles.

15. Muscle fibers lengthen during ______________________ contraction.

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DEPARTMENT OF BIOMEDICAL SCIENCES

PHYSICAL THERAPY SPECIALIST

ANATOMY

May 1975

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

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Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

SW 3ABR91330-I-7
May 1975

ANATOMY

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c. Flat bones are located where protection is needed. They protect the brain and other visceral organs, Examples: cranial bones, ribs, sternum.

This supersedes SW 3ABR91330-1-6, 3AZR91370-1-6, Feb 73

MYOLOGY OF THE AXIAL SKELETAL SYSTEM

OBJECTIVE

Given a list of facial expressions and joint motions of the neck and trunk, name the prime movers with 80% accuracy.

INSTRUCTIONS

1. The muscles you will be required to know in order to successfully pass the criterion objective will be covered in lecture.

2. List the prime movers as they are discussed by the instructor. If the name of a muscle is given, list the motion performed by that muscle.

3. Use the muscle testing manual you have been issued for work outside the classroom.

4. Complete all myology exercises.

These muscles are found in the muscle testing manual - pages 162-174.

FACIAL MUSCLES

INSTRUCTIONS

List the motion performed by the following muscles:

Muscle	Motion
1. Frontalis	______
2. Orbicularis oculi	______
3. Procerus	______
4. Nasalis	______
5. Dilator naris	______
6. Orbicularis oris	______
7. Zygomaticus	______
8. Risorius	______
9. Triangularis	______
10. Buccinator	______

The muscles above are innervated by the ______________ nerve.

Craniomandibular muscles

1. Temporalis — Common Motion
2. Masseter
3. External pterygoid

The muscles are innervated by the ______________ nerve.

MYOLOGY EXERCISE #2 (Facial Muscles)

Instructions: Fill in the blanks in each of the sentences below. This information is presented in lecture and/or the muscle testing manual.

1. The muscle which raises the eyebrows is called ______________. It originates on the ______________________ bone and inserts into the skin over the supra-orbital ridge.

2. The lateral angle of the mouth is raised upward and lateralward by the ______________________________.

3. "Grimacing" is the facial expression produced by contraction of the ______________________________.

4. The corners of the mouth are drawn down strongly by the ______________________________.

5. The muscle that compresses the cheeks for whistling is the ______________________________.

6. Two muscles used to close the jaws tightly (elevation of mandible) are the ____________________ and ________________. This motion takes place at the __________________ joint.

7. The frontalis is innervated by the ________________ nerve.

8. The craniomandibular muscles are innervated by the ________________ nerve.

9. The nostrils are flared by the ____________ ______________.

10. The lips are brought together and compressed (as when kissing) by the ____________________ __________________.

11. The eyelids are closed tightly by contraction of the ______________ ________________________.

12. Diagonal wrinkles are formed across the bridge of the nose by the __________________________.

13. The zygomaticus is innervated by the ______________________ nerve.

14. The nostrils are compressed by the ______________________________.

15. The seventh (7 th) cranial nerve is called the ________________ nerve.

MYOLOGY (NECK AND TRUNK)

Give the motion performed by the muscles listed below.

1. Sacrospinalis group	1. ______________
2. Quadratus lumborum	2. ______________
3. Rectus abdominis	3. ______________
4. Internal and external obliques	4. ______________
5. Trapezius (upper fibers),	5. ______________
6. Splenius capitis	6. ______________
7. Scalenus	7. ______________
8. Sternocleidomastoid	8. ______________

MYOLOGY EXERCISE #3 (Neck and Trunk)

1. Bilateral contraction of the ______________ causes neck flexion. Unilateral contraction of this muscle produces neck ______________ to the (opposite-same) side.

2. Contraction of the upper fibers of the ______________ produces neck extension. Other neck extensors include the:

a. __________ __________

b. __________ __________

c. __________ __________

3. Trunk extension is produced by the ______________.

4. The trunk is flexed by the __________ __________. While you were studying the respiratory system, you learned that this muscle also assists in forced ______________. It also protects __________ __________.

5. Unilateral contraction of the __________ __________ causes elevation of the pelvis.

6. The internal and external obliques produce trunk ______________.

7. When the trunk is fixed, the rectus abdominus produces __________ of the ______________.

8. The splenius capitis is an anatgonist to neck ______________.

9. The sacrospinalis is an antagonist during trunk ______________.

10. When the movement of back extension takes place, the ______________ ______________ must relax.

UPPER EXTREMITIES SCHEMATICS

OBJECTIVE

Given anatomical schematics, each student will correctly identify 70% of the bones of the upper extremities and their selected parts.

INSTRUCTIONS

1. The following schematics have been supplied for your use during classroom discussion. Label all bones and their parts as they are discussed by the instructor. If you wish to complete a section before the lecture, use AFM 160-2 as a reference.

2. In order to satisfactorily complete the criterion objectives for osteology, each student will be required to label these schematics without instructor assistance or reference material.

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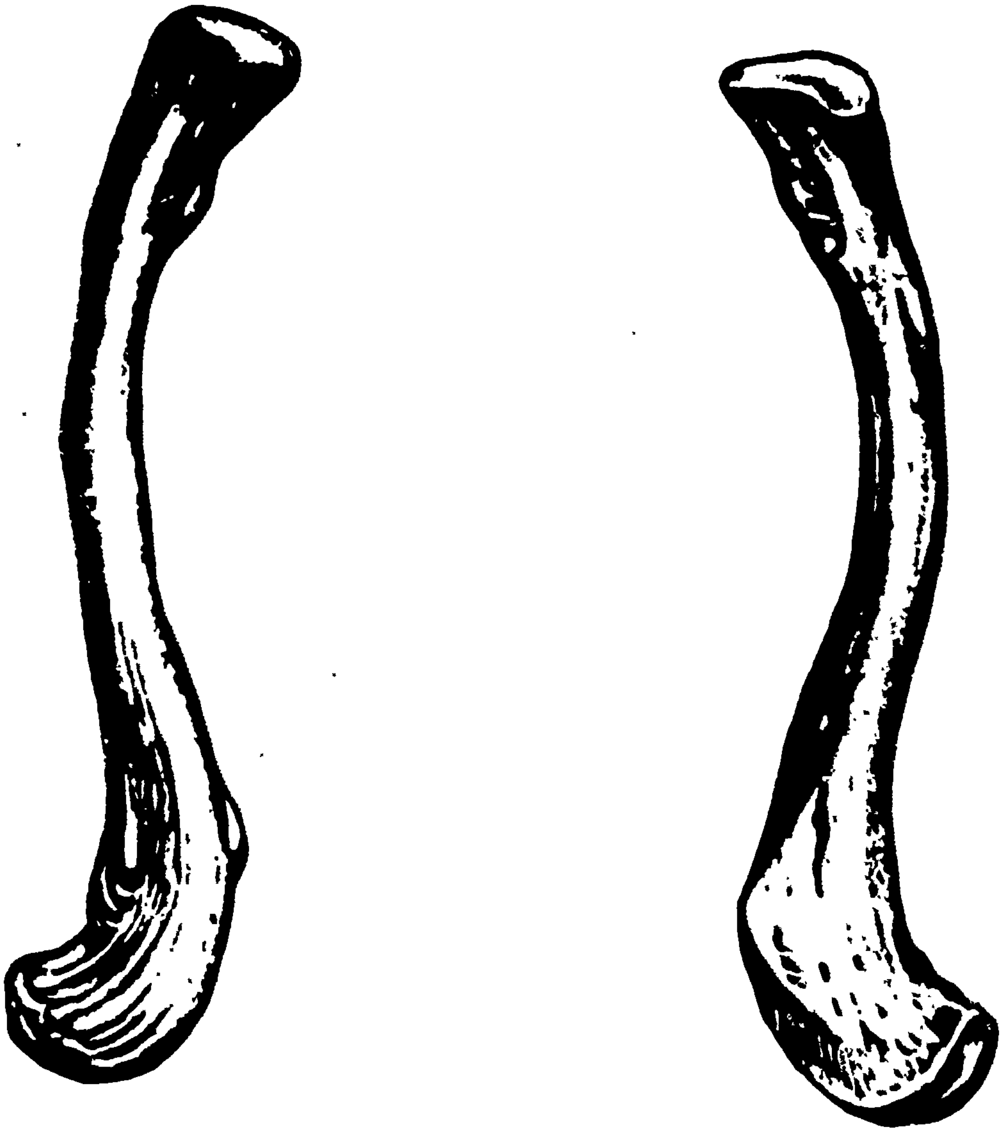

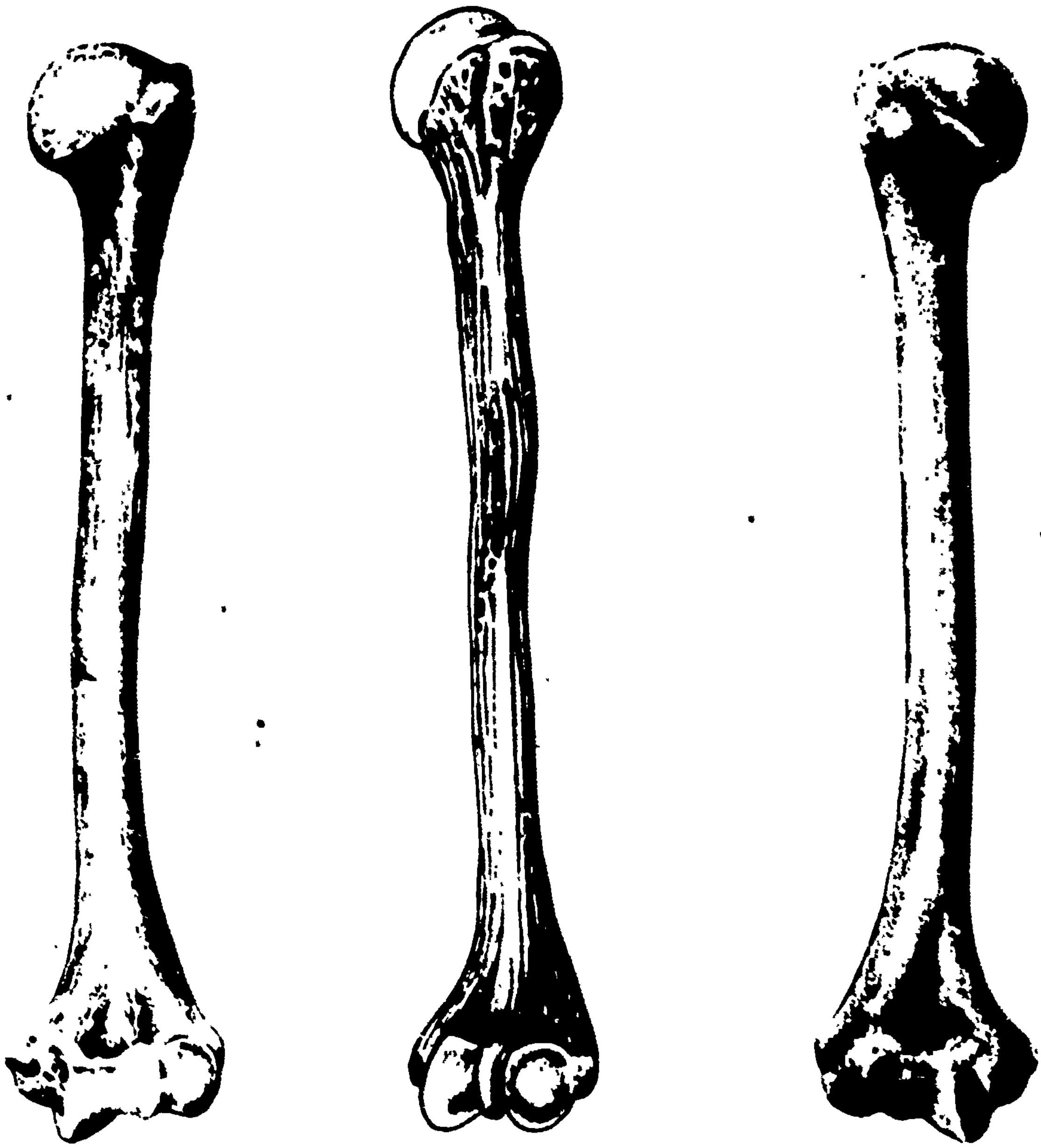

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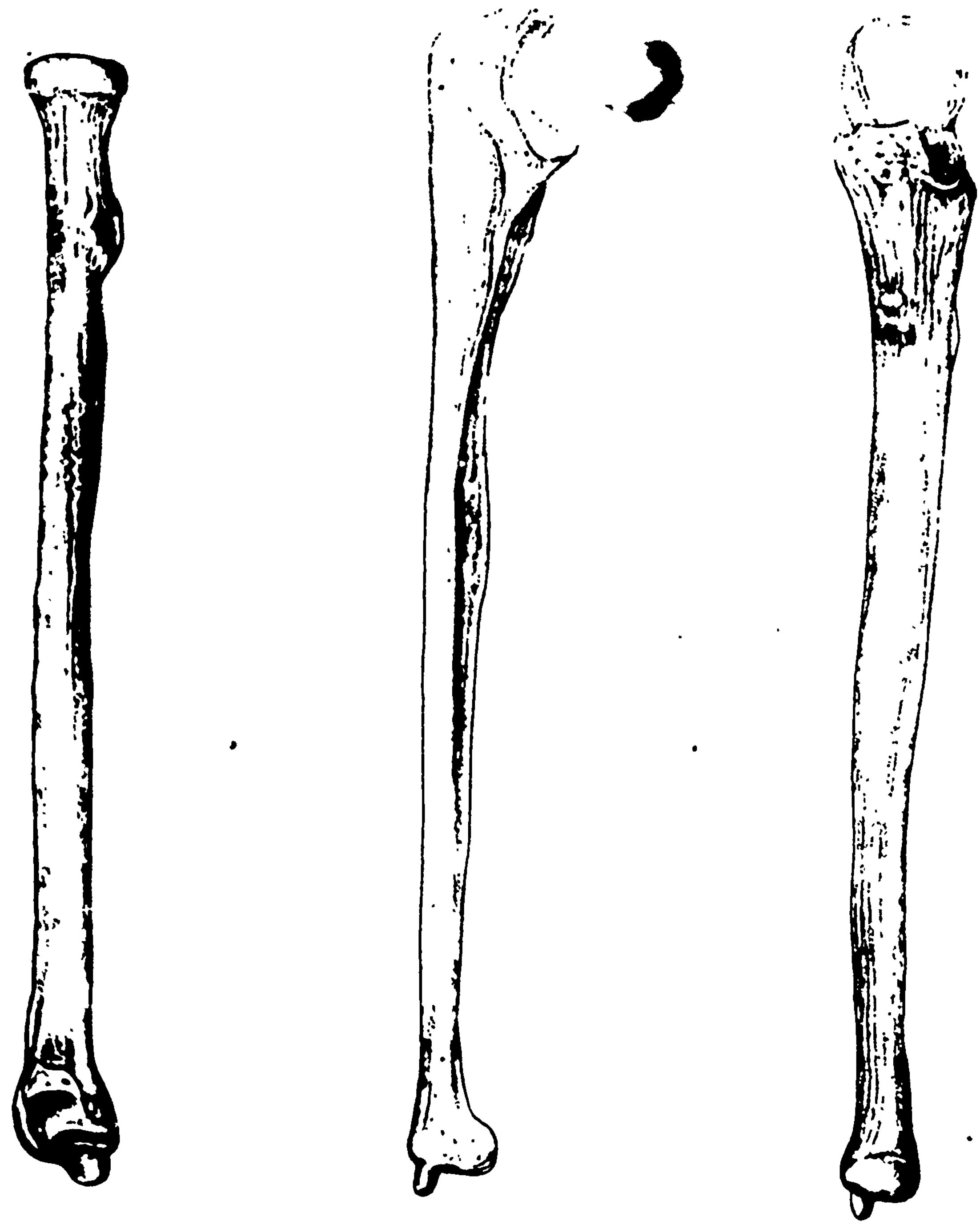
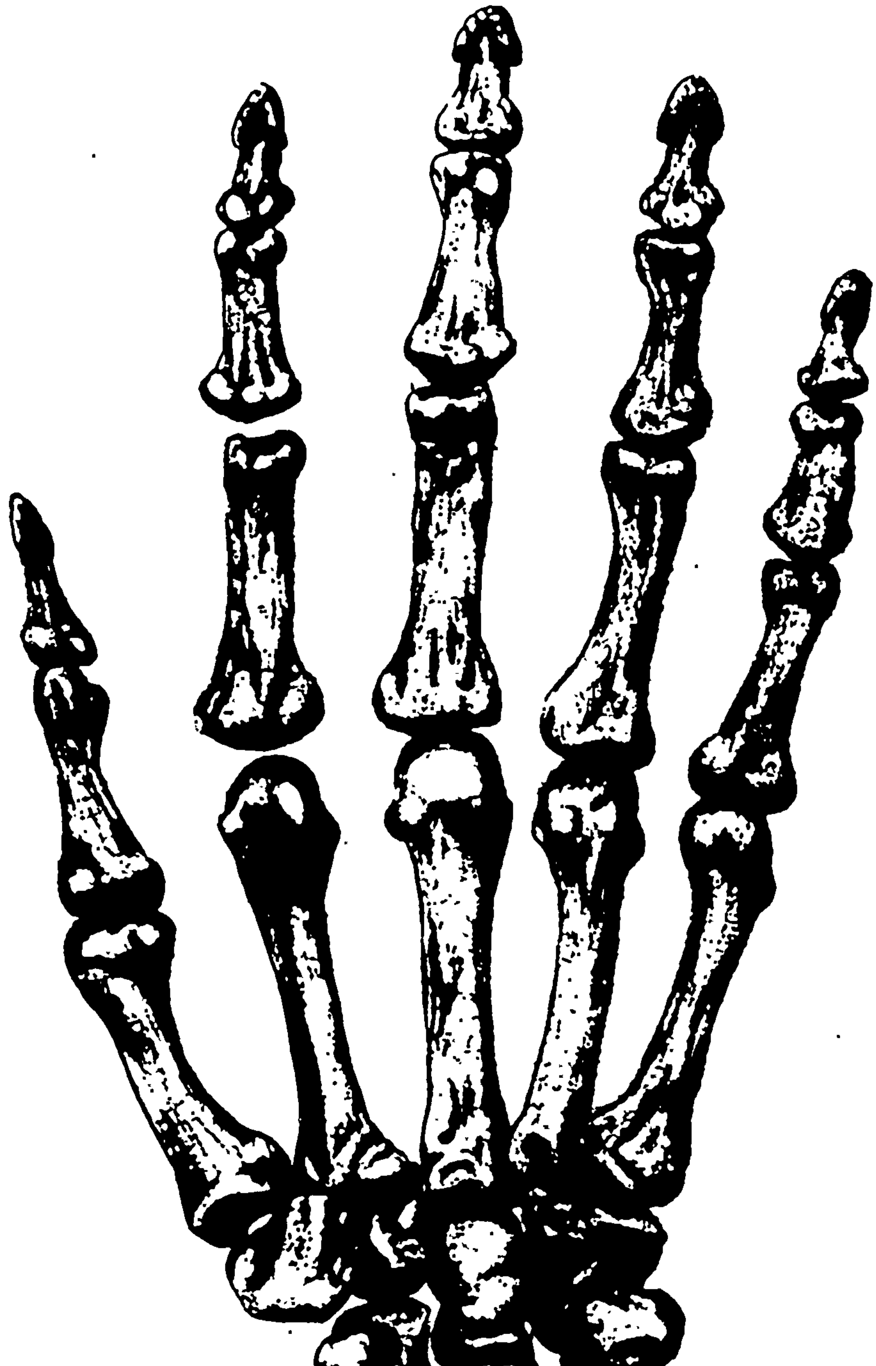
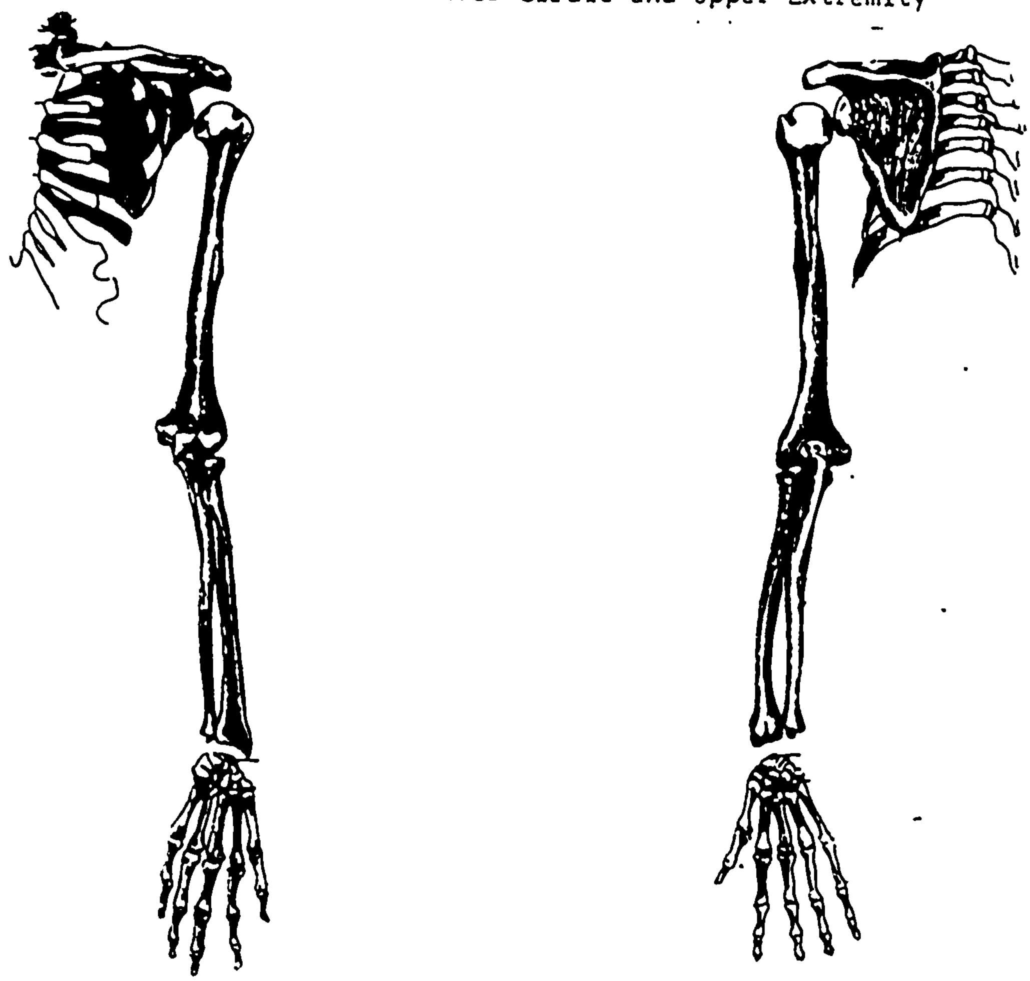




Joints of the Shoulder Girdle and Upper Extremity



1. Shoulder Girdle Joints. There are two joints of the shoulder girdle.

a. Acromioclavicular Joint. The lateral end of the clavicle joins with the acromion process of the scapula to form the acriomioclavicular joint. This articulation permits scapular rotation.

b. Sternoclavicular Joint. The medial end of the clavicle joins with the manubrium of the stermum. It is a double arthrodial (gliding) joint that permits scapular elevation, depression, adduction, abduction, rotation, and circumduction.

2. Shoulder Joint. The shoulder joint, is often referred to as the glenohumeral joint; it is formed by the humeral head and the glenoid fossa of the scapula. This is a ball-and-socket type of diathrodial joint; it is protected and held together by numerous muscles, tendons, and ligaments. [illegible] joints permit more freedom of movement than do other joints in the body. The motions permitted are shoulder flexion, extension, abduction, adduction, rotation, and circumduction.

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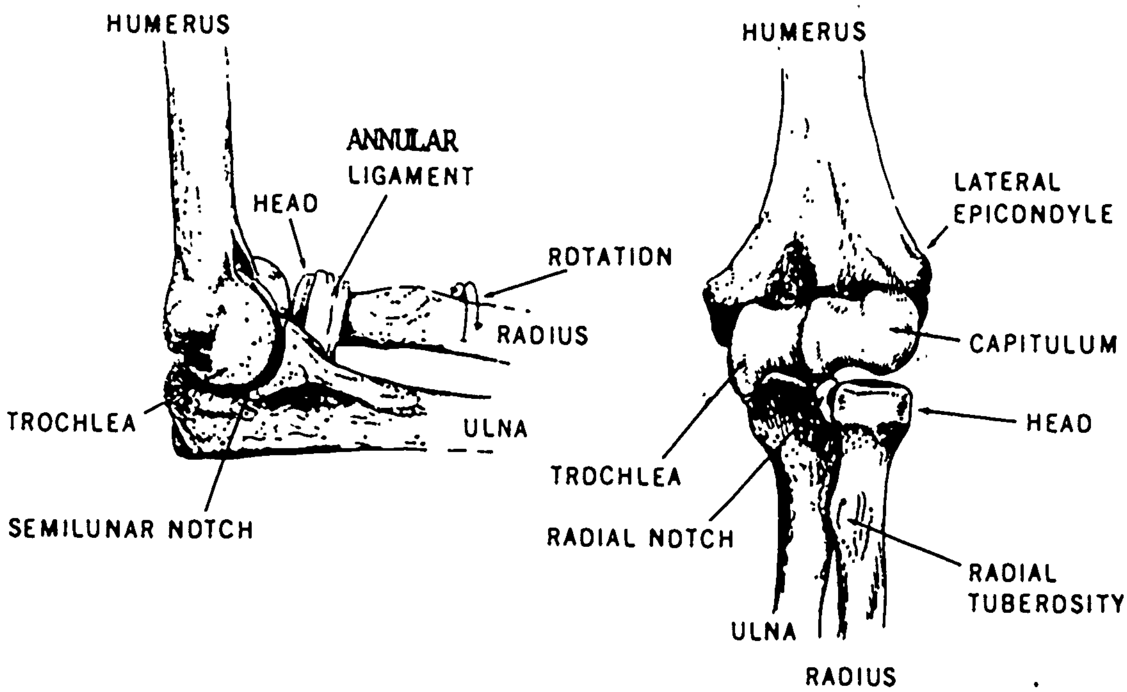
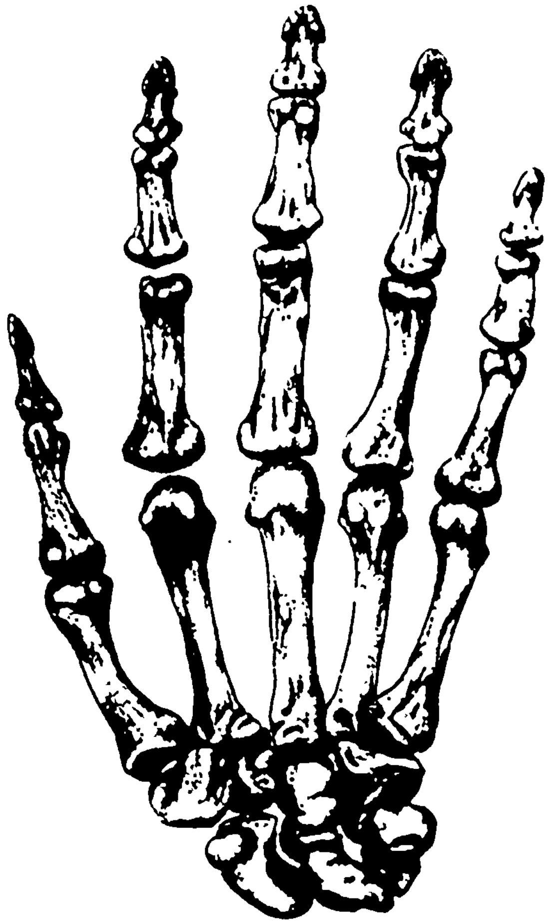


3. Elbow Joint. The semilunar notch of the ulna articulates with the trochlea of the humerus and the capitulum of the humerus articulates with the fovea on the head of the radius to form the elbow joint. When the forearm is flexed, the head of the radius articulates with the capitulum of the humerus. When the forearm is extended, there is a larger space between the radial head and the capitulum. The elbow joint is a classic example of the hinge joint.

4. Forearm Joints. The proximal and distal radioulnar articulations form the forearm joints.

a. Distal Radioulnar Joint. The distal radioulnar articulation is a pivot-joint formed between the head of the ulna and the ulnar notch of the distal end of the radius.

b. Proximal Radioulnar Joint. The proximal radioulnar joint is a pivot joint formed between the head of the radius and the radial notch of the ulna. Together these joints form a pivot joint which permits supination and pronation of the forearm.



5. Wrist Joint. The wrist joint is formed primarily by the radiocarpal articulations. The intercarpal joints listed above as the joints of the hand are sometimes included in the wrist. The radiocarpal joint is formed by the distal end of the radius and the under surface of the articular disk above and the navicular, lunate, and triangular bones below. The joint is surrounded by a capsule and strengthened by ligaments.

6. Hand Joints. The hand joints include the carpometacarpal joints and the intercarpal joints.

a. Carpometacarpal Joints. The first metacarpal joins with the greater multangular to form the saddle joint of the thumb; the second metacarpal joins with the greater multangular, lesser multangular, and capitate; the third metacarpal joins with the capitate; the fourth metacarpal joins with the capitate and hamate; and the fifth metacrapal joins with the hamate. The latter four joints are gliding-type joints.

b. Intercarpal Joints. These are gliding-type joints that add to the overall flexibility of the wrist joint.

7. Joints of the Fingers: The phalanges join as follows:

a. The distal phalanges join proximally with the distal ends of the middle phalanges. These joints are termed the distal interphalangeal (DIP) joints. The DIP joints are hinge-type joints that permit flexion-extension.

b. The middle phalanges of digits 2 through 5 join proximally with the distal end of the corresponding proximal phalanges. They are also hinge joints and are known as the proximal interphalangeal (PIP) joints.

c. The proximal phalanges join proximally with the distal end of the metacarpals to form the metacarpophalangeal (MP) joints, commonly called the knuckles. These are condyloid joints that permit flexion, extension, abduction, adduction, and circumduction.

LOWER EXTREMITIES SCHEMATICS

OBJECTIVE

Given anatomical schematics, each student will correctly identify 70% of the bones of the lower extremities and their selected parts.

INSTRUCTIONS

1. The following schematics have been supplied for your use during classroom discussion. Label all bones and their parts as they are discussed by the instructor. If you wish to complete a section before the lecture, use AFM 160-2 as a reference.

2. In order to satisfactorily complete the criterion objectives for osteology, each student will be required to label these schematics without instructor assistance or reference material.

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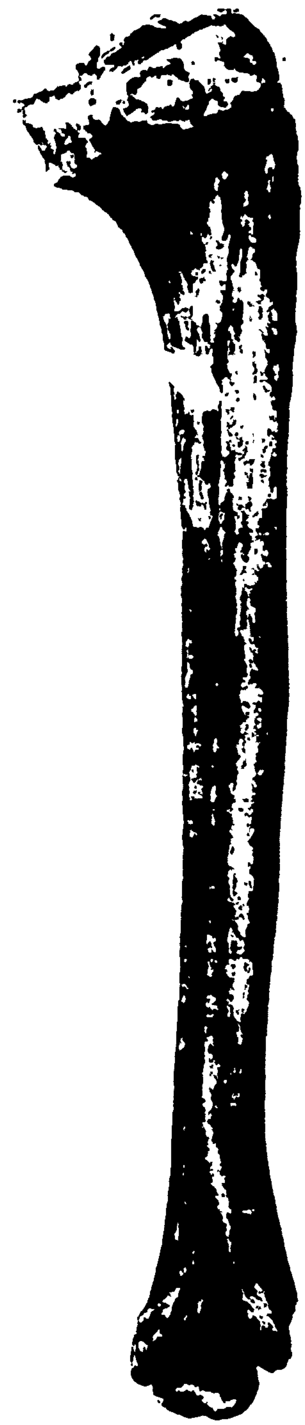

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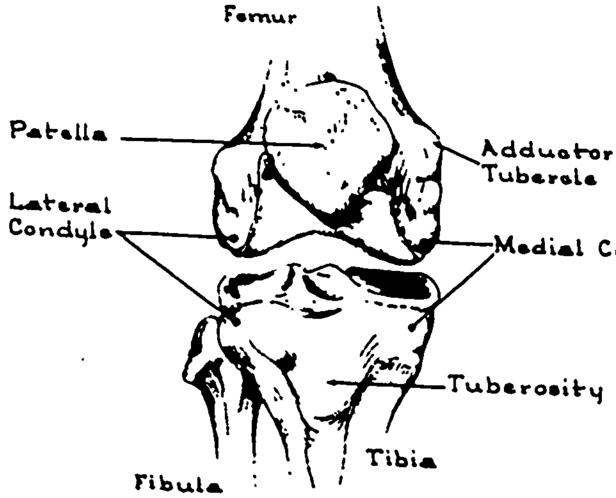
JOINTS OF THE HIP AND PELVIS

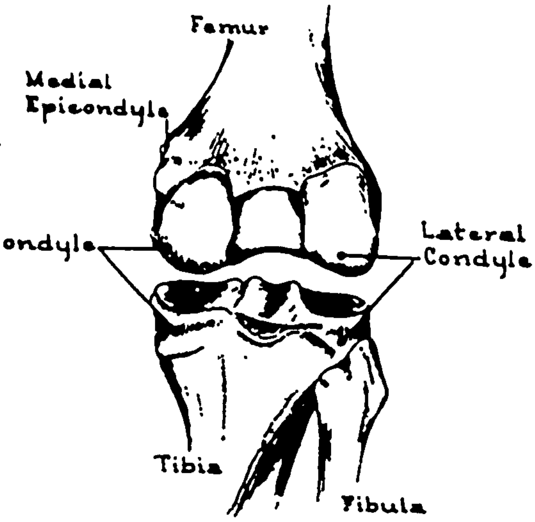
Hip Joint. The head of the femur articulates with the acetabulum of the innominate bone to form the hip joint. This is a ball and socket joint which permits flexion, extension, adduction, abduction, rotation and circumduction.

Sacro-iliac joints. These two joints are formed by the articular surfaces on the medial aspect of the ilium and the superio-lateral surfaces of the sacrum.

Symphysis Pubis. The symphysis pubis is the articulation of the two pubic bones anteriorly and is located at the middle of the anterior part of the pelvis. The three pelvic joints are partially movable.



ANTERIOR RIGHT



POSTERIOR RIGHT

The knee joint consists of two joints - the patellofemoral and the tibiofemoral.

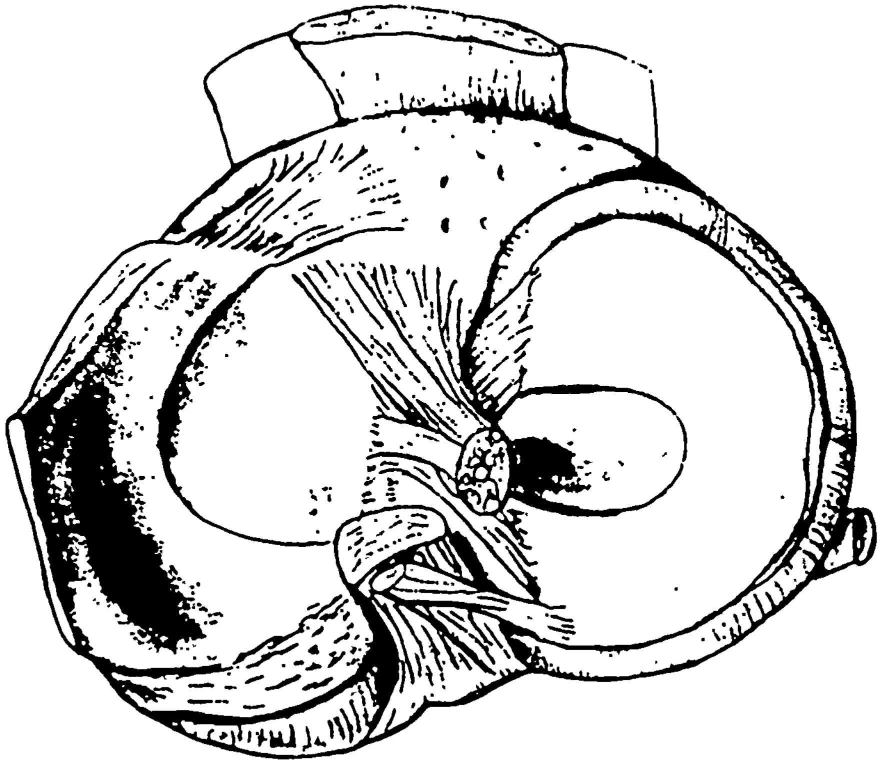
1. The patellofemoral joint is formed by the patella articulating with the adjacent surface of the femur. The patella is contained within the quadriceps tendon and is attached to the tibial tuberosity by the patella ligament. The patella offers some protection to the tibiofemoral joint and provides added leverage for the quadriceps muscle.

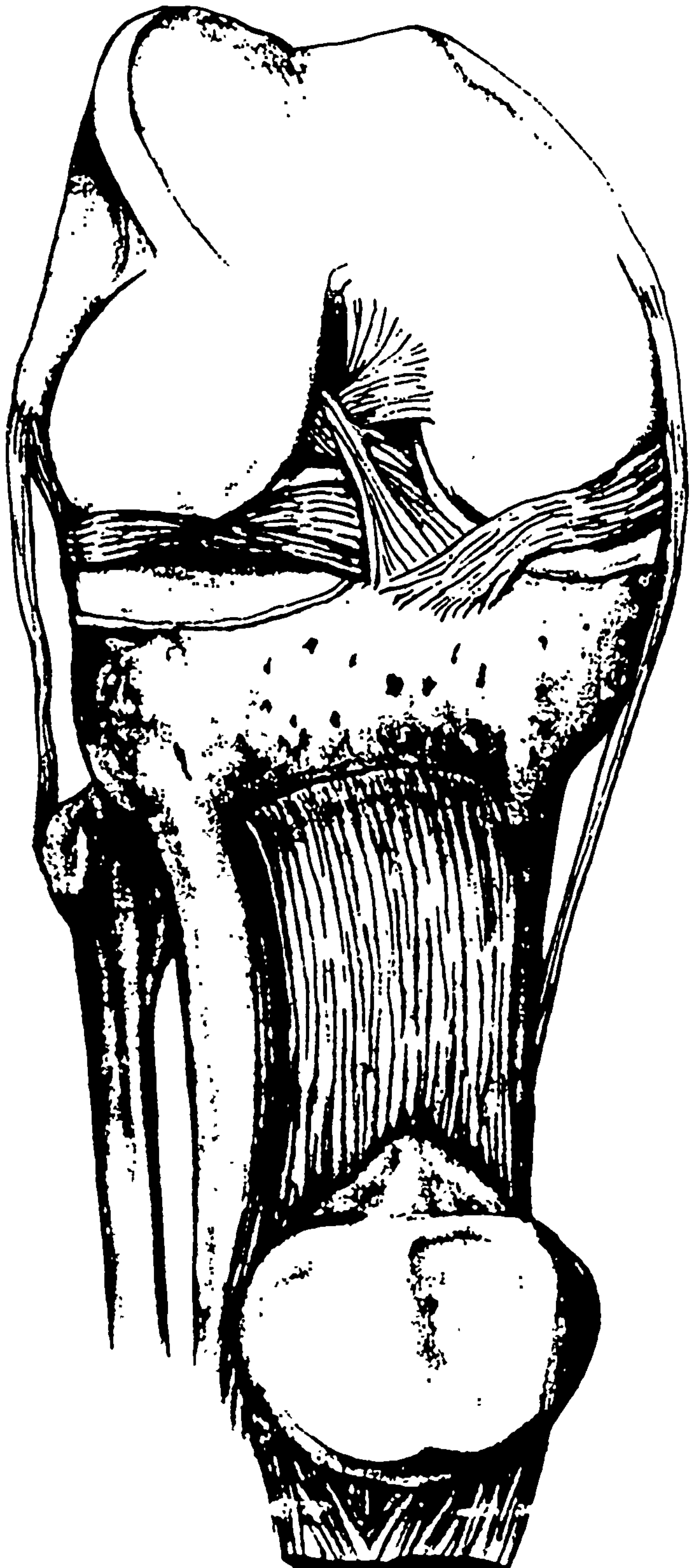
2. The tibiofemoral joint is formed by articulation between the femoral and tibial condyles. During full knee extension passive support by the joint capsule provides the knee with anterior-posterior stability. During knee flexion, active support of the quadriceps perform this function. Additional structures of stabilization are listed below.

a. Cruciate ligaments lie deep within the knee joint. They form a cross as they pass in opposite directions to attach the tibia to the femur. They extend from the intercondylar notch of the femur to the upper surface of the tibia. These ligaments prevent anterior-posterior displacement of the tibia.

b. Menisci are semilunar shaped cartilages situated between the articulating surfaces of the tibia and femur. They absorb much of the shock which is transfered to the knee while walking, running, etc. They also provide a better surface for articulation of the femur by deepening the shallow joint surfaces of the tibia.

c. Collateral ligaments, which are situated on either side of the knee joint, prevent medial-lateral displacement of the tibia. They bind the medial epicondyle of the femur to the tibia and the lateral femoral condyle to the fibula.





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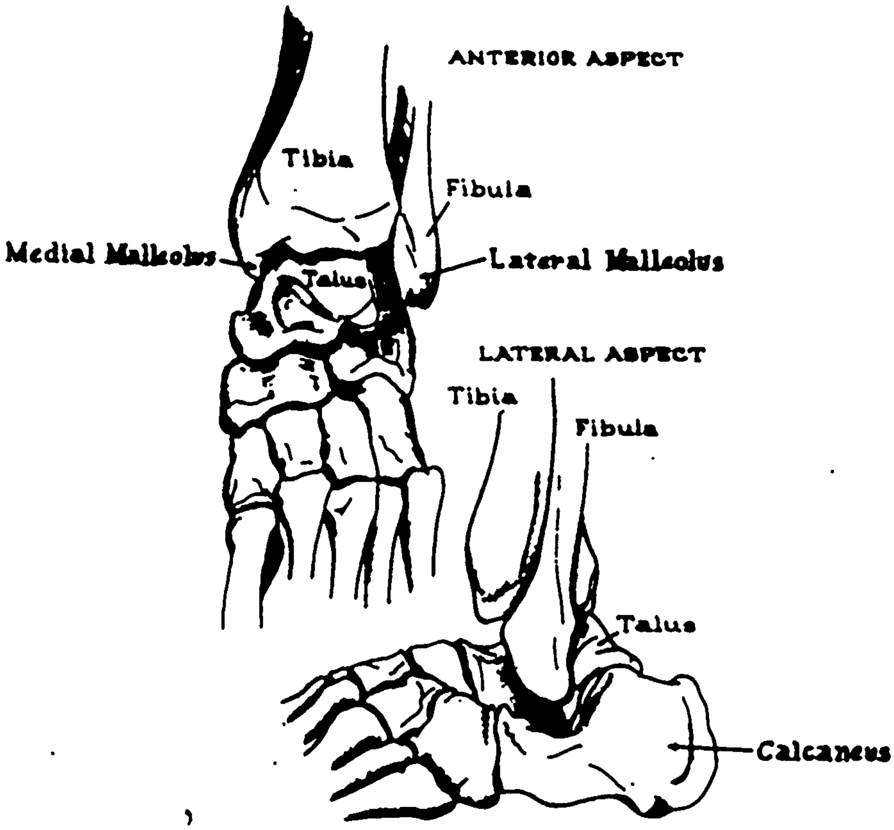
ANKLE JOINT



The ankle joint is a hinge type joint formed by the superior surface of the talus in articulation with the:

a. distal articular surface of the tibia

b. medial malleolus of the tibia

c. lateral malleolus of the fibula

MYOLOGY AND NEUROLOGY OF THE EXTREMITIES

OBJECTIVE

Given a list of joint motions of the upper and lower extremity, each student will name the prime movers with 80% accuracy.

INSTRUCTIONS

1. Included in this section is a list of joint motions corresponding to each myology lecture. List the prime movers as they are discussed in class.

2. The myology exercises are designed to help you determine how well you are learning the material. Fill in the blanks as well as you can without reference. You should be able to find the answers either in a preceeding section of this workbook or in the muscle testing manual.

List the prime movers as they are discussed in class.

SHOULDER GIRDLE

1. Scapula abduction

2. Scapula adduction

3. Scapula elevation

4. Scapula depression

5. Upward rotation of scapula

6. Downward rotation of scapula

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[illegible]OLO[illegible] EXERCISE #4 (SHOULDER GIRDLE)

1. Squeezing the shoulder blades together is termed ______________.

2. The action described above is performed by contracting the ______________________ and ______________________.

3. The muscle which is antagonistic to the motion described in item #1 is the ______________________.

4. The muscles that squeeze the shoulder blades together insert on the ______________________.

5. Two of the three muscles you have listed above also rotate the scapula. They are the ______________ for downward rotation and the ______________________ for upward rotation.

6. Movement of the scapula away from the vetebral column is called ______________________. The muscle which performs this action is the ______________________. It originates on the ______________ and passes underneath the scapula to insert on the ______________ ____________ of the scapula.

7. Two muscles which elevate the scapula are the ______________ and ______________________.

8. The only muscle of the shoulder girdle that inserts on the clavicle is the ______________________.

9. The other scapula elevator inserts on the ______________.

10. The muscle that depresses the scapula is the ______________.

11. Winging of the scapula may be caused by paralysis of the ______________________.

12. Two muscles located between the scapulae are the ______________ and ______________________.

13. The muscle located on the lateral thorax is the ______________.

List the prime movers as they are discussed in class.

SHOULDER JOINT

1. Flexion

   a.

   b.

2. Extension

   a.

   b.

   c.

3. Abduction

   a.

   b.

4. Shoulder Horizontal Abduction

5. Shoulder Horizontal Adduction

6. Shoulder External Rotation

   a.

   b.

7. Should Internal Rotation

   a.

   b.

   c.

   d.

MYOLOGY EXERCISE #5 (SHOULDER JOINT)

1. Raising the arm anteriorly is termed __________ __________.

2. The motion described above is produced by the __________ __________ and __________.

3. If the arm is raised in the lateral direction, the motion is termed __________. This motion is performed by __________ and __________ __________.

4. Shoulder extension is produced by contraction of the:

a.

b.

c.

5. Returning the arm to the anatomical position from 90^{o} flexion is accomplished by eccentric contraction of the __________ __________ and __________.

6. The muscle involved in more shoulder joint movements than any other muscle is the __________.

7. When the arm is raised above 90^{o}, the __________ is rotated upward.

8. The prime mover in shoulder horizontal abduction is the __________ __________.

9. Shoulder horizontal adduction is performed by the __________ __________.

10. The primer movers in shoulder external rotation are the

a.

b.

11. Shoulder internal rotation is performed by the:

a.

b.

c.

d.

12. Two muscles involved in both shoulder internal rotation and shoulder extension are:

a.

b.

13. They muscle which has fibers extending from the ilium to the arm is the ____________ ____________.

14. Shoulder joint muscles which originate on the scapula and insert on the arm are:

a.

b.

c.

d.

e.

f.

15. The muscle bellies of two muscles are partly covered by the scapula. These muscles are the ____________ ____________ and the ____________.

16. Muscles which originate inferior to the spine of the scapula are the

a.

b.

c.

MYOLOGY ELBOW, FOREARM, WRIST

1. Elbow Flexion
   a.
   b.
   c.
2. Elbow Extension
3. Forearm Supination
   a.
   b.
4. Forearm Pronation
   a.
   b.
5. Wrist Flexion
   a.
   b.
6. Wrist Extension
   a.
   b.
   c.
7. Radial Deviation (Abduction)
   a.
   b.
8. Ulnar Deviation (Adduction)
   a.
   b.

MYOLOGY EXERCISE #6 (ARM, FOREARM, WRIST)

1. The muscle which is antagonistic to elbow flexion is the __________.

2. The elbow flexor which originates on the scapula is the __________.

3. The muscle which bends the elbow when the forearm is in the mid position is the ____________________. The belly of this muscle is in the ____________________.

4. Two motions which are performed by the biceps are

   a. ____________________

   b. ____________________

5. Turning the palm upward is termed ______________________________.

6. Turning the palm downward is ______________________________. This motion is performed by the

   a. ____________________

   b. ____________________

7. Another term for wri^t adduction is ____________ ____________.

8. Bending the wrist ir ı dorsal direction is termed wrist __________.

9. Pronation and supination takes place at the ____________ joints.

10. Muscles which abduct the wrist are the

   a. ____________________

   b. ____________________

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MYOLOGY (HAND)

1. Flexion of Metacarpophalageal Joints of fingers
   a.
   b.
   c.
2. Flexion of Interphalangeal Joints of fingers
   a. Promimal (P.I.P.)
   b. Distal (D.I.P.)
3. Extension of Metacarpophalangeal and Interphalangeal Joints of fingers
   a.
   b.
   c.
4. Finger Abduction
   a.
   b.
5. Finger Adduction
6. Thumb Flexion
   a.
   b.
7. Thumb Extension
   a. M.P. Joint
   b. I.P. Joint
8. Thumb Abduction
   a.
   b.
9. Thumb Adduction
   a.

10. Opposition of thumb and fifth finger

a.

b.

MYOLOGY EXERCISE #7 (HAND)

1. There are 11 muscles in the hand, divided into three groups which flex the M.P. joints and extend the P.I.P. and D.I.P. joints. Name these three groups.

   a.

   b.

   c.

2. The __________ of the proximal phalanges is the area of insertion for these three groups of muscles.

3. Of these three groups of muscles the __________ group is the group whose only function is to flex the M. P. joints and extend the two distal phalanges.

4. The ________________ are the prime movers for finger adduction.

5. Finger abduction is the action of the ____________ and the __________.

6. Finger abduction and adduction occurs at the ____________ joints.

7. The D.I.P. joints of the fingers are flexed by the ______________.

8. Flexion, extension, adduction, abduction, and circumduction occur at the ______________ joints of the fingers.

9. The ________________ flexes the P.I.P. joints of the fingers.

10. During the movement of opposition the tips of the ____________ and ____________ approximate each other.

11. The ________________ may extend all four fingers at the same time.

12. The extensor digiti quinti proprius extends the ________________.

13. The index finger may be extended by the ______________ in addition to the extensor digatorum communis.

14. The muscles working during opposition of the thumb and little finger are the ______________ and ______________________.

15. The little finger is abducted by the ______________________.

16. The I.P. joint of the thumb is flexed by the ____________________ and extended by the ____________________.

17. Extension of the thumb M.P. joint is done by the ________________ and the same joint is flexed by the ____________________.

18. The thumb is abducted by the ____________________ and the ____________.

19. Adduction of the thumb is done by the two divisions of the __________.

20. The ____________________ joint of the thumb permits circumduction, flexion, abduction, extension, and adduction.

MAJOR NERVES OF THE UPPER EXTREMITY

INSTRUCTIONS: List the muscles innervated by the following nerves.

1. Axillary Nerve

   a.

   b.

2. Musculocutaneous

   a.

   b.

   c.

3. Median Nerve

   a.

   b.

4. Ulnar Nerve

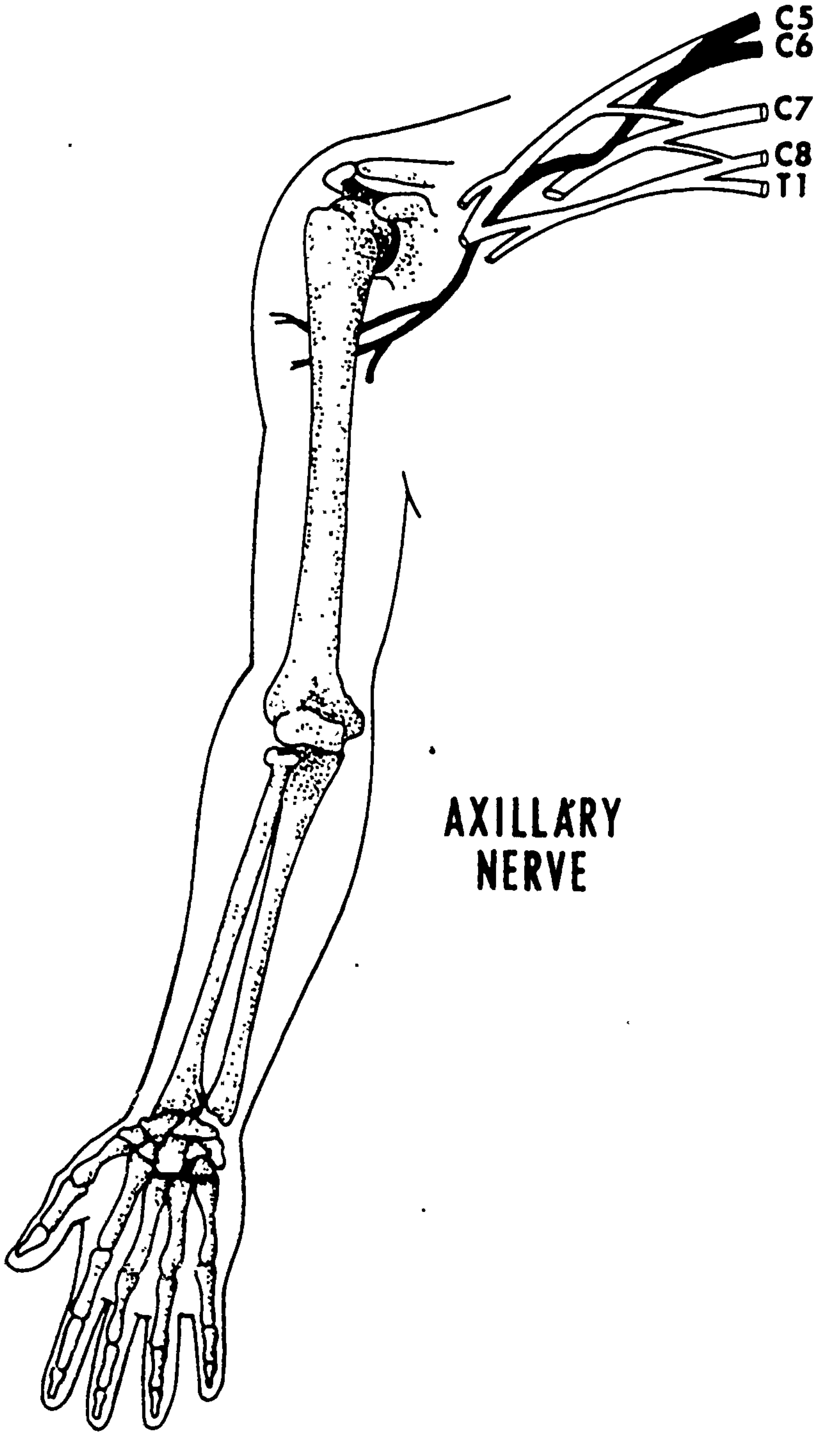
   a.

5. Radial Nerve

   a.

   b.

   c.



AXILLARY
NERVE

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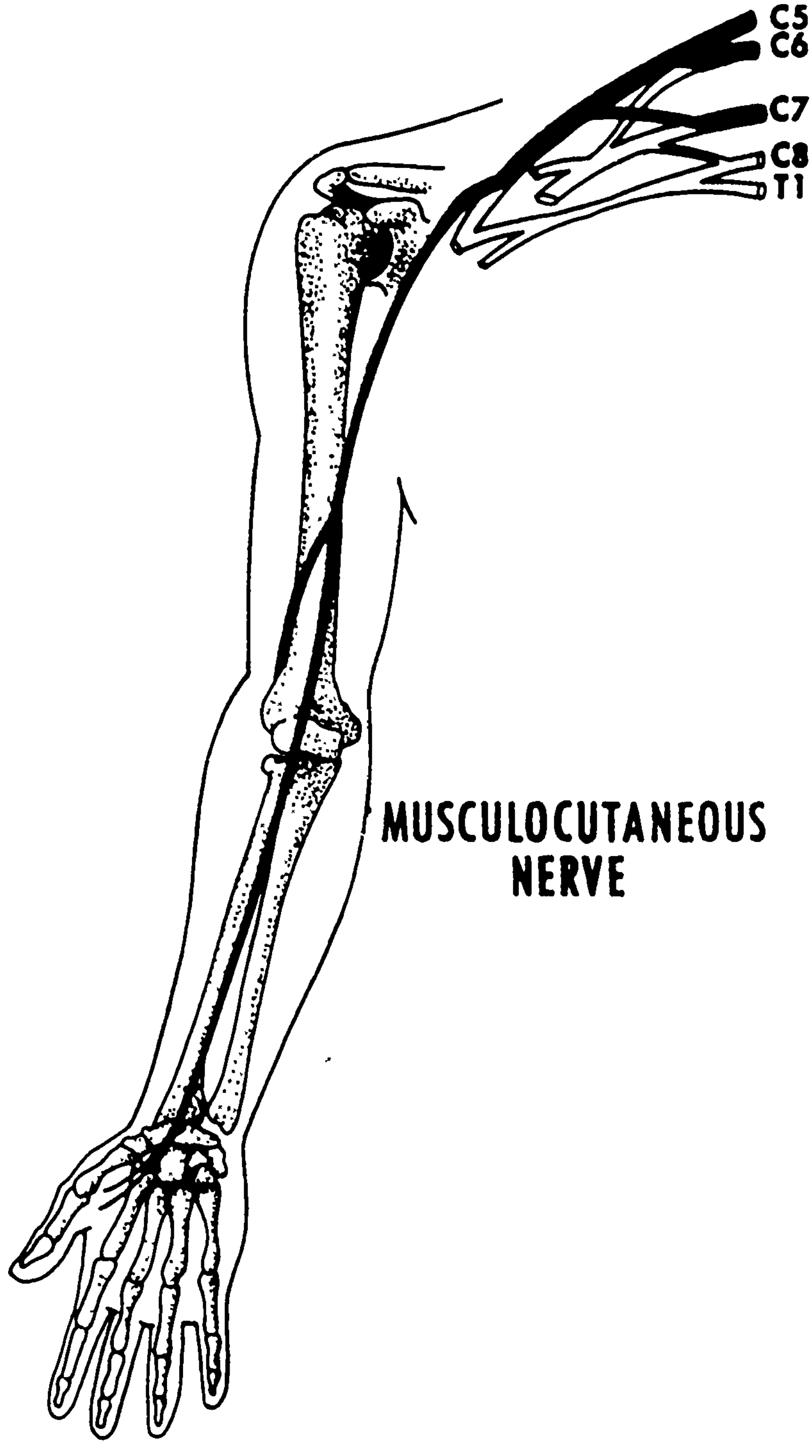
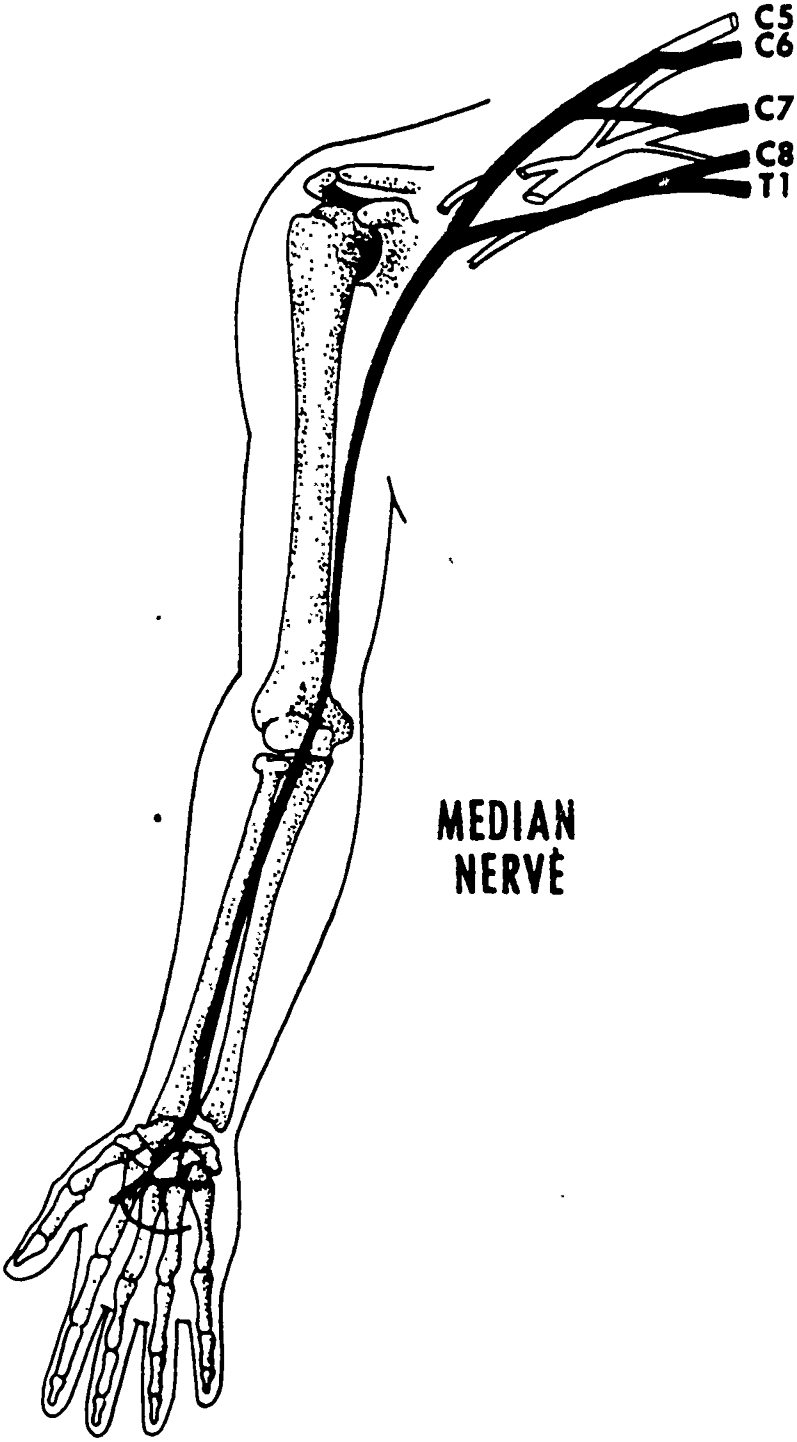


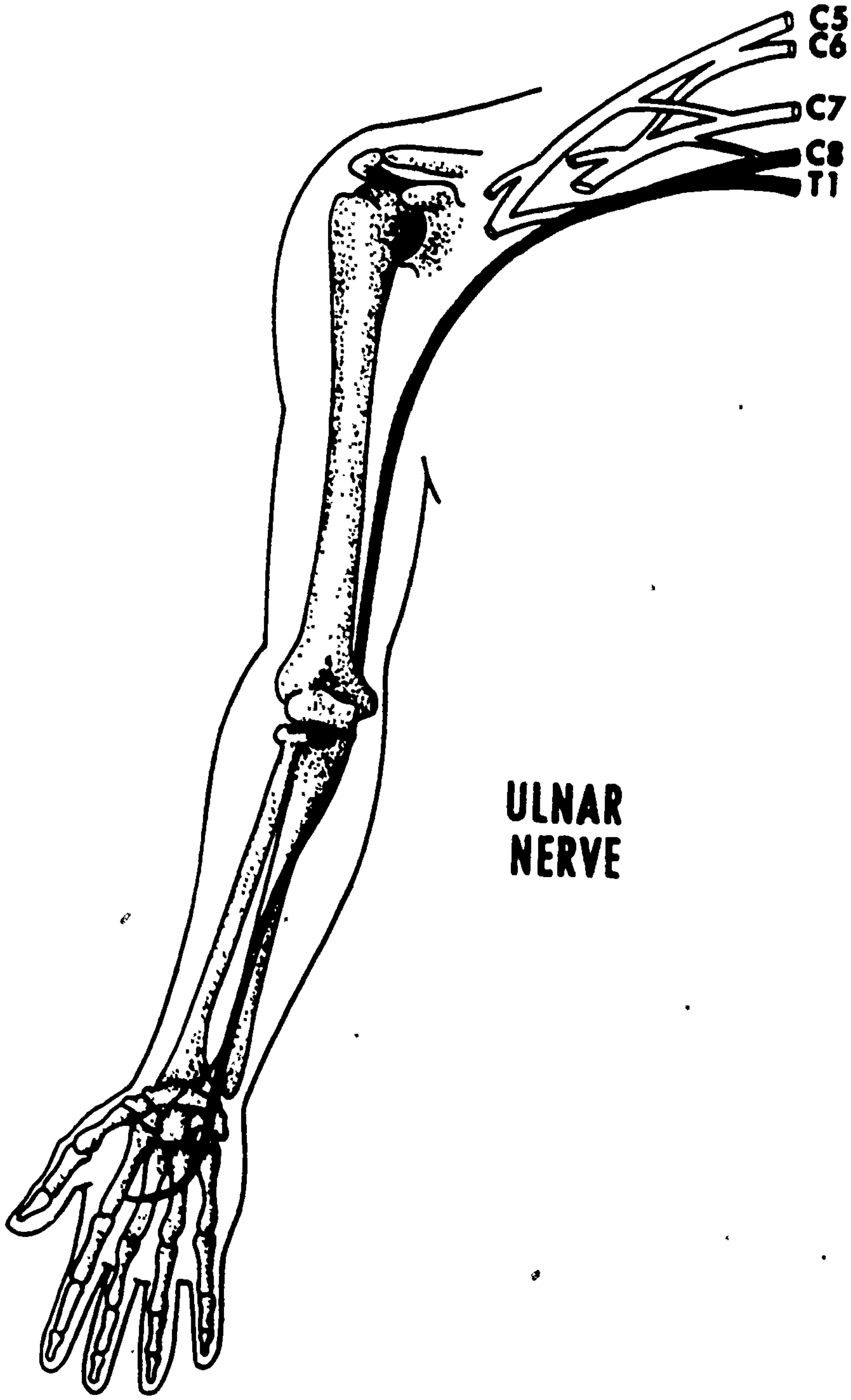
MUSCULOCUTANEOUS
NERVE

175

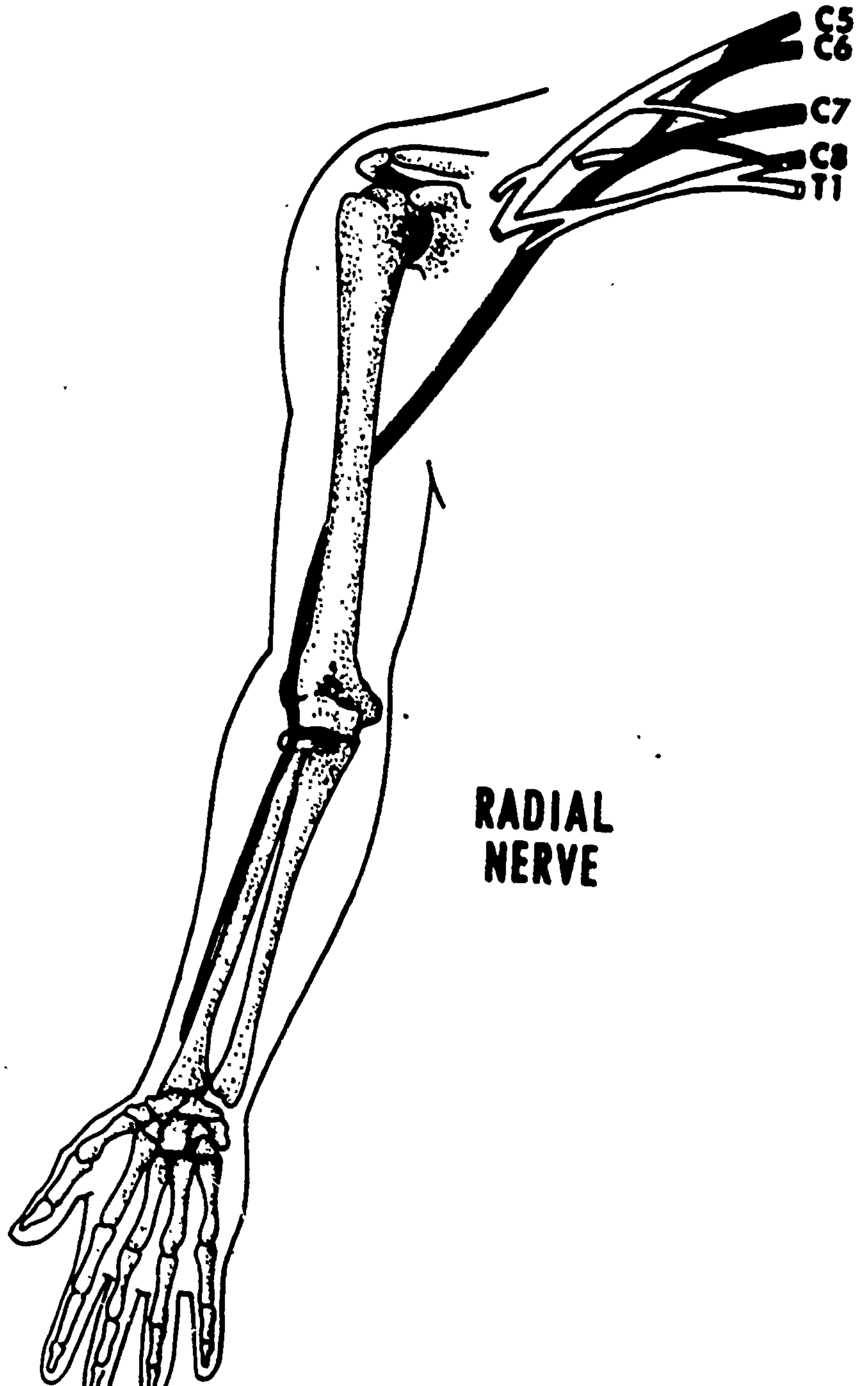


MEDIAN
NERVE

176



ULNAR NERVE


C5
C6
C7
C8
T1
RADIAL
NERVE

MYOLOGY OF THE HIP AND THIGH

Name the muscle(s) which perform the following motions.

1. Hip flexion

   a.

   b.

   These two muscles are collectively named the ____________________.

2. Hip extension

   a.

   b.

3. Hip abduction

4. Hip adduction

   a.

   b.

   c.

   d.

   e.

5. Hip internal rotation

   a.

   b.

6. Hip external rotation

   a.

7. Knee flexion

   a.

b.

c.

8. Knee extension

a.

b.

c.

d.

These muscles are collectively named the ______________________.

MYOLOGY EXERCISE #8 (HIP AND THIGH)

1. Knees extension is performed by four muscles which are called the _______________ group.

2. One of the knee extensors is a two joint muscle. It originates on the _______________ and is called the _______________ _______________. This muscle assists in _______________ _______________.

3. The other three extensors of the knee are the

a.

b.

c.

4. These muscles insert by tendon on the _______________ which is attached by ligament to the _______________ _______________.

5. The knee is classified as a _______________ joint. Therefore, movements allowed are _______________ and _______________.

6. Articulation of the weight bearing bones of the lower extremity take place between the _______________ and _______________ condyles. Between these joint surfaces there is a shock absorbing cartilage called the _______________.

7. When the knee is weight bearing in the fully extended position, the joint is stabilized by the joint _______________.

8. When the knee is bent and weight bearing, anterior-posterior stabilization is aided by partial contraction of the_______________ muscles.

9. Anterior-posterior displacement of the tibia is prevented by the _______________ ligaments.

10. Medial-lateral stability of the knee is provided by the _______________ ligaments.

11. The knee is flexed by three muscles which are collectively called the _______________. They are two joint muscles which originate on the _______________ tuberosity. Because of their origin, they assist the _______________ _______________ in hip extension.

MOLOGY OF THE LEG AND FOOT

List the muscles which perform the following motions.

1. Plantarflexion

    a.

    b.

    These muscles are collectively called the ________________________.

2. Dorsiflexion

    a.

3. Inversion

    a.

    b.

4. Eversion

    a.

    b.

5. Flexion of great toe

    a. M.P. Joint -

    b. I.P. Joint -

6. Flexion of toes 2 thru 5

    a. D.I.P. Joint -

    b. P.I.P. Joint -

    c. M.P. Joint -

7. Extension of great toe

    a. M.P. Joint -

    b. I.P. Joint -

8. Extension of lateral 4 toes

   a. M.P. Joint:

      (1)

      (2)

   b. D.I.P. Joint -

   c. P.I.P. Joint -

9. Toe abduction

   a. Great toe -

   b. Fifth toe -

   c. Toes 2, 3, 4 -

10. Toe adduction

   a. Great toe -

   b. 2nd thru 5th toes -

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MAJOR NERVES OF THE LOWER EXTREMITY

INSTRUCTIONS: Name the muscles innervated by the nerves listed below.

1. Obturator Nerve

   a.

   b.

   c.

2. Femoral N.

   a.

   b.

   c.

   d.

   e.

   f.

   g.

   h.

3. Sciatic N. - Tibial Division

   a.

   b.

   c.

4. Tibial N.

   a.

   b.

   c.

   d.

   e.

5. Common Peroneal N.

a.

b.

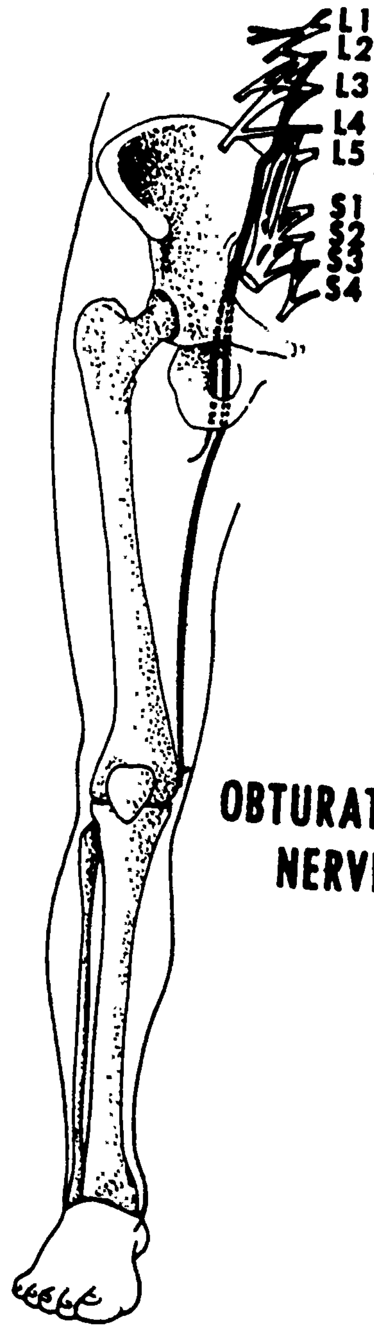
c.

d.

e.

f.

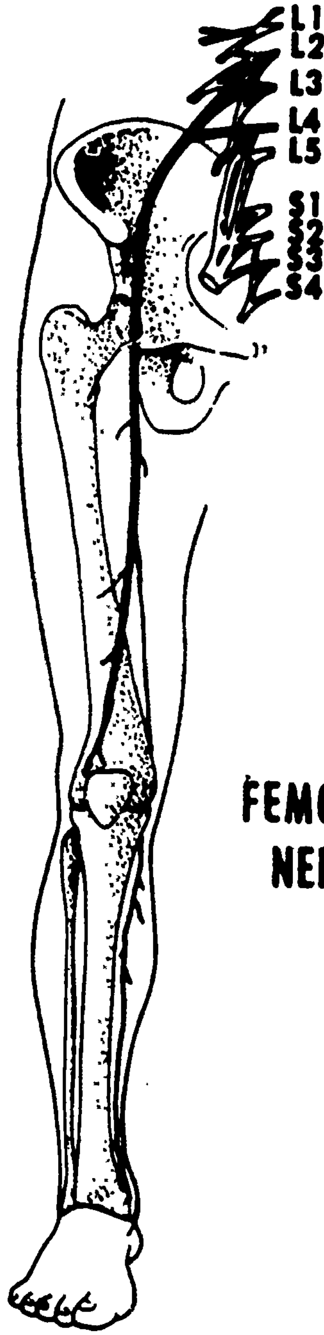
185



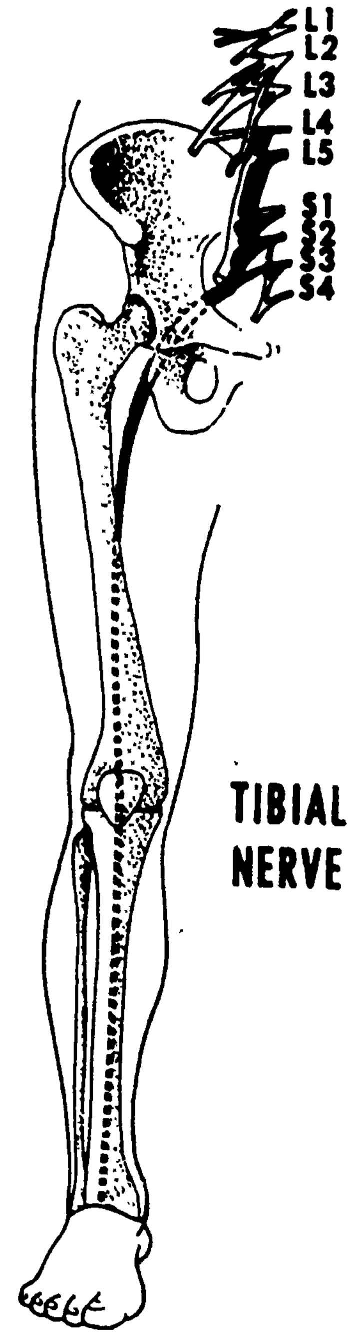
OBTURATOR
NERVE

209

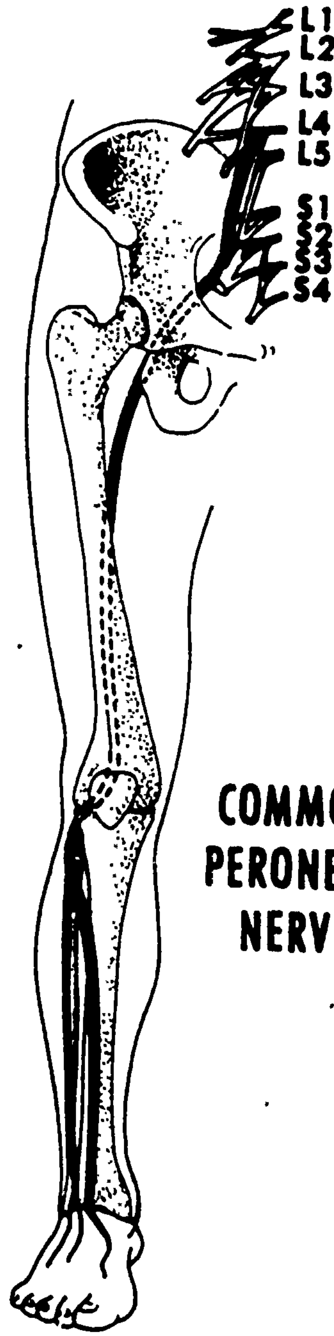
146



FEMORAL
NERVE



TIBIAL
NERVE



COMMON
PERONEAL
NERVE

149

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB [signature] 10 OCT 1975	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
II	Procedures and Modalities

LESSON TITLE: Orthopedic and Neurological Conditions

LESSON DURATION

CLASSROOM/Laboratory	~~LABORATORY~~ Complementary	TOTAL
15 hrs/0 hrs	4 hrs	19 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
6	22 July 1975	1a

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 March 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
NA	NA	NA	AFM 160-2 Chaps 4 & 6 Films: FLC 18/115, Della FR 1024, Surgical Repair of the Posteriorly Unstable Shoulder TF-6144, Patellectomy With Reconstruction of Quadriceps Tendon (over)

CRITERION OBJECTIVES AND TEACHING STEPS

1a. Identify orthopedic and neurological conditions which may be treated with physical therapy.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

GPO: 1972 779-388/

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB 10 OCT 1975	
COURSE NUMBER 3ABR91330	**COURSE TITLE** Physical Therapy Specialist
BLOCK NUMBER II	**BLOCK TITLE** Procedures and Modalities

LESSON TITLE Surgical and Internal Medical Conditions

LESSON DURATION

CLASSROOM/Laboratory	~~LABORATORY~~ Complementary	TOTAL
3 hrs/0 hrs	0 hrs	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
6	22 July 1975	1 b

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 March 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
NA	NA	NA	AFM 160-2 Chaps 4 & 5

CRITERION OBJECTIVES AND TEACHING STEPS

1b. Identify surgical and internal medical conditions which may be treated with physical therapy.

(Teaching steps listed in Part II)

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APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB Wilson 10 OCT 1975	
COURSE NUMBER 3ABR91330	**COURSE TITLE** Physical Therapy Specialist
BLOCK NUMBER II	**BLOCK TITLE** Procedures and Modalities

LESSON TITLE
Asceptic Techniques for Physical Therapy

LESSON DURATION

CLASSROOM/LABORATORY	Complementary	TOTAL
2 hrs/0 hrs	1 hrs	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
7	22 July 1975	4a

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 March 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Tony M Conner	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
NA	NA	NA	Afm 160-2, Chap 9 3 and

CRITERION OBJECTIVES AND TEACHING STEPS

4a. Explain the principles of asceptic technique required in the operation of a physical therapy department.

(Teaching steps listed in Part II)

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE: MSDB 10 OCT 1975 ~~8 MAY 1974~~	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: II	BLOCK TITLE: Procedures and Modalities

LESSON TITLE: Positioning

LESSON DURATION

CLASSROOM/Laboratory	Complementary	TOTAL
2 hrs/0 hrs	1 hr	3 ~~2~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
7 ~~8~~	8 JUL 1975 ~~15 Feb 1974~~	4 ~~2~~

STS/CTS REFERENCE

NUMBER	DATE
STS 91330	~~10 Jan 1974~~ 28 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Ray M. Conner	10 MAY 1974	Ray M. Conner	17 OCT 1975
Ray M. Conner	25 OCT 1974		
Ray M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 9 and 6; SW 3ABR91330-II-2 Procedures and Modalities

CRITERION OBJECTIVES AND TEACHING STEPS

4 ~~2~~. Explain the principles of positioning patients for physical therapy care.

(Teaching steps listed in Part II)

LESSON PLAN (Part I, General)

SERVICE AND DATE 1 0 OCT 19	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER II	BLOCK TITLE Procedures and Modalities

LESSON TITLE
Therapeutic Exercise

LESSON DURATION

CLASSROOM/Laboratory	Complementary	TOTAL
4 Ohrs	2 hrs	6 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
7	~~15 Feb 1974~~ 2 2 JUL 1975	4c

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	1 0 MAY 1974	[signature]	1 7 OCT 1975
[signature]	2 5 OCT 1974		
[signature]	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N-K Table with Slotted Weights (12) Ankle Exerciser with Slotted weights (12) Exercise weights (2)	N/A	N/A	AFM 160-2, Chapt 9 SW 3ABR91330-II-4c Therapeutic Exercise Films: ~~TF1-8014, Therapeutic Exercise, Introduction~~ FLC 18/90, Range of Motion Therapy

CRITERION OBJECTIVES AND TEACHING STEPS

4c. Recognize and explain the classification, psychological effects, indications, contraindications and principles of application of therapeutic exercise.

(Teaching Steps listed in Part II)

ATC FORM 770

10 OCT 1975 **LESSON PLAN (Part I, General)**

SERVICE AND DATE	INSTRUCTOR
NSDB ~~7 MAY 1974~~	
COURSE NUMBER	**COURSE TITLE**
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
II	Procedures and Modalities

LESSON TITLE

Therapeutic tests and measurements

LESSON DURATION

CLASSROOM /Laboratory	Complementary	TOTAL
2 hrs / 0 hrs	.5 hrs	2.5 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
7 ~~8~~	22 JUL 1975 ~~15 February 1974~~	4 ~~e~~ d

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Fay M. Conner	10 MAY 1974	Fay M. Conner	17 OCT 1975
Fay M. Conner	[illegible]		
Fay M Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Goniometers (2) Tape Measure (4)	N/A	N/A	AFM 160-2, Chap 9 2nd SW 3ABR91330-II-~~2e~~ 4d Therapeutic Tests and Measurements

CRITERION OBJECTIVES AND TEACHING STEPS

4d. ~~2e~~. Recognize and explain the principles of joint range of motion, extremity girth, and leg length measurement.

(Teaching steps listed in Part II)

FORM AUG 72 770

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LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
20 OCT 1975 ~~2 MAY 1974~~	
COURSE NUMBER 3ABR91330	**COURSE TITLE** Physical Therapy Specialist
BLOCK NUMBER II	**BLOCK TITLE** Procedures and Modalities

LESSON TITLE
Transfer Activites

LESSON DURATION

CLASSROOM/Laboratory	~~xxxxxxxx~~ Complementary	TOTAL
1 hr /0 hrs	.5 hrs	1.5 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
8	~~15 Feb 1974~~ 2 JUL 1975	4 ~~2~~

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Fay M. Conner	1 0 MAY 1974	Fay M. Conner	1 7 OCT 1975
Fay M. Conner	[illegible] 1974		
Fay M. Conner	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Wheelchair (4)	N/A	N/A	AFM 160-2, Chap 2 ~~9~~ SW 3ABR91330-II-4e ~~2e~~ ~~Procedures and Modalities~~ Transfer Activities and Gait Training

CRITERION OBJECTIVES AND TEACHING STEPS

4e ~~2e~~. Recognize and explain the principles of transfer activities.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

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LESSON PLAN (Part I, General)

OFFICE AND DATE: MSDB 17 OCT 1975 ~~10 MAY 1974~~	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: II	BLOCK TITLE: Procedures and Modalities
LESSON TITLE: ~~Gaits~~ Crutch and Cane Ambulation	

LESSON DURATION

CLASSROOM/Laboratory	Complementary	TOTAL
2.0 hrs	0.5 hr	2.5 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
8	8 JUL 1975 ~~Feb 1974~~	4 ~~2~~

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 January 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	10 MAY 1974	Kay M. Conner	17 OCT 1975
Kay M. Conner	25 OCT 1974		
Kay M Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Axillary Crutches (1) Forearm Crutches (3) Cane (2)	N/A	N/A	AFM 160-2, Chap 9 SW 3ABR91330-II-~~2~~ ~~Transfer Activities and Gait Training~~

CRITERION OBJECTIVES AND TEACHING STEPS

4 ~~2~~. Recognize and explain the principles of ~~gaits~~ crutch and cane ambulation.

(Teaching steps listed in Part II)

FORM 770 AUG 72

LESSON PLAN (Part I, General)

OFFICE AND DATE: MSDB 17 OCT 1975	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: II	BLOCK TITLE: Procedures and Modalities
LESSON TITLE: Massage	

LESSON DURATION

CLASSROOM/Laboratory	Complementary	TOTAL
2 hrs	1 hr	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
8	2 2 JUL 197~~15 Feb 1974~~	4 ~~2~~ 9

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	1 0 MAY 1974	Kay M. Conner	1 7 OCT 1975
Kay M. Conner	2 5 [illegible]		
Kay M. Conner	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 29 ~~94~~ SW 3ABR91330-II-~~2~~ ~~Procedures and Modalities~~

CRITERION OBJECTIVES AND TEACHING STEPS

4g, ~~2k~~. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of massage.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

LESSON PLAN (Part I, General)

~~Preparation~~ AND DATE 17 OCT 1975 MSDB ~~10 MAY 1974~~	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER II	BLOCK TITLE Procedures and Modalities
LESSON TITLE Postural Drainage	

LESSON DURATION

CLASSROOM /Laboratory 1.0 hrs	~~XXXXXXXX~~ Complementary .5 hr	TOTAL 1.5 ~~1.4~~ hrs

POI REFERENCE

PAGE NUMBER 8	PAGE DATE ~~15 FEB 1974~~ 2 JUL 1975	PARAGRAPH 4~~a~~h

STS/CTS REFERENCE

NUMBER STS 913X0	DATE ~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Tony M. Connor	1 0 MAY 1974	Tony M. Connor	1 7 OCT 1975
Tony M. Connor	0 8 OCT [illegible]		
Tony M. Connor	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 2 ~~9-4~~ ~~SW 3ABR91330-II-26, Procedures and Modalities~~

CRITERION OBJECTIVES AND TEACHING STEPS

4h. ~~22~~. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of postural drainage.

(Teaching steps listed in Part II)

FORM AUG 72 770

GPO: 1972 779-308/88

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB Wilson 10 OCT 1975	
COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	BLOCK TITLE
II	Procedures and Modalities

LESSON TITLE
Physical Therapy Procedures

LESSON DURATION

CLASSROOM /Laboratory	~~XXXXXXXXX~~ Complementary	TOTAL
0 hrs/ 18 hrs	5 hrs	23 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
8	~~22 Jun 75~~ 8 8 JUL 1975	4 i

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 Mar 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Troy M Conner	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N-K Table with Slotted weights (12) Ankle Exercisor w/ weights (12) Wheelchair (4) Axillary Crutches (1) Forearm Crutches (3) Cane (2) Exercise Weights (2)	NA	NA	AFM 160-2, Chap 9 SW 3ABR91330-II-4b

CRITERION OBJECTIVES AND TEACHING STEPS

4i. Given the necessary equipment in a simulated USAF Physical Therapy Department, administer therapeutic exercise, joint range of motion, extremity girth and leg length measurements, crutch and cane ambulation, massage and postural drainage to student patients as prescribed on Standard Form 513, Consultation Sheet.

(Teaching steps previously taught in POI elements 4a through 4h)

ATC FORM AUG 73 770

LESSON PLAN (Part I, General)

~~RANK AND DATE~~ 20 OCT 1975 MSDB ~~MAY 1974~~	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER II	BLOCK TITLE Procedures and Modalities
LESSON TITLE Heat	

LESSON DURATION

CLASSROOM/Laboratory	~~xxxxxxxxx~~ Complementary	TOTAL
2 hrs/0 hr	1 hr	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
9	2 2 JUL 1975 ~~15 Feb 1974~~	6 ~~4~~a

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Roy M. Conner	1 0 MAY 1974	Roy M. Conner	1 7 OCT 1975
Roy M. Conner			
Roy M. Conner	2 5 APR 1975		

PRECLASS PREPARATION.

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N/A	N/A	N/A	AFM 160-2, Chap 9 ~~4~~ SW 3ABR91330-II-~~2~~ 2

CRITERION OBJECTIVES AND TEACHING STEPS

6 ~~4~~a. Explain the general principles of the physiological effects, indictions, contraindications for applying heat.

(Teaching steps listed in Part II)

FORM 770

LESSON PLAN (Part I, General)

ORGANIZATION AND DATE	INSTRUCTOR
MSDB 17 OCT 1975	
COURSE NUMBER 3ABR91330	**COURSE TITLE** Physical Therapy Specialist
BLOCK NUMBER II	**BLOCK TITLE** Procedures and Modalities

LESSON TITLE
Infrared Light

LESSON DURATION

CLASSROOM /Laboratory	Complementary	TOTAL
1.5 ~~2~~ hrs/0 hrs	.5 ~~.5 hrs~~ hr	2.0 ~~2.5~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
9	2 2 JUL 1975 ~~15 Feb 1974~~	6b

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	1 0 MAY 1974	Kay M. Conner	1 7 OCT 1975
Kay M Conner	2 5 OCT 1974		
Kay M. Conner	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Infrared Light (3)	N/A	N/A	AFM 160-2, Chap 9, 41 SW 3ABR91330-II

CRITERION OBJECTIVES AND TEACHING STEPS

6b Recognize and explain the physiological effects, indications, contraindications and the principles of the application of infrared light.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE 17 OCT 1975	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER II	BLOCK TITLE Procedures and Modalities
LESSON TITLE Moist Heat	

LESSON DURATION

CLASSROOM	Complementary	TOTAL
Laboratory 1.5 hrs/0 hrs	.5 hrs	2 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
9	2 JUL 1975	6c

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Tony M. Conner	10 MAY 1974	Tony M Conner	17 OCT 1975
Tony M. Conner	25 OCT 1974		
Tony M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Moist Heat Packs (2)	N/A	N/A	AFM 160-2, Chap 9 SW 3ABR91330-II-~~3c~~ 4b

CRITERION OBJECTIVES AND TEACHING STEPS

~~6d.~~ 6c. Recognize and explain the physiological effects, indications, contraindications and principles of the application of moist heat.

(Teaching steps listed in Part II)

FORM AUG 72 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB 10 OCT 1975	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist

BLOCK NUMBER	BLOCK TITLE
II	Procedures and Modalities

LESSON TITLE
Paraffin Baths

LESSON DURATION

CLASSROOM/Laboratory	Complementary	TOTAL
1 hrs/ohr	.5 hrs	1.5 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
9 ~~10~~	22 JUL 1975 ~~Feb 1974~~	6 ~~4d~~

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	10 MAY 1974	Kay M. Conner	17 OCT 1975
Kay M. Conner	15 OCT 1974		
Kay M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Paraffin Bath (12)	N/A	N/A	AFM 160-2, Chap 9 SW 3ABR91330-II-~~9~~ 4

CRITERION OBJECTIVES AND TEACHING STEPS

6d. ~~4c~~ Recognize and explain the physiological effects, indications, contraindications, and principles of the application of paraffin baths.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

204

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE: ~~V MSDB~~ 10 OCT 1975	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: II	BLOCK TITLE: Procedures and Modalities

LESSON TITLE: Whirlpool

LESSON DURATION

CLASSROOM /Laboratory	Complementary	TOTAL
1 ~~2~~ hrs/ 3hrs	.5 ~~X~~ hr	1.5 ~~X~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
9 ~~10~~	~~15 Feb 1974~~ 2 2 JUL 1975	6 ~~4~~ e

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	1 0 MAY 1974	Kay M. Conner	1 7 OCT 1975
Kay M. Conner	2 1 OCT 1974		
Kay M. Conner	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Whirlpool (6)	N/A	N/A	AFM 160-2, Chap 9 Jan 1 SW 3ABR91330-II-~~4a~~ 6

CRITERION OBJECTIVES AND TEACHING STEPS

6e. ~~4f.~~ Recognize and explain the physiological effects, indications, contraindications, and principles of the application of whirlpool.

(Teaching steps listed in Part II)

LESSON PLAN (Part I, General)

APPROVAL AND DATE: 17 OCT 1975 / 8 MAY 1974	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: II	BLOCK TITLE: Procedures and Modalities
LESSON TITLE: Microwave Diathermy	

LESSON DURATION

CLASSROOM/Laboratory	Complementary	TOTAL
3 hrs / hrs	1 hrs	4 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
~~22~~ 9	~~15 Feb 1974~~ 2 JUL 1975	6 ~~f~~

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1973~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Tony M. Connor	10 MAY 1974	Tony M. Connor	17 OCT 1975
Tony M. Connor	2 OCT 1974		
Tony M. Connor	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Microwave Diathermy (6)	N/A	N/A	AFM 160-2, Chap 9 and 4; SW 3ABR91330-II-~~30~~

CRITERION OBJECTIVES AND TEACHING STEPS

6f. ~~4i~~. Recognize and explain the physiological effects, indications, contraindications and principles of the application of microwave diathermy.

(Teaching steps listed in Part II)

ATC FORM 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE 10 OCT 1975	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER II	BLOCK TITLE Procedures and Modalities

LESSON TITLE
Shortwave Diathermy

LESSON DURATION		
CLASSROOM /Laboratory 3 2 hrs / 0 hr	~~XXXXXXXXX~~ Complementary 1 ~~.5~~ hrs	TOTAL 4 ~~2.5~~ hrs

POI REFERENCE		
PAGE NUMBER 9 ~~10~~	PAGE DATE 2 2 JUL ~~Feb 1974~~	PARAGRAPH 6 ~~9~~

STS/CTS REFERENCE	
NUMBER STS 913X0	DATE ~~10 Jan 1974~~ 2 5 MAR 1975

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
Tony M. Conners	1 0 MAY 1974	Tony M Conners	1 7 OCT 1975
Tony M. Conners	2 5 OCT 1974		
Tony M Conners	2 5 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Shortwave Diathermy (6)	N/A	N/A	AFM 160-2, Chap 2 ~~4~~ SW 3ABR91330-II-2 ~~3~~

CRITERION OBJECTIVES AND TEACHING STEPS

6 ~~4~~. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of shortwave diathermy.

(Teaching steps listed in Part II)

FORM AUG 72 770

GPO : 1972 770-356/80

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE: [illegible signature] OCT 197[illegible] MSDM [illegible] MAY 1974	INSTRUCTOR
COURSE NUMBER: 3ABR91330	COURSE TITLE: Physical Therapy Specialist
BLOCK NUMBER: II	BLOCK TITLE: Procedures and Modalities

LESSON TITLE: Ultrasound Diathermy

LESSON DURATION

CLASSROOM /Laboratory	XXXXXXXX Complementary	TOTAL
3 hrs/[illegible]	1 hr	4 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
10	22 JUL [illegible]	4h

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	[illegible] 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	10 MAY 1974	[signature]	17 OCT 1973
[signature]	25 OCT 1974		
[signature]	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Ultrasound Diathermy (12)	N/A	N/A	AFM 160-2, Chap 2&4, SW 3ABR91330-II-[illegible]

CRITERION OBJECTIVES AND TEACHING STEPS

4h. Recognize and explain the physiological effects, indications, contraindications, and principles of the application of ultrasound diathermy

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

LESSON PLAN (Part I, General)

OFFICE AND DATE 10 OCT 1975 MSDB	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER I	BLOCK TITLE Basic Sciences
LESSON TITLE Electrical Stimulation	

LESSON DURATION

CLASSROOM/Laboratory	Complimentary	TOTAL
2 hrs / 0 hrs	1 hr	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
10	8 JUL 1975 ~~15 Feb 1974~~	6 ~~7~~

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Kay M. Conner	26 APR 1974	Kay M. Conner	17 OCT 1975
Kay M. Conner	25 OCT 1974		
Kay M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Electrical Stimulator (6)	N/A	N/A	AFM 160-2, Chap 29 SW 3ABR91330-II-2d

CRITERION OBJECTIVES AND TEACHING STEPS

6i. Recognize and explain the physiological effects, indications, contraindications and principles of the application of electrical stimulation.

(Teaching steps listed in Part II)

FORM 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE 10 OCT 1975 MSDB Wilson ~~8 NOV 1974~~	INSTRUCTOR
COURSE NUMBER 3ABR91330	COURSE TITLE Physical Therapy Specialist
BLOCK NUMBER II	BLOCK TITLE Procedures and Modalities
LESSON TITLE Traction	

LESSON DURATION

CLASSROOM /Laboratory	~~XXXXXXXX~~ Complementary	TOTAL
2 hrs / 0 hrs	1 ~~.5~~ hrs	3 ~~2.5~~ hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
10	22 JUL 1975 ~~15 Feb 1974~~	6 ~~f~~ j

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 JAN 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Fay M. Conner	10 MAY 1974	Fay M. Conner	17 OCT 1975
Fay M. Conner	08 OCT 1974		
Fay M Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Traction Machine (6)	N/A	N/A	AFM 160-2, Chap ~~9~~ 20 4b SW 3ABR91330-II-~~2c~~

CRITERION OBJECTIVES AND TEACHING STEPS

6j ~~4f~~. Recognize and explain the physiological effects, indications, contraindications and principles of the application of traction.

(Teaching steps listed in Part II)

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB 10 OCT 1975	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
II	Procedures and Modalities

LESSON TITLE

Ultraviolet Light

LESSON DURATION

CLASSROOM /Laboratory	Complementary	TOTAL
2 hrs/0 hrs	1 hr	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
10	2 JUL 1975 ~~15 Feb 1974~~	6 k

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	~~10 Jan 1974~~ 25 MAR 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Fay M. Conner	10 MAY 1974	Fay M. Conner	17 OCT 1975
Fay M. Conner	25 OCT 1974		
Fay M. Conner	25 APR 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Ultraviolet Light (6)	N/A	N/A	AFM 160-2, Chap 10 SW 3ABR91330-II-16

CRITERION OBJECTIVES AND TEACHING STEPS

6k. Recognize and explain the physiological effects, indications, contraindications and principles of the application of ultraviolet light

(Teaching steps listed in Part II)

Part I, General

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB Wilson 10 OCT 1975	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
II	Procedures and Modalities

LESSON TITLE
Cryotherapy

LESSON DURATION

CLASSROOM/Laboratory	~~xxxxxxxxx~~Complementary	TOTAL
2 hrs/0 hrs	1 hr	3 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
10	22 July 75	6 L

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 March 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Terry M Connor	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
NA	NA	NA	AFM 160-2, Chap 9 ~~[illegible]~~

CRITERION OBJECTIVES AND TEACHING STEPS

61. Recognize and explain the physiologica effects, indications, contraindications, and principles of the application of cryotherapy, contrast baths, and contrast packs.

(Teach steps listed in Part II)

ATC FORM AUG 72 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB Wilson 10 OCT 1975	
COURSE NUMBER	**COURSE TITLE**
3ABR91330	Physical Therapy Specialist
BLOCK NUMBER	**BLOCK TITLE**
II	Procedures and Modalities

LESSON TITLE
Physical Therapy Modalities Laboratory

LESSON DURATION

CLASSROOM/Laboratory	XXXXXXXXXXComplementary	TOTAL
0 hrs/22 hrs	6 hrs	28 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
10	22 Jul 75	6 m

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 Mar 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
Tony M. Conner	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Ultraviolet Light (6) Spot Quartz UV (6) Infrared Light (3) Moist Heat Packs (2) Cold Pack (2) Traction Machine (6) Paraffin Bath (12) (See Back)	NA	NA	AFM 160-2, Chaps 2 & 9 SW3ABR91330-II-4b

CRITERION OBJECTIVES AND TEACHING STEPS

6m. Given the necessary equipment in a simulated USAF Physical Therapy Department, administer infrared light, moist heat, paraffin bath, whirlpool, microwave diathermy, shortwave diathermy, ultrasound diathermy, electrical stimulation, traction, ultraviolet light, and cryotherapy to student patients as prescribed on Standard Form 513, Consultation Sheet.

(Teaching steps previously taught in POI elements 6a through 6l)

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APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDB [signature] 10 OCT 1975	

COURSE NUMBER	COURSE TITLE
3ABR91330	Physical Therapy Specialist

BLOCK NUMBER	BLOCK TITLE
II	Procedures and Modalities

LESSON TITLE: Physical Therapy Activities

LESSON DURATION

CLASSROOM/LABORATORY	~~XXXXXXXXX~~ Complementary	TOTAL
0 hrs /24 Hrs	4 hrs	28 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
11	22 July 1975	7

STS/CTS REFERENCE

NUMBER	DATE
STS 913X0	25 March 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
[signature]	17 OCT 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
N-K TAble with slotted weights (12) Ankle Exerciser with slotted weights (12) Wheelchair (4) Axillary crutch Forearm crutch (see back)	NA	NA	AFM 160-2, Chaps 9 and 12

CRITERION OBJECTIVES AND TEACHING STEPS

7a. Given the necessary equipment and supplies in a simulated USAF Physical Therapy Department, administer physical therapy care to student patients as prescribed on Standard Form 513, Consultation Sheet, and maintain proper cleanliness and order of the physcial therapy department and equipment.

(Teaching step previously taught in POI elements 4a through 4 h, and 6a through 6l)

ATC FORM 770 AUG 72

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Technical Training

Physical Therapy Specialist

PROCEDURES AND MODALITIES

October 1975

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
Department of Biomedical Sciences
Sheppard Air Force Base, Texas 76311

Designed For ATC Course Use

DO NOT USE ON THE JOB

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This supersedes SSW 3ABR91330-II-1--7, October 1971 and SW 3ABR91330-2-II:10-13, March 1970

Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas 76311

SW 3ABR91330-II-4b
October 1975

PROCEDURES AND MODALITIES

OBJECTIVES

After completing this study guide and workbook you will be able to explain the principles of positioning patients for treatment and explain the physiological effects, indications, and contraindications of massage, heat, infrared, moist heat, paraffin bath, whirlpool, microwave diathermy, shortwave diathermy, ultrasound diathermy, electrical stimulation, traction, and ultraviolet.

INTRODUCTION

As a physical therapy specialist it will be necessary for you to treat patients with various diseases and injuries. To facilitate the rehabilitation of the patient you will be positioning patients to ensure the efficient application of the selected procedures and modalities as well as the safety of the patients. Your having a knowledge of the physiological effects, indications, contraindications, and the principles of application of the procedures and modalities should enable you to provide quality physical therapy care to the patients you are treating.

INFORMATION

POSITIONING

Aspects of Positioning

PURPOSE. Positioning of the patient is used to assist in obtaining the maximum therapeutic response from a physical therapy treatment program.

GUIDELINES. There are guidelines to be followed to assure that the patient's therapeutic response through positioning will be maximal.

COMFORT. The patient is to be positioned so that he will be comfortable during the treatment. It may not be possible at all times to have the patient placed in a position which is the most comfortable to him. We need to remember that the patient be positioned so we can treat him safely and efficiently. The most comfortable position to the patient may not permit us to treat him safely and efficiently. If the patient is comfortable he is most likely to be relaxed and if he is relaxed his response to the treatment will be better.

PRIVACY. The patients should have an area which offers them privacy while they are undressing and preparing for treatment. Patients do not need any extra eyes staring at them. A simple curtain may be all that is needed to provide the patient with the privacy needed.

SECURITY. For the patient to be comfortable and relaxed he needs to be positioned so he will not feel that he is about to fall off the treatment table. There should be no feeling that the part being treated is about to fall. The patient should not have to exert any conscious effort to remain in position.

MODESTY. Never expose the patient in a manner that will make him feel embarrassed or ill at ease. The patient will be draped with a sheet, towels, or some type of gown so that the only part of the patient exposed will be the part being treated. When draping the patient make sure that the patient's clothing adjacent to the area being treated is protected and will not be soiled during the treatment.

BASIC POSITIONS. There are five basic positions used for positioning patients. These five basic positions are standard positions for certain body areas. The basic positions may be modified to meet any situation.

Prone. This position is used primarily for treatments to the posterior aspects of the body. In this position the patient will be lying on his stomach with a pillow placed under the abdominal area to reduce the lumbar curve. Another pillow will be placed under the ankles to slightly flex the knees and relieve the pressure from the end of the treatment table on the dorsal aspect of the feet. A small pillow or folded bath towel or sheet may be placed under the patient's head.

Supine. This position is used primarily for treatments to the anterior aspects of the body. In this position the patient will be lying on his back with a pillow placed under his knees and another pillow may be placed under his head.

Lateral Recumbent. This position is used primarily for treatments to the lateral aspect of the body. In this position the patient will be lying on his side with a pillow placed between his knees and a pillow placed under the patient's head. A pillow may be placed along the anterior or posterior aspect of the trunk of the body. The patient's legs should not be straight. He may have one or both of his knees flexed.

Semi-recumbent. This position is used primarily for treatments to the face. Some patients with certain respiratory conditions may be placed in the semi-recumbent position. In this position the patient will be lying on his back with one end of the plinth raised. If the end of the plinth cannot be raised a chair padded with pillows will serve the same purpose. A pillow should be placed under the patient's head and another pillow under the patient's knees.

Sitting. This position is used primarily for treatments to the shoulder and upper back. In this position the patient will generally be sitting in a chair or possibly on a stool. There are several modifications of the sitting position. Three of the most frequently used modifications will be discussed.

1. Sitting with arms resting on the lap. In this position the patient is to be comfortably seated with one to three pillows placed on the lap to support the arms.

2. Sitting, leaning forward on the plinth. In this position the patient will be comfortably seated, leaning forward and resting on the plinth. One to three pillows may be placed on the plinth for the patient to lean into. Special care should be taken to position the patient so that his knees are comfortably placed under the plinth and not bumping into the edges of the plinth.

3. Sitting with an upper extremity supported on the plinth. In this position the patient is to be comfortably seated beside the plinth with his upper extremity resting on one or two pillows which have been placed on the top of the plinth. In this position the shoulder should be in approximately 90 degrees of abduction.

QUESTIONS

1. What is used to assist in obtaining the maximal therapeutic response from a treatment program?

2. What guidelines are to be followed when positioning the patient?

a.

b.

c.

d.

3. Why is it necessary to comfortably position the patient?

a.

b.

c.

4. To help prevent extra eyes from staring at them, patients need ______________.

5. If a patient must exert any conscious effort to remain in position, it would indicate that he is not ________________.

6. What can we do to keep the patient from feeling embarrassed or ill at ease?

7. List the basic positions used for positioning patients.

a.

b.

c.

d.

e.

8. Where are the pillows placed when the patient is in the prone position?

a.

b.

c.

9. In the prone position, what area of the body may be treated?____________

10. What area of the body may be treated from the supine position?____________

11. Where are the pillows placed when the patient is in the supine position?

a.

b.

12. When the patient is in the lateral recumbent position, what part of the body may be treated?

____

13. In the lateral recumbent position, where would the pillows be placed?

a.

b.

c.

14. What position is used primarily to treat the face?____________

15. In the sitting position, what areas of the body may be treated?

a.

b.

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16. What are the modifications to the sitting position?

a.

b.

c.

NOTES:

MASSAGE

Aspects of Massage

DEFINITION. Massage is the scientific and systematic manipulation of the soft tissues of the body for therapeutic purposes. It is one of the oldest forms of physical treatment, yet with refined application it is still an effective means of treating certain musculoskeletal conditions. Administering massage scientifically calls for an understanding of the muscles and joints of the area to be treated as well as knowledge of the condition treated. Systematic application indicates the massage must be planned and executed in a manner which promotes the desired physiological effects. Since the actual massage is primarily a motor skill frequent practice is needed to develop coordination and establish firm patterns.

PHYSIOLOGICAL EFFECTS. The effects of massage on the human body have been scientifically studied and documented. These effects will be presented by anatomical structure to emphasize what happens in the areas massaged.

The Skin. Mechanical stimulation of the skin dilates the arterioles producing a temporary hyperemia, promotes the movement of fluids, exerts a cleansing effect, and promotes a feeling of warmth.

The Subcutaneous Tissue. In the subcutaneous tissue, massage promotes movement of fluids and loosens elastic tissue.

The Blood Vessels. In the skin and subcutaneous tissues, venous blood vessels can be effectively emptied which in turn promotes arterial flow, active hyperemia, and more active reabsorption of fluids and wastes.

The Muscles. Massage improves circulation, removes waste products, and helps to stretch intramuscular connective tissue.

The Nervous System. Nervous tissue, primarily sensory nerve endings, may be stimulated or sedated by massage.

INDICATIONS FOR MASSAGE. The following are indications for giving massage.

1. Traumatic conditions of muscles and joints such as sprains, strains, and edematous conditions.
2. Muscle spasms.
3. Fibrositis and myositis.
4. Arthritis.
5. Adhesions and scar formations.
6. Recent amputees.
7. Certain respiratory conditions.

CONTRAINDICATIONS FOR MASSAGE. The following contraindications for giving massage are to be followed.

1. Wounds, skin eruptions, and inflammatory processes on or beneath the skin.
2. Acute inflammatory conditions.

3. Tubercular joint conditions.

4. Malignancies.

5. Advanced debilitating conditions.

6. Neuritis and neuralgia during the acute inflammatory stages.

7. Phlebitis or an area where a thrombus may exist.

8. Cellulitis.

Media Used for Massage

LUBRICANTS. For general massage the most frequently used media is mineral oil; but other media such as olive oil, cold cream, or talcum powder are used. For scars, healed skin grafts, and healed burns use lanolin, cocoa butter, olive oil, cold cream, or various mixtures of these agents. Lubricants should be used generously when there is excessive hair, thick dead skin, especially after a limb is removed from a cast, and when there is extremely thin skin which is often present in old, emaciated or very young patients.

ALCOHOL. The patient should be warned that the alcohol will feel cool. Before applying the alcohol, pour it into the hand so that it will be warmed slightly. Alcohol may be used to remove excessive amounts of lubricants from the skin after the massage. It is not used on the patient's face.

CARE OF MATERIALS. Keep mineral oil and alcohol bottles clean. Wipe bottles after each use. Wash and refill bottles periodically. Pour liquids into the hand without touching the rim of the bottle. Lanolin, cold cream, and other ointments should be removed from their containers with a tongue depressor. All lids should be replaced immediately after use.

Basic Considerations for Massage

PLANNING. When massage is to be administered, consideration should be given to preparing for the treatment by planning in the following areas.

1. Personal hygiene. Keep your hands soft and free of calluses. Keep fingernails short and free of hangnails and avoid wearing rings and bracelets. Wash hands in warm water prior to the treatment.

2. Treatment area. The area should be private but well lighted. The linen should be clean and neat, and the treatment table should be firm.

3. The patient. Utilize the techniques for proper positioning, drape exposed areas adjacent to the area to be treated.

Massage Movements

IMPORTANCE. In mastering massage you must learn the types of movements and their purpose and be able to execute them properly.

STROKING. (effleurage). Stroking is even or uniform pressure exerted along a certain path which is directed toward the center of the body along the lines of venous circulation. It is applied in a slow, gentle, rhythmic manner and may be administered with varying degrees of pressure. Superficial or light pressure stroking (effeurage) has a reflex action which may be stimulating or sedative depending on the manner in which it is used. Deep pressure stroking (effleurage) has a mechanical reaction and is used to empty blood and lymph vessels, relieve edema, and stretch adhesions.

KNEADING (petrissage). Kneading strokes do not glide over the skin, but lift the muscle or tissue between the thumb and fingers or between the palmar surfaces of both hands. Kneading is performed with circular movements of the hand or the thumb and fingers. Usually four circles are made in one area and then the hands glide to an adjacent area where the circular movements are repeated. Pressure is exerted toward the midline of the body and in the direction of venous flow.

FRICTION (compression). Friction consists of a series of small circular movements performed with the thumbs, fingertips, or the heel of the hand in firm contact with the part so that underlying tissues are moved. The fingers do not move on the skin; the fingers move the tissues under the skin. Friction is used to free adhesions around scar tissue and to promote absorption of exudates around edematous joints.

TAPOTEMENT (striking). Tapotement consists of any series of brisk blows which follow each other rapidly. The hands and fingers are relaxed with the movement coming mainly from the wrists. Tapotement is stimulating and, since most therapeutic massage is for relaxation, tapotement is seldom used. Types of tapotement include:

1. Hacking. Striking the skin with the ulnar border of the hands and the little fingers.

2. Clapping. Striking the skin with the finger tips and the heel of the cupped hand.

3. Tapping. Tapping with one or more fingertips.

4. Beating. Beating with the ulnar border of the closed fist.

VIBRATION. Vibration consists of a shaking or tremulous movement which comes from the shoulder to the hands and fingers. The elbow is kept slightly flexed while the wrist and fingers are kept stiff. Manual vibration is seldom used except to assist in postural drainage.

General Techniques for Massage Application

APPLICATIONS. The following techniques are to be followed to effectively apply massage.

1. Plan the massage routine and execute it in an efficient method.

2. Use the proper type of libricant to support the purpose of the massage.

3. Examine the patient's skin prior to massage.

4. Avoid the appearance of hurrying.

5. Always start and end the massage with superficial effleurage.

6. During stroking and kneading keep the fingers together.

7. Use correct posture, keep the feet apart with the outside foot in front, follow through with the body by bending slightly at the knees and hips.

8. End the treatment in a manner which promotes relaxation. Wipe off lubricant, apply alcohol warmed by the hands, and then dry the part.

Dos and Don'ts of Massage

PERSONAL CONDUCT. The application of massage is a treatment which becomes personal in nature due to the hand contact. Therefore, your conduct during the treatment is of the utmost importance. The following list should guide your actions and conduct.

1. Speech and manners should be impersonal.

2. Keep both hands in firm contact with the patient at all times.

3. Never allow careless wandering of the hands.

Massage Procedures

ADAPTATION OF STROKES. Once you have mastered the strokes and techniques of massage you should be able to adapt them to any area of the body. Rather than cover each area, we will select the areas that are most frequently massaged.

Massage to the Cervical Region

POSITION OF THE PATIENT. The usual position of the patient is prone with the face straight down and a pillow under the chest, a pillow under the ankles, or the feet over the end of the plinth, a folded towel under the forehead, and the arms relaxed at the sides, or abducted with the elbows flexed. An alternative to the prone position is the sitting position and is used when the patient is not comfortable in the prone position. Seated on a stool or chair, the patient leans forward resting his chest on the plinth with his forehead on crossed arms, supported on one or two pillows.

POSITION OF THE TECHNICIAN. When the patient is prone, the physical therapy technician stands at the side of the plinth at the level of the patient's mid dorsal region. He stands with his feet apart, with the outside foot forward.

USUAL CLINICAL PROCEDURE FOR CERVICAL REGION MASSAGE. The following steps are usually followed.

1. Stroking (effleurage). Approximately eight strokes.

a. Place the hands so that the fingertips are on the area of the patient's mastoid processes. Cross the thumbs at the cervical spine.

b. Stroke downward over the posterior and posterolateral neck, using as much of the palmar surface of the hand and fingers as will conform to the part.

c. As the stroke nears the base of the neck, spread the hands and stroke from the base of the neck laterally over the shoulder and deltoid muscles.

d. Release the pressure and return the stroke over the posterior deltoid and shoulder muscles to the base of the neck. Cross the thumbs and stroke upward to the mastoid region.

2. Kneading (petrissage). Approximately four series.

a. Place the hands so that the fingertips are below the patient's mastoid processes.

b. Make circular kneading movements with the infgers and thumbs pressing downward and toward the midline.

c. A cycle consists of four circular movements with pressure on the downward portion of the stroke. After four strokes, advance the hands downward to the new area and continue the movement. Four cycles usually brings the hands out over the shoulders.

d. Release the pressure and return the stroke over the posterior deltiod and shoulder muscles to the base of the neck. Cross the thumbs and carry the stroke upward to the mastoid region. Repeat the procedure four times.

3. Friction. Both hands, two series.

a. Using both hands, place the hands so that the fingertips are below the mastoid processes. Rest the hands on the tips of the index, middle, and ring fingers.

b. Make circular movements simultaneously with the fingertips. The direction of the circles, count, and pressure are similar to that of kneading.

c. Advance the movements downward to the base of the neck, then swing laterally over the shoulder, and the deltiod muscles.

d. Release the pressure and return the stroke over the posterior deltoid and shoulder muscles. Cross the thumbs and stroke upward to the mastoid process. Repeat the procedure twice.

4. Friction. One hand.

a. Place the thumb on one side of the patient's cervical spine and the index or middle fingers on the other side. Rest the free hand at the base of the neck.

b. Make circular movements with the thumb and index finger until the base of the neck is reached, then use both hands to swing laterally over the shoulder and deltoid muscles.

c. Release the pressure and return the strokes over the posterior deltoid and shoulder muscles to the base of the neck. Cross the thumbs and stroke upward to the mastoid region. Repeat the procedure twice. Conclude the massage with stroking.

Massage to the Back

POSTION OF THE PATIENT. The usual position of the patient is prone, with a pillow under the abdomen, the feet over the end of the plinth, a folded towel under the forehead to support the head (or the patient may rest his forehead on his hands), and the arms relaxed at his side or abducted with the elbows flexed. The back is exposed from the neck to the gluteal cleft. Although seldom used, under certain circumstances the sitting position or the side lying position may be used.

POSITION OF THE TECHNICIAN. For stroking and friction, the technician stands at the side of the plinth at a point just below the patient's hips, facing the patient at an angle. He stands with his feet apart with the outside foot slightly forward. For kneading the technician stands at the side of the plinth at the level of the lumbar area, facing the patient. To facilitate movement of the hands across the back, he stands with a stride stance with the feet parallel and the knees slightly flexed.

USUAL CLINICAL PROCEDURE FOR BACK MASSAGE. Except as noted below, the number of strokes and series specified are the same for massage to the entire back, massage to the upper back, and massage to the lower back.

1. Stroking. These strokes will be superficial and progress to deep strokes.

a. Place both hands on the upper gluteal region, with the thumbs parallel and about 1 inch from the midline. Hold the fingers close together with the thumb at an angle of approximately 60 to 90 degrees. Relax the hands so that all the palmar surface touches the patient's back.

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b. Move the hand upward in this position to the midscapular region and draw the fingers in toward the thumbs. Move the hands upward over the area of the trapezius at the base of the neck and then swing them outward over the shoulder and deltoid region.

c. Release the pressure on the return stroke. Move the hands over the posterior axillary muscles, returning them to the starting position without losing contact. Repeat this procedure approximately eight times.

2. Kneading. Two series.

a. Place the hands approximately 2 inches away from, and at right angles to, the spine on the far side of the patient's back. Place the hand nearest the feet at the lower border of the sacrum and the other hand parallel to it at about 1 inch distance. Keep the thumbs close to the index fingers.

b. With circular movements, move both hands counterclockwise (or clockwise) and timed so that as one hand moves away from the spine across the muscles of the back the other hand moves medially toward the spine. The hands should be almost flat, being shaped to contour the back. Pick up the tissues between the hands as they pass each other. At this time, execute the forceful part of the stroke so that the muscles of the back are pressed downward and rolled between the hands.

c. After four repetitions of this stroke in one place, move upward by sliding the upper hand to a new position and letting the lower hand slide up to where the upper hand has just been massaging.

d. Continue circular movements to the base of the neck. Then proceed with circular movements over the shoulder and deltoid muscles.

e. Keeping the hands parallel, return to the starting position with a light gliding stroke. At the lumbosacral region, glide over the same region on the near side and start kneading again.

f. Repeat kneading twice over the entire back.

3. Friction. Two series. The starting position is the same as for stroking.

a. Place the hands over the sacral area, supporting them on the thumbs and fingertips with minimal pressure on the fingers. Place the thumbs 1 inch to 1½ inches from and parallel to the spinal column. Rest the fingers lightly on the back and do not brace the thumbs.

b. Place the ball of each thumb or the fingertips on each side of the spinous process in the erector spinal mass. Make small circles with the thumbs or fingertips, pressing down so that no movement occurs between the thumbs or fingertips and the skin surface (movement occurs in the underlying tissues). The movements do not glide across the skin, as in stroking; nor do they squeeze the tissues, as in kneading. Friction presses the tissue.

c. After four circles in one place, move upward about an inch. Repeat friction cycles until the lower cervical region is reached. The return stroke is the same as for stroking. The hands stroke the area of the upper trapezius at the base of the neck and then swing outward over the shoulder and deltoid muscle.

d. Repeat friction twice (from sacral region to cervical).

Massage to the Upper Back

PROCEDURE. Place the hands at approximately the level of the patient's first lumbar vertebra. Execute stroking, kneading, and friction in the same manner as for massage of the entire back.

Massage to the Lower Back

PROCEDURE. Place the hands at the level of the upper area of the patient's buttocks. Execute stroking, kneading, and friction in the same manner as for massage of the entire back. Terminate the strokes at the mid-dorsal region of the back.

Massage to the Shoulder

POSITION OF THE PATIENT. Two different positions may be used.

1. Sitting. The patient is seated with the back supported and the arm supported in abduction on the table or plinth; or he may be seated on a stool, with pillows on his lap and the forearm resting on the pillows.

2. Side lying. The patient lies on the unaffected side with a doubled pillow under his head, a pillow between his legs, and a pillow supporting the arm on the affected side.

POSITION OF THE TECHNICIAN. The position of the technician will be dictated by the following patient positions.

1. Patient sitting. The physical therapy technician stands behind the patient, or if the support is narrow, he stands at the point of the patient's elbow, facing the patient's shoulder.

2. Patient side lying. The physical therapy technician stands behind the patient.

Special Instructions. The physical therapy technician massages with one hand and uses the other to support the patient's shoulder against the direction of the massage pressure.

USUAL CLINICAL PROCEDURE FOR SHOULDER MASSAGE. The following procedure is usually followed.

1. Stroking. Approximately eight strokes each, posterior and anterior surfaces.

a. Place the hand fartherest from the midline of the patient's body on his midarm, so that the thumb and index finger span the lateral surface with the fingers over the posteromedial surface. With the free hand, support the patient's arm medially. Stroke upward to the axilla, then swing the hand over the posterior aspect of the shoulder to the base of the neck. Release pressure and return to the starting position.

b. Change hands so that the hand that has been supporting the patient's arm is placed with the fingers over the medial surface, the palm over the anterior surface, and the thumb over the lateral surface. The other hand supports the posterior aspect of the patient's arm. Massage upward to the axilla, then swing the hand over the anterior aspect of the shoulder to the base of the lateral neck. Release the pressure and return to the starting position.

2. Kneading. Approximately eight series each, posterior and anterior surface.

a. Using the start position for stroking, perform a circular movement with pressure upward, then out and away from the bone, completing four circular movements with smooth, even rhythm before moving proximally.

b. Proceed upward from the midarm to the base of the neck. Repeat the procedure eight times on the posterior aspect; then change hands and repeat the procedure eight times on the anterior aspect of the shoulder.

3. Friction. Friction is seldom ordered. If indicated, apply small circular movements with the thumb.

Special Instructions. In the massage section of this study guide and workbook we have discussed massage to the cervical region, back, and shoulder. Massage may be applied to any area of the body, but we have covered the most frequently massaged areas. Once you have mastered the different strokes they may be applied to any area of the body.

QUESTIONS

1. Massage is the ____________________ and ____________________ manipulation of the ________________ tissues of the body for therapeutic purposes.

2. Systematic application indicates the massage must be ____________________ and ____________________ in a manner which promotes the desired ____________________ effects.

3. Since massage is primarily a ________________ ________________, frequent practice is needed to develop ____________________ and establish firm patterns.

4. List physiological effects that massage has on the skin ____________________
____
____.

5. In the subcutaneous tissue, massage promotes ____________________
and ____.

6. In the muscles, massage improves ______________ ______________, removes ____________________, and helps to stretch ____________________
____.

7. During massage sensory nerve endings may either be ____________________ or ____________________.

8. List four indications for massage:

a. ____________________

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9. List four contraindications for massage:

   a. ______________________________

   b. ______________________________

   c. ______________________________

10. The lubricant media most frequently used in massage is ______________.

11. Lubricants should be used generously when there is ______________

______________________________.

12. Most lubricants can be removed from the skin with the use of ______________.

13. When applying massage keep finger nails ______________ and free ______________

and avoid wearing ______________ and ______________.

14. Stroking is ______________ or ______________ pressure,

exerted along a ______________ which is directed toward the

______________ of the body, along the lines of ______________

______________ circulation.

15. Superficial stroking has a ______________ action which may be

______________ or ______________ depending on the manner in which it is used.

16. Deep pressure stroking has a ______________ action and is used to empty

______________ and ______________ vessels, relieve ______________

and stretch ______________.

17. Kneading strokes do not ______________ over the skin, but lift the ______________

or ______________ between the ______________ and ______________ or

between ______________ of both hands.

18. In friction, the fingers do not ______________, the

fingers move ______________.

19. Tapotement consists of any of ______________ which follow

each other rapidly.

20. Vibration consists of a ______________ or ______________ movement

which comes from the ______________ to the hands and fingers.

21. Always start and end the massage with ______________________________.

22. End the treatment in a manner which promotes ________________________.

23. Use the proper type of lubricant to ________________________ the purpose of the massage.

NOTES:

THERAPEUTIC HEAT

Aspects of Therapeutic Heat

UNIVERSAL FORM OF TREATMENT. Heat is one of the oldest and most universally used forms of treatment. The use of heat is a well established and major portion of the treatment program in physical therapy and continues to grow in importance. The role of the physical therapy technician in the application of therapeutic heat is also growing in importance. As a technician you will be applying many forms of heat. Treatment may range from a basic moist heat pack to sophisticated heating modalities. To apply any form of heat safely and effectively, however, you will need to gain an understanding of the nature of therapeutic heat, its effects on the body and specific conditions controlling its use.

METHODS OF THERAPEUTIC HEATING. Conduction, convection, conversion, and radiation are the four methods used to transfer heat to the body for therapeutic purposes. Although these methods are most frequently used separately, some treatments in physical therapy may utilize a combination. It should be noted that the body can lose heat by conduction, convection, and radiation

Conduction. Heat transfer by CONDUCTION occurs when two objects of different temperatures come into contact. Heat always tends to pass from warmer to colder objects. The bot object becomes colder and the cold object becomes hotter until both have a common temperature. This method of heating is seen in the use of moist heat packs.

Convection. Heat transfer by CONVECTION occurs when there is an exchange of heat between the surface of an object and a fluid or gas which is moving past the surface of the object. Heat transfer by convection is a special type of conduction since the exchange of heat between the surface of the object and the moving fluid or gas occurs by conduction. The movement of the fluid or gas carries the heat to or away from the surface of the object. An excellent example of convective heating is seen in the circulating water of a whirlpool bath.

Conversion. Heat transfer by CONVERSION occurs when various types of energy penetrate into the deep layers of the body tissue where it is converted into heat. This method of heating is accomplished by various deep heating modalities such as ultrasound and short-wave diathermy.

Radiation. The last method of heat transfer is by RADIATION. Radiation occurs when there is an exchange of heat in the form of infrared rays. These rays are actually electromagnetic waves which travel through space. At the instant they strike an object these waves are transformed into heat.

PHYSIOLOGICAL EFFECTS OF HEAT. Many changes will take place in the body with the application of heat. You, the technician, will be able to recognize some of these physiological effects while other effects will remain unobservable. Basically, two types of effects, local and distant, may occur within the body.

Local Effects. These occur in the immediate area being treated. The primary effect will be an increase in temperature at the site of application. The increase in temperature in the tissues in the immediate area causes an increase in their metabolic rate. This increased metabolic rate produces a further increase in heat at the site of application and, also, an increase in the production of metabolities which are waste products produced as a result of cellular metabolism. The increased formation of metabolities causes an arterioler dilation which results in two effects. First, capillary blood flow is increased and second, capillary hydrostatic pressure is increased. Increased [illegible] is beneficial to the body in several ways. The increase in heat and metabolities is carried away from the site of application. Oxygen, nutrients, antibodies, and leukocytes are transported to the site of application which aids in the healing process. An increase in hydrostatic pressure may be an adverse effect in patients who tend to form edema easily. Excessive edema is not a desirable effect and measures must be taken to reduce edema caused by heat.

Relief of Pain. The preceding local physiological effects have been a result of an increase in the metabolic rate at the site of application. Analgesia, the relief of pain, is one local effect which may not be the direct result of an increase in local metabolic rate. The physiological reaction of analgesia at the site of application is not fully understood at this time; however, analgesia is probably the one local physiological effect for which heat will frequently be prescribed.

Precautions. As in all forms of treatment, there are precautions which should be observed when administering therapeutic heat. A normal reaction to the application of heat is an increased blood flow which results in a convective loss of heat from the area being treated. If the patient's vascular system is unable to respond adequately there is no convective transfer of heat by the blood from the skin surface. If this accumulation of heat happens, the patient will be burned by dosages which could normally be tolerated.

Distant Effects. As a result of local heating there are certain physiological effects which occur at some distance away from the site of heat application. These effects are known as distant or systemic effects. When heat is applied to one extremity, for example, the local physiological effects which occur at the site of application will also occur in the opposite extremity. This reflex response is called a consensual reaction. This consensual reaction, occurring in the opposite extremity, will be less pronounced and its intensity is dependent on the size of the area receiving heat at the site of application. The consensual effect is useful when heat cannot be applied directly to an area with impaired sensation.

Precautions. Some systemic effects may require precautionary measures to avoid injury to the patient. As a result of convective transfer of heat to the rest of the body, a general sedative effect is brought about. This reaction is not completely understood at this time. Precautions should be taken to insure that the patient will not be harmed should he fall asleep. Another systemic effect requiring precautionary measures is that of an increased cardiac output. This effect is slight; however, the patient with a heart condition or the very old can be injured by the increased demand placed on the heart.

Factors Determining Physiological Effects. With the application of heat, the previously mentioned physiological effects will occur. In determining the number and intensity of these effects, we must first understand some major factors. The level of tissue temperature is one major factor. It is important to note that the appropriate therapeutic range for tissue temperature is 104° to 113.9°F (40° to 45.5°C) and that the duration of this tissue temperature elevation is important in determining therapeutic value. The treatment duration is from 3 to 30 minutes in length depending on the type of modality used. Intensity of physiological effects, to a large extent, is determined by the rate of temperature rise in the tissues. Another major factor is the size of the site of heat application. The temperature of tissues in the site of application is greatly affected by the body's ability to disperse heat from the area. Tissue temperature is more intense as the size of the area being treated is increased.

CATEGORIES OF HEATING. All physical therapy heating modalities are placed in two categories--vigorous heat and mild heat. A general description of each category will be useful to the technician in determining which modality should be used.

Vigorous Heating. Vigorous heat is the most intense application of heat with the highest temperature being produced where the therapeutic response is needed. The tissue temperature is increased almost to the tolerance level which will be just under 113.9°F (45.5°C) to be effective. With this type of heat, the effective tissue temperature is maintained for a relatively long period of time. Normally, most treatments are 20 minutes in length; however, this period of time should not exceed 30 minutes to insure tissue damage does not occur. Tissue temperature is increased at a very rapid rate and in most cases takes approximately 5 minutes to reach the tolerance level. Vigorous heating is used mostly in treating chronic disease processes. This intense heating produces greater extensibility in fibrous tissues such as tendons, joint capsules, and scars. Vigorous heat is also used in the treatment of joint contractures and deep chronic inflammatory diseases. Marked increases in vascularity is produced with this heat and range of motion therapy is aided due to greater extensibility of the tissues. Vigorous heating is contraindicated in the presence of acute inflammatory processes. Applying vigorous heat to an acute inflammatory process may cause tissue necrosis by increasing the intensity of the already inflamed condition. An acute protruding intervertebral disc (ruptured disc) is an example of a contraindication. In this condition, added heat in an inflamed area and an increase in edema causing extra pressure on nerve roots may lead to undesirable effects.

Mild Heating. With mild heating a relatively low temperature is produced at the site of the pathological lesion. A higher temperature is produced in the superficial tissues as these tissues are closer to the source of heat and distant from the pathological lesion. The tissue temperature is increased at a slow rate and in most cases it takes approximately 10 minutes to increase the tissue temperature to an effective level. This effective tissue temperature is maintained for only a short period of time. Mild heating is used mostly for treating subacute disease processes such as sprains and strains (after first 24-48 hours) and also muscle spasm.

INDICATIONS. The relief of pain is probably the most common and frequent indication for therapeutic heat. This analgesic effect of heat is effective in relieving pain of superficial origin and also beneficial for relieving the pains of arthritis or muscular trauma. An increase in cutaneous blood flow is also an indication for heat. If there is good circulation the heat may be applied locally; however, if the site of application has impaired circulation a consensual reaction is required. With the use of either method the increased blood flow will promote the healing of wounds and ulcers due to an increased supply of oxygen and nutrients. Along with oxygen and nutrients special leukocytes known as phagocytes are transported to the site of heat application. The function of phagocytes is to engulf and destroy foreign particles and micro-organisms such as bacteria. This suppurative (pus-producing) process greatly accelerates the healing of infections. Although an increased blood flow has many beneficial effects, heat to the area may tend to aggravate the pain already present. This negative effect occurs when edema irritates sensitive nerve endings. It should be noted that this negative effect, in itself, does not contraindicate the use of heat. Another indication for heat is sedation. Heat can produce relaxation and sedation and may reduce the requirement for drugs.

CONTRAINDICATIONS. Contraindications must be observed and followed closely by the technician in preventing serious injury or producing undesirable effects to the patient. Impaired circulation or impaired sensation for pain or temperature are unobservable contraindications. If heat is applied to an area having impaired circulation, the skin may be burned and the deeper tissues severely damaged. If sensation is impaired and heat is to be applied, precautions must be taken. First, reduce the intensity of the heat below what is normally used. The area being heated must be visually inspected frequently and to be safe do not use shortwave or microwave diathermy when heating areas of impaired sensation since the patient's sensation must be relied on for tolerability of dosage. Noninflammatory edema is an undesirable effect of heat which is contraindicated. Local or remote heating aggravates edema and it is best not to use heat in the presence of noninflammatory edema unless there is a very strong indication for it. When applying heat, the technician should consider age as a contraindication in the young and [illegible] patient. Infants are not able to tolerate heat very well because their thermoregulatory mechanisms are not functioning adequately. It is difficult to evaluate the heat dosage due to a lack of communication between the technician and infant.

Children are also restless and usually will not lie still which makes it very difficult and dangerous to use shortwave and microwave diathermy and other heating devises. Elderly patients frequently have impaired circulation and sensation which are contra-indications for heat. Their cardiac and respiratory reserves may be reduced causing them to have a poor tolerance to more than minimal heating. During hot and humid weather it may be necessary to shorten the duration or lower the intensity of the heat treatment. A last contraindication for heat is the presence of embedded metals. Embedded metals may vary from large nails to small screws or metal wires. Shortwave and microwave diathermy should not be used if there are embedded metals in the area to be treated. Selective heating of these metals causes extreme temperatures in the surrounding tissues. This condition can lead to tissue damage. It should also be noted that metals lying on the skin in the area being treated will also be selectively heated resulting in thermal burns.

QUESTIONS

1. Four methods of heating are:

   a.

   b.

   c.

   d.

2. Heat transferred between two objects in contact with each other is termed heating by ____________________.

3. A whirlpool bath is an example of heating by ____________________.

4. The transformation of energy to heat in the deep layers of body tissue is heating by ____________________.

5. Heating by infrared rays is the transfer of heat by ____________________.

6. Infrared energy travels through space in the form of ____________ ____________.

7. Two types of physiological effects resulting from the application of heat are ____________________ and ____________________ effects.

8. The primary effect of local heating results in an increase in ____________________ at the ____________ ____ ____________.

9. An increase in tissue temperature results in an increase in ____________________ ____________________.

10. An increase in tissue temperature causes an increase in cellular waste products called ____________________.

11. Dilation of arterioles causes increased ______________ ______________ and ______________ ______________.

12. Increased circulation aids the healing process by transforming ______________, ______________, ______________, and ______________ to the site of application.

13. Increased hydrostatic pressure may cause severe ______________.

14. Heat will frequently be prescribed to achieve the desirable effect of ______________.

15. Poor vascular supply may result in ______________ at the site of application.

16. Effects occuring at some distance away from the site of application are ______________ effects.

17. A reflex response occuring at a site opposite that being treated is known as a ______________.

18. The ______________ effect causing a patient to fall asleep may result in damage to the patient.

19. Increased ______________ ______________ can be an adverse effect in the elderly.

20. Therapeutic range for tissue temperature is ______________ degree F. to ______________ degrees F.

21. Therapeutic range in terms of length of tissue temperature elevation is from ______________ to ______________ minutes.

22. Two categories of heating are:

a.

b.

23. Maximum safe tissue temperature is just under ______________ degrees F.

24. Tissue damage may result with an application of a maximum safe tissue temperature for longer than ______________ minutes.

25. Vigorous heating takes approximately ______ minutes to reach the tolerance level.

26. Vigorous heating produces greater extensibility in fibrous tissues such as _______, __________, and __________.

27. Vigorous heat is contraindicated in the presence of _________ _________ _________.

28. Mild heating in most cases takes approximately _____ minutes to reach an effective tissue temperature level.

29. Most subacute disease processes such as _________, _________, and _____________ _________ are treated with mild heat.

30. The relief of pain, an indication for heat, is called ________________________.

31. Special leukocytes called ____________ help fight infections which accelerates the healing process.

32. Caution should be taken to prevent ____________ occurring with an application of heat.

33. List five contraindications of heating:

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

34. Embedded metals may result in __________ __________ of the metal.

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INFRARED HEATING

General Characteristics

RADIANT ENERGY. Radiation is the process by which energy is propagated through space. Every substance with a temperature above absolute zero (-459°F) emits radiant energy in the form of heat radiation. When electrical or chemical forces of a suitable intensity are applied to various sources of matter, luminous and other forms of radiant energy are produced in the form of electromagnetic waves.

WAVE PROPAGATION. Radiant energy in the form of electromagnetic waves normally travels in straight lines and is subject to the following phenomenons.

1. Reflection. Rays are bounced back from the skin surface.

2. Deflection. Rays are bounced off the skin surface at an angle.

3. Absorption. Up to 95 percent of infrared radiant energy is absorbed by the skin tissues to a maximum of 3 millimeters.

ANGULATION OF RAYS. The patient receives the optimum radiation if the source of radiation is at right angles to the area being treated. This is known as Lambert's cosine law.

INTENSITY. Intensity of radiation varies with the distance between the heat source and the area treated. Increasing the distance decreases the intensity; and conversely, decreasing the distance increases intensity. In determining distance/intensity relationships, the Inverse Square Law is used. Intensity varies inversely with the square of the distance.

Sources of Infrared Radiation

NON-LUMINOUS INFRARED. Heated coils or carborundum filaments emit this low temperature radiation. Because of the long wavelength produced, it is sometimes called far infrared. Non-luminous infrared is seldom used due to the low temperatures produced.

LUMINOUS INFRARED. Incandescent bulbs of various strengths are used to produce this high temperature infrared. Luminous infrared is also called near infrared due to its short wavelengths. The two most commonly used luminous lamps are the 250 watt and 1000 watt intensities. Another type of infrared lamp that is used is the quartz infrared. See Figure 1.

Physiological Effects of Infrared

EFFECTS OF HEAT. Generally speaking the effects of heat will be the same regardless of the source. The key to understanding the body's reaction to heat is arranging the effects in the proper order and then looking for the relationship between the items.

1. Rise in temperature in the part being treated.

2. Increase in cellular metabolism.

3 Vasodilation with a resulting increase in circulation. It should be remembered that heat can be detrimental if circulation is not adjusted to meet the needs of the cell.

4. Stimulation of sweat glands due to activation of the hypothalamus which regulates ... temperature.

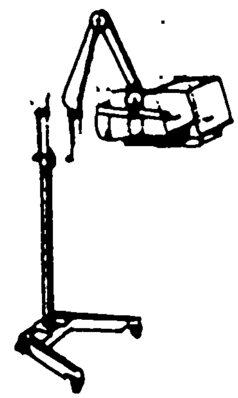

Figure 1. Quartz Infrared Lamp

5. Sedation of nerve endings resulting in relief of pain.

6. Relief of muscle spasm by increased blood supply and sedation of nerve endings.

Dangers of Excessive Heating. Excess heat can cause a counter irritation, wheal formation, local edema and if prolonged, a second degree burn.

Application of Infrared

ADVANTAGES OF INFRARED HEAT. Following are the main advantages for using infrared heat.

1. Permits observation of the area being treated.
2. Exerts no pressure on the part being treated.
3. Easy adjustment in intensity of heat.
4. Large areas can be treated.
5. Awkward positioning of patient does not restrict its use.
6. Ease of application and operation.
7. Although a superficial heat, elevation of temperature in deeper tissues may occur.
8. Heat at constant temperature is supplied to the area throughout the entire treatment.

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INDICATIONS FOR TREATMENT WITH INFRARED. The following are indications for infrared.

1. Preliminary to other treatments. Heat warms the tissues making them more supple for manipulation with massage, exercise, or electrical stimulation.

2. Traumatic and inflammatory conditions such as sprains, strains, contusions, synovitis, myositis, muscle spasm and dislocations.

3. Arthritic condictions.

CONTRAINDICATIONS FOR TREATMENT WITH INFRARED. The following contraindications are to be followed.

1. Areas of impaired skin sensation.

2. Areas of impaired or reduced circulation.

TECHNIQUE OF APPLICATION. Use the following technique when applying infrared.

1. Safety check the equipment. Plug, switch and element.

2. Warm up the lamp prior to treatment. Allow 10 minutes for the warm up when using far infrared or non-luminous lamps.

3. Observe the area to be treated and insure the patient has normal sensitivity.

4. Instruct the patient of treatment aims and type of feeling of warmth to expect.

5. Instruct the patient to report any uncomfortable feeling of heat.

6. Position patient properly.

7. Align lamp and adjust distance of lamp from the skin surface.

8. Set the timer for treatment duration, usually 20 minutes.

9. Check the patient during the treatment.

10. If giving a facial treatment, protect the eyes with either wet cotton balls or dark glasses.

11. Following the treatment, allow the patient sufficient time to cool off.

DOSAGE FACTORS. The length of an infrared treatment will remain constant with the application of any infrared lamp. In determining dosage, we need to consider two factors, intensity of the bulb and distance of the lamp from the skin surface.

TIME. Treatment time is usually 20 minutes.

DISTANCE. Start the treatment at the specified distances for the following infrared lamps.

1. 1000 watt lamp - 30 inches from skin.

2. 250 watt lamp - 15 inches from skin.

Inverse Square Law. When raising or lowering the lamp to adjust dosage, consider the inverse square law.

PRECAUTION. Hyperemia is a desired effect. If the intensity is too high, blotchy areas will appear against a background of hyperemia.

QUESTIONS

1. Infrared is a ____________ type energy.
2. Infrared travels in the form of ____.
3. Three factors affects infrared waves are: ____________ ____________ ____________ ____________.
4. ____________ mm is the maximum penetration of infrared in the skin tissues.
5. Define Lambert's cosine law.

6. Define the Inverse Square Law.

7. A low-temperature radiant heat is produced by a ____________ infrared lamp.
8. The lamp used most often in Physical Therapy is the ____________ infrared.
9. One adverse physiological effect which might occur with excess infrared is a ____________ ____________ ____________.
10. Infrared can be used as a preliminary treatment for ____________, ____________ and ____________ ____________.
11. Sprains, strains, myositis and muscle spasm are some ____________ ____________ treated with infrared heat.
12. The infrared lamp should be allowed to warm up _____ minutes prior to treatment.
13. Two contraindications for infrared are ____________________, and ____________ ____________.
14. Normal treatment time for infrared is _____ minutes.
15. Two factors which determine dosage are bulb ____________ and ____________ of the lamp to the ____________.
16. Two commonly used intensities are the ________ watt and ________ watt lamps.

17. When raising or lowering the lamp to adjust dosage, the ____________ ____________ ____________ should be considered.

18. The 1000 watt lamp should be spaced __________ inches from the skin.

19. The 250 watt lamp should be spaced __________ inches from the skin.

20. A desirable physiological effect with application of infrared is ______________.

21. ____________ ____________ will appear on the skin if the intensity of the heat is too high.

MOIST HEAT PACKS

Physiological Effects of Moist Heat

CLASSIFICATION OF PHYSIOLOGICAL EFFECTS. The physiological effects of moist heat are similar to those of other forms of local heat. Although much overlapping may be seen, we will identify the specific effects of moist heat. Physiological effects may be classified as either local or systemic.

Local Effects. These following effects occur in the area near the source of heat.

1. Local increase in tissue temperature.

2. Increase in local metabolic note.

3. Increase in local circulation.

   a. Arteriolar dilation.

   b. Increase in capillary blood flow.

   c. Increase in capillary hydrostatic pressure. It should be noted that an increase in hydrostatic pressure leads to an increased tendency to form edema.

4. Analgesia (Relief of pain).

5. Increase phagocytosis. A phagocyte is any cell that ingests micro-organisms or other cells and foreign particles.

Systemic Effects. The following systemic effects may occur.

1. Sedation.

2. Reflex vasodilation.

3. Increased cardiac output.

4. Increased pulmonary output.

Application of Moist Heat Packs

INOICATIONS. Following are indications for using moist heat packs.

- [illegible] to other treatment: i.e massage, exercise, and electrical stimulation.

2. Traumatic and inflammatory conditions. The following are listed:

a. Sprains and strains. However, moist heat should not be applied within the first 24-48 hours or with the presence of excessive edema.

b. Muscle spasm.

c. Dislocations.

d. Synovitis and myositis.

e. Contusions.

3. Arthritic conditions.

CONTRAINDICATIONS. The following contraindications for moist heat packs are given.

1. Areas of impaired circulation.

2. Areas of impaired sensation.

3. Areas where the weight of the pack would not be tolerated by the patient.

TECHNIQUE OF APPLICATION OF MOIST HEAT. It will be helpful to use the following technique when applying moist heat packs.

1. Have patient remove the clothing from the area to be treated. A visual inspection of the area is necessary to detect abnormalities on the skin surface such as burns, scar tissue, or open wounds.

2. Position and drape patient for treatment.

3. Select a pack from the hydrocollator unit, which has been sufficiently preheated. Packs which have been used require a minimum of 10 minutes in the hydrocollator unit to reheat properly.

4. There should be 6 to 8 thicknesses of bath towels between the patient and the pack. Commercially prepared covers may be used when available.

5. Apply the moist heat pack so the surface of the treated area is heated uniformily and the pack is secure.

6. Set a timer, allowing 20 minutes for treatment.

7. Put a call bell within the patient's reach or be within verbal calling distance. The patient should be checked for tolerance to the heat during the first 10 minutes.

8. Post treatment care.

a. Remove pack and replace in hydrocollator unit.

b. Wipe moisture from the area treated.

c. Allow the patient to cool, especially in the winter.

d. Clean and ready the treatment area for the next patient.

DISADVANTAGES. Following are some disadvantages of moist heat packs.

1. Area being treated is not visible.
2. Positioning pack may be awkward.
3. Weight of the pack may cause the patient some discomfort.

Moist Heat Equipment

HYDROCOLLATOR PACK. The hydrocollator pack is canvas covered and filled with a silica gel. It is the most common type of moist heat pack and is available in different sizes and shapes.

CERVICAL MOIST HEAT PACK. The cervical pack is a special hydrocollator pack designed to conform to the cervical area.

HYDROCOLLATOR UNIT. Hydrocollator packs are contained and heated to 170°F in this water filled cabinet. (See Figure 2). In most of the units the temperature of the water is thermostatically controlled.

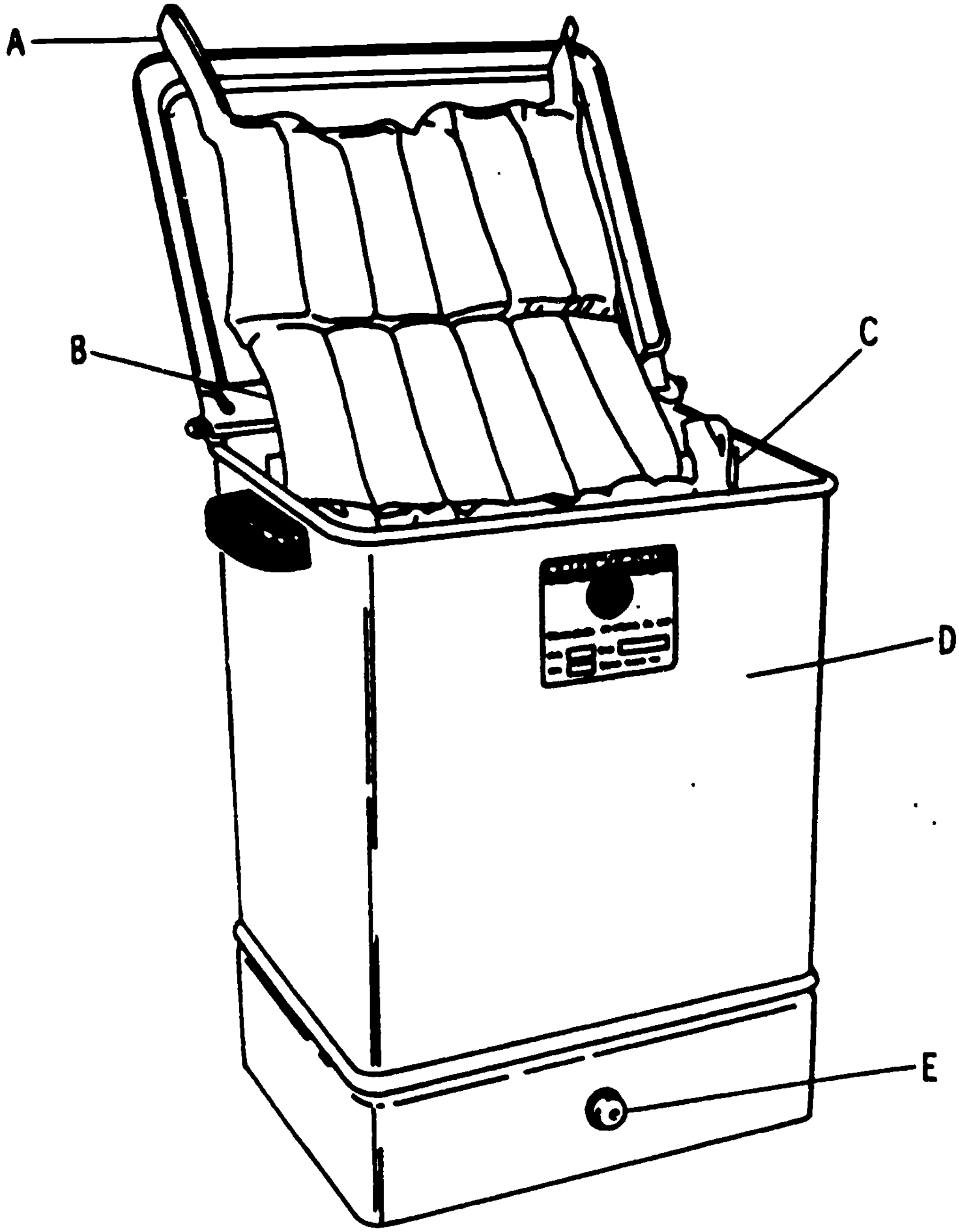

Figure 2. Hydrocollator Cabinet

QUESTIONS

1. List five indication for moist heat pack.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

2. The weight of a moist heat pack on the patient might be considered to be a _______.

3. Impaired ______________ and ______________ are contraindications.

4. The first step in applying a moist heat pack is removal of ________________ from the area.

5. Proper reheating of a moist heat pack requires at least ______ minutes.

6. Moist heat packs will be wrapped in ____________ thickness of towels.

7. Normal treatment time for a moist heat pack is ______ minutes.

8. Patients should be checked during the first _____ minutes of treatment to insure that tolerance to the heat is not exceeded.

9. Allow the patient sufficient time to ______________ before leaving the clinic.

10. List three disadvantages of moist heat packs.

    a. ______________________________

    b. ______________________________

    c. ______________________________

11. The ___________ ___________ ___________ is designed for treatment of the neck.

12. Hydrocollator packs are ______________ covered and filled with ________________ ______________ _____________.

13. The temperature maintained within the hydrocollator unit is _________ °F.

PARAFFIN BATH

General Characteristics

DESCRIPTION. Paraffin baths consist of melted paraffin wax and mineral oil, kept at a constant temperature, to provide heat to the elbows, forearms, hands, ankles and feet. (See Figure 3.).

MIXTURE. The paraffin bath contains seven parts paraffin wax to one part mineral oil. A correct mixture is determined by the end product which should be a soft pliable glove. More oil is needed in the mixture if the glove is too crisp. More wax is needed if the glove is too mushy.

TEMPERATURE. The temperature of most waxes that are not thinned with mineral oil are normally too hot for therapeutic use. When mineral oil is added to pa 'fin in a 1 to 7 ratio, the melting point is lowered to 125.6°F. The temperature of , bath solution is kept between 128° and 130°F. This temperature in water is scalding; however, it is tolerated well in a paraffin bath. Due to a difference in the density of the paraffin mixture, heat is transferred to the skin more slowly, allowing the circulatory system enough time to conduct heat away from the skin surface. Treatment with paraffin above 130° may be injurious to normal skin.

ADVANTAGES. The following are advantages of paraffin bath.

1. This local heat can be tolerated at temperatures higher than those produced by other heating modalities.

2. It leaves the skin pliable (mineral oil).

3. The part being treated can be elevated reducing the production of edema with the application of this heat.

4. The wax completely coats the part and provides a uniform heat.

DISADVANTAGES. The following disadvantages are associated with paraffin bath.

1. Treatment is limited to the distal extremities, i.e. hands, forearms, feet.

2. Wax cannot be applied over open lesions.

3. Some patients cannot tolerate the high heat of paraffin.

4. Paraffin treatments tend to be messy and the bath itself tends to collect dirt and debris from the skin.

INDICATIONS. Following are indications for using paraffin bath.

1. Any condition which will benefit from a superficial local heat.

2. Rheumatoid or Osteoarthritis. The very high temperature causes a decrease in pain within the joints.

3. Prior to exercise o assage.

4. Tenosynovitis. Inf. ation of a tendon and its sheath may be treated successfully with paraffin, especially when the condition affects the wrists or ankles.

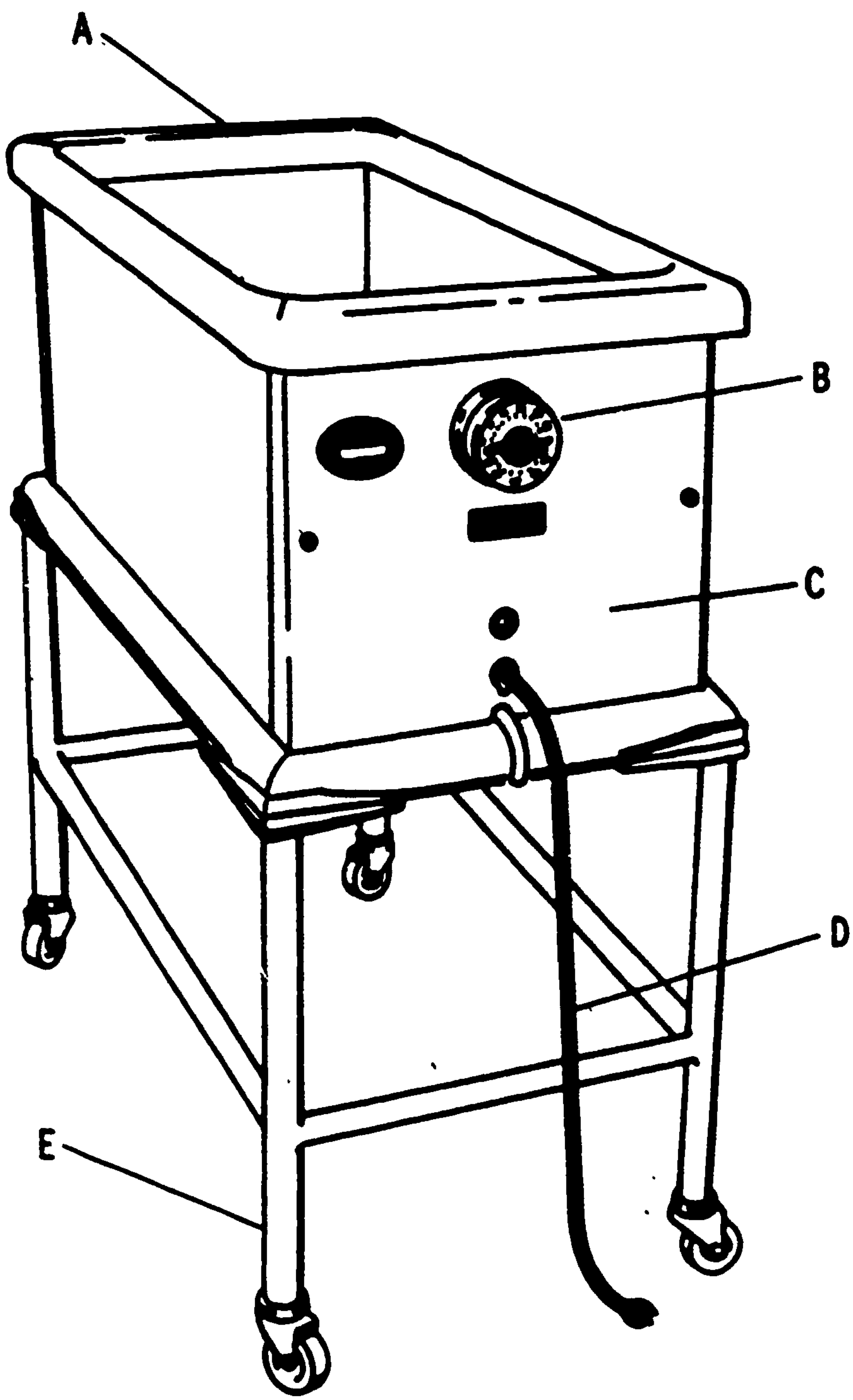

Figure 3. Paraffin Bath

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CONTRAINDICATIONS. The following are contraindications for using paraffin bath.

1. Paraffin cannot be applied over open lesions.

2. Paraffin cannot be applied over rings or any jewelry.

3. Paraffin should not be applied in certain skin conditions.

PHYSIOLOGICAL EFFECTS. These will be the same as those from other methods of therapeutic heat.

Application of Paraffin Bath

PRINCIPLES OF APPLICATION. The following principles are to be followed:

1. Check the temperature of the bath at the beginning of each day.

2. Check the temperature prior to each treatment.

3. Have the patient wash the part prior to treatment.

4. Check the part for lesions and jewelry.

5. Have all necessary equipment close at hand.

6. Properly drape the patient to protect clothing.

7. Choose the method of application.

METHODS OF APPLICATION. Choose one of the two following methods for applying paraffin wax.

1. DIP and WRAP

a. The part to be treated is dipped in the paraffin 8 to 10 times.

b. Allow to harden between dips (10-15 seconds).

c. After the appropriate number of coats have been applied, wrap the part with either a plastic bag or paper towels and over this, wrap the part in a turkish towel. Commercially available gloves are sometimes used in place of the turkish towel.

d. Instruct the patient to be seated and set a timer for 20 minutes.

2. IMMERSION

a. The part to be treated is dipped 8 to 10 times.

b. After the appropriate number of coats have been applied, have the patient immerse the part in the bath and leave it there for the treatment period of 20 minutes. If the heat becomes uncomfortable, the patient may temporarily remove the part being treated from the paraffin bath.

QUESTIONS

1. Paraffin baths consist of ____________ and ____________ ________.

2. The mixture ratio of a paraffin bath is _____ parts paraffin to _____ part mineral oil.

3. The melting point of the wax-oil mixture is ________°F.

4. Temperatures in the bath are kept between ________° and ________°F.

5. Temperatures above ________°F can result in burns.

6. List two advantages of paraffin baths:

   a. ______________________________

   b. ______________________________

7. List two disadvantages of paraffin bath:

   a. ______________________________

   b. ______________________________

8. List two indications for paraffin baths:

   a. ______________________________

   b. ______________________________

9. Jewelry and open lesions are ______________ for paraffin bath.

10. Two methods of application are:

    a. ______________________________

    b. ______________________________

11. Treatment time for both methods is __________ minutes.

12. To prevent collection of dirt and debris in the bath, the patient should _______ the part prior to treatment.

WHIRPOOL

Basic Terms

HYDROTHERAPY. The use of water in any of its three forms: ice, liquid, and steam or vapor for therapeutic purposes.

WHIRLPOOL BATH. A vessel in which water at a given temperature is kept in constant agitation and which permits immersion of an extremity. (See Figures 4, 5 and 6.)

HUBBARD TANK. A modified T-shaped or butterfly shaped vessel which permits immersion of the entire body into water which is in constant agitation. (See Figure 7.)

THERAPEUTIC POOL. A pool of heated water of sufficient size and depth to permit exercises and gait training using the bouyancy of water.

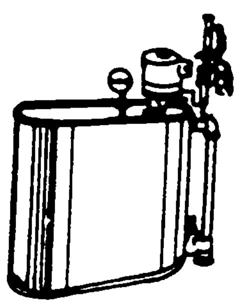

Figure 4. Leg Whirlpool

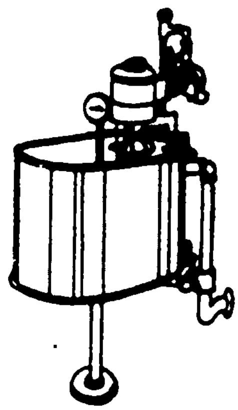

Figure 5. Arm Whirlpool

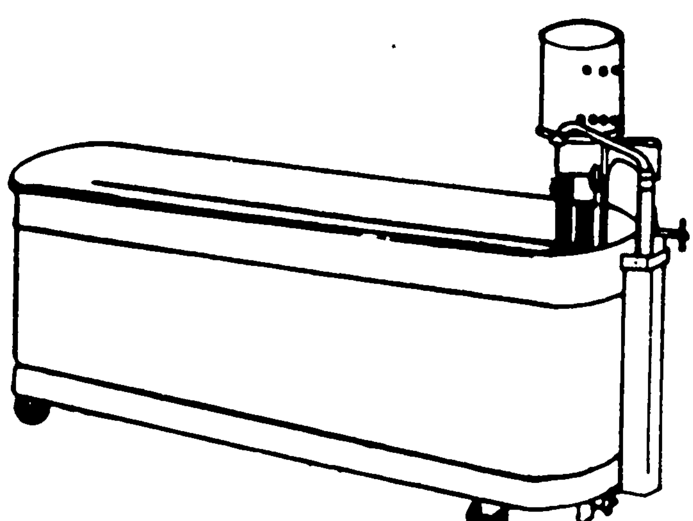

Figure 6. Lo Boy or Low and Long Whirlpool

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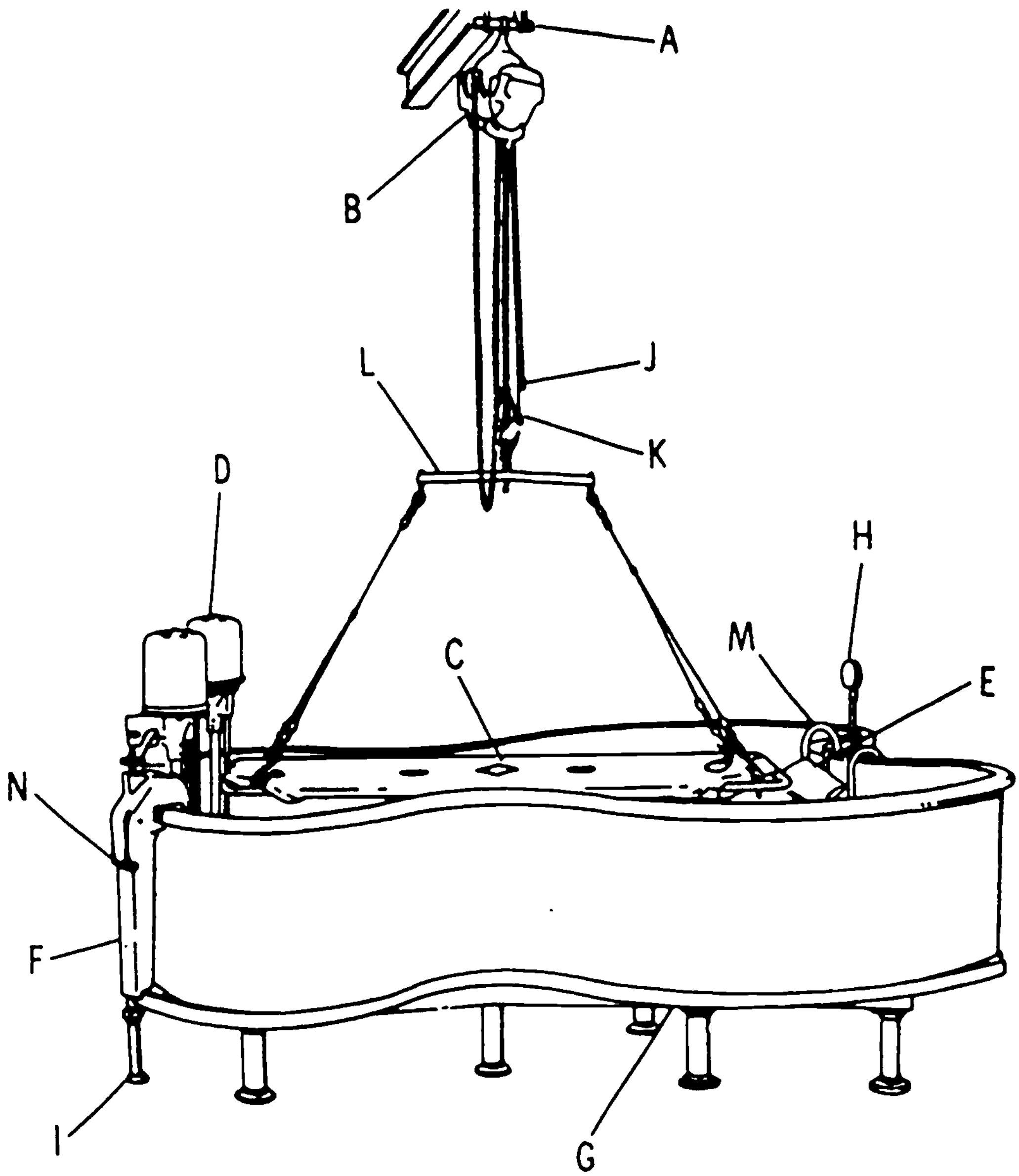

Figure 7. Hubbard Tank

General Characteristics

PHYSIOLOGICAL EFFECTS. Heated water produces all the physiological effects that most other superficial or local heat applications produce.

1. Circulation

   a. General peripheral vasodilation

   b. Lymph circulation and drainage increased

   c. Cardiac output and pulse rate increased.

2. Body temperature increased

3. Respiration increased

4. Metabolism increased

5. Profuse perspiration

6. Muscle relaxation

7. Sedation of nerve endings

THERAPEUTIC USES. Following are some therapeutic uses for whirlpool.

1. Heating. The constant temperature and uniform coverage provide an excellent superficial heat. Large areas of the body can be treated with this modality.

2. Massage. Body tissues are compressed and massaged by the action of the moving water.

3. Debridement. Burns and open wounds are cleansed by the agitation of the whirlpool bath. A bactericidal agent is normally added to the bath.

4. Heat/Cold. Contrast baths for increased circulation.

5. Buoyancy. Aids in exercise routines, especially ambulation and range of motion exercises.

INDICATIONS. The following are indications for using whirlpool.

1. Arthritis or Arthralgia. Generalized with multiple joint involvement.

2. Joint Stiffness. Post casting frequently require whirlpool in regaining range of motion.

3. Traumatic and Inflammatory Conditions. Sprains, strains and contusions, myalgia, neuritis and tenosynovitis.

4. Muscle Spasm and Spasticity.

5. Skin Care. Post casting and debridement of burns and open wounds.

6. Preliminary Treatment. Prior to administering exercise, massage, or electrical stimulation.

CONTRAINDICATIONS. The following contraindications are to be observed.

1. Advanced Cardiac Conditions. Strain on the circulatory system could result.

2. Hyperthyroidism. A currently high metabolism is further increased.

TEMPERATURE RANGES. The following temperature ranges are to be observed when administering whirlpool.

1. Leg and Arm Whirlpool, (100° - 110°F). These temperatures are subject to change due to the patient's disability and sensitivity and also the physical therapist's preference.

2. Hubbard Tank, (90° - 100°F). These temperatures are based on the same factors as for whirlpools. The "Sitz Bath" is maintained at approximately the same temperatures as the Hubbard Tank.

COMPONENTS OF A TYPICAL WHIRLPOOL UNIT. Most whirlpool units have the following components. (See Figure 8.)

1. Tank. The stainless steel vessel holding the water.

2. Turbine or Aerator. The electric motor with an attached water pump which mixes air and water to give the massaging effect to the patient. Most turbines or aerators will have two valves controlling air and water flow.

a. AERATOR VALVE. This valve regulates the air mixed with the water.

b. WATER CONTROL VALVE. Regulation of the flow of water by increasing or decreasing the hydromassage effect is performed by this valve.

3. Temperature Gage. All tanks should be equipped with a temperature gage to measure the water temperature within the tank.

4. Mixture Control Valve. Most tanks are equipped with this valve which regulates the temperature of water as it enters the tank. The more expensive models may also have a temperature gage attached to the mixture control valve such as some Hubbard tanks. This feature allows for exact temperature control.

Application of Whirlpool

TECHNIQUES. The following techniques for administering whirlpool are to be observed.

1. Fill the tank to the desired depth and temperature. Do not leave a filling whirlpool unattended. Carefully measure any bactericidal agent. High sudsing action may result if too much is added to the whirlpool.

2. Instruct patient in the treatment procedures.

3. Have the patient remove sufficient clothes. For certain treatments, it may be necessary for the patient to make provision for wearing a swimming suit.

4. Position the patient for treatment making sure that the edge of the tank is padded whenever the skin comes in contact with it.

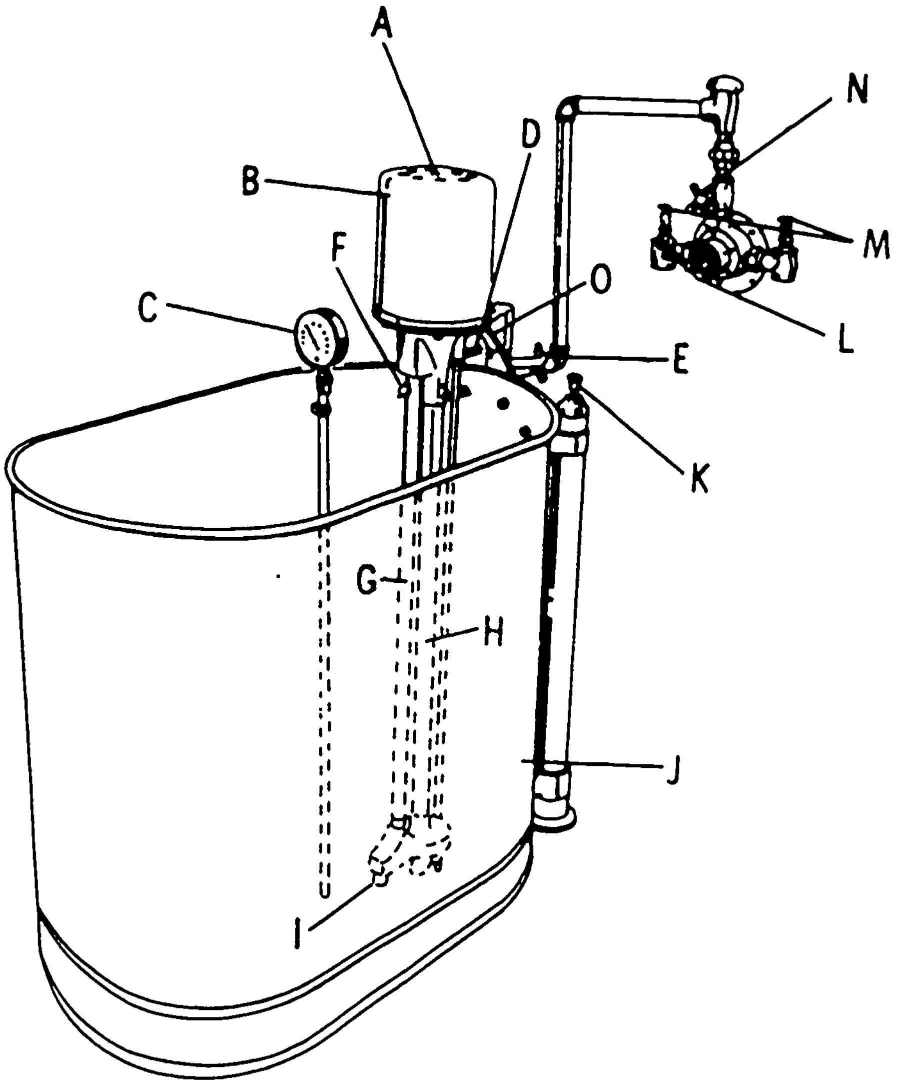

Figure 8. Whirlpool Components

5. Instruct the patient about the hazards of the agitator, on and off switch, and water motion. The patient should not be allowed to turn on or turn off the agitator. In certain situations, it may be wise to use a safety strap on the patient due to the sedative effect. Insure that all dressings are removed from bath prior to starting the turbines.

6. Check on the patient frequently during treatment.

7. Assist the patient after treatment.

8. Drain and clean the whirlpool after each patient, using proper cleaning and sterilizing techniques.

ASCEPTIC PROCEDURES. The following asceptic procedures are to be observed.

1. Dispose of all bandages, dressings, and waste material in proper containers.

2. Cultures. Cultures should be performed at least once a week on each tank. More frequent cultures may be necessary if open wound or burn patients are being treated.

3. Sterile Equipment. Burn packs, sterile sheets, towels, dressings and other sterile materials are often used. Proper handling and disposition of these items is necessary.

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QUESTIONS

1. The use of water for therapeutic purposes is termed ______________.

2. List three modalities of hydrotherapy.

   a. ______________

   b. ______________

   c. ______________

3. Immersion of an extremity is permitted in a ________ ________ while full body immersion is accomplished in a ________ ________.

4. Whirlpool provides what type of heat?

5. List five physiological effects of whirlpool.

   a. ______________

   b. ______________

   c. ______________

   d. ______________

   e. ______________

6. List three reasons for administering whirlpool.

   a. ______________

   b. ______________

   c. ______________

7. Cleaning of open wounds and burns is termed ______________

8. Agitation of water provides a ______________ effect on the body tissues.

9. Whirlpool is frequently given to post casting patients for ________ ________ and ________ ________.

10. Whirlpool may be administered prior to ________, ________, or ________ ________.

11. List two contraindications for whirlpool.

   a. ______________

   b. ______________

12. Leg and arm whirlpool temperature ranges from ______°F to ______°F, while a Hubbard tank or sitz bath ranges from ______°F to ______°F.

13. Temperatures of whirlpools are subject to the patients __________, __________, and also the physical therapist's preference.

14. List four component parts that most whirlpool units have.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

15. Air flow in a turbine is controlled by the __________ __________.

16. Water flow in a turbine is controlled by the __________ __________ __________.

17. With most tanks the temperature of the water entering the tank is regulated by the __________ __________ __________.

18. Never let a patient handle the __________ due to the potential electrical hazard.

19. A safety strap maybe required due to a __________ __________.

20. The turbines may become clogged if __________ are not removed from the bath prior to starting the turbines.

21. Cultures should be taken at least once a ________.

MICROWAVE DIATHERMY

Characteristics

DESCRIPTION. Microwave Diathermy (MWD) is the therapeutic application of radar waves in the form of electromagnetic radiation. The electromagnetic current produced by a microwave diathermy machine is similar to the waves produced by a radar station. The waves produced by the microwave diathermy travel through space; when they enter the body they are converted to heat by the resistance offered by the body tissues. A MWD machine is shown in Figure 9. The following features of microwaves should be noted.

1. Although penetration is limited, MWD is classed as a deep form of heat.

2. Microwaves are in the form of electromagnetic radiation.

3. Microwaves travel at the speed of light and can be propagated through a vacuum.

4. Microwaves can be reflected, scattered, refracted, or absorbed. Absorbtion and reflection of microwaves is affected greatly by the density of the material being exposed and the frequency and power intensity.

Equipment

CIRCUITRY. There are three basic components of circuitry which are common to all microwave diathermy machines; power supply, magnetron, and the antenna.

1. Power Supply. The power supply changes the alternating wall current to a direct current. This rectified high voltage current is then applied to the magnetron tube. The rectified voltage applied to the magnetron is regulated by a variable transformer.

2. Magnetron. This is a special tube which transforms the rectified voltage into high frequency oscillations. The frequency of the oscillations is controlled by the Federal Communications Commission. Only one frequency is allowed for microwave diathermy operation, 2450 megahertz with a wavelength of 12.2 centimeters.

3. Antenna. The antenna apparatus consists of an adjustable arm(s), coaxial cable(s), and an applicator (director).

a. Coaxial Cable. High frequency oscillations are transferred from the magnetron to the applicator through the heavily insulated cable.

b. Applicator. Four applicators are commercially available. Applicators are sometimes referred to as directors "A," "B," "C," and "E." (See Figure 10.)

(1) "A" Director. The "A" director is round with a diameter of about 4 inches. The beam of radiation from the "A" director is shaped like a ring with the intensity in the center of ring being half the value of the intensity of the outer aspects of the ring.

(2) "B" Director. This director is similar in shape and pattern of radiation. The difference is in size. The "B" director has a diameter of about 6 inches.

(3) "C" Director. The "C" director is almost square and measures about 4-1/2 inches by 5 inches. The beam of radiation is oval shaped with the maximum intensity being in the center of the field.

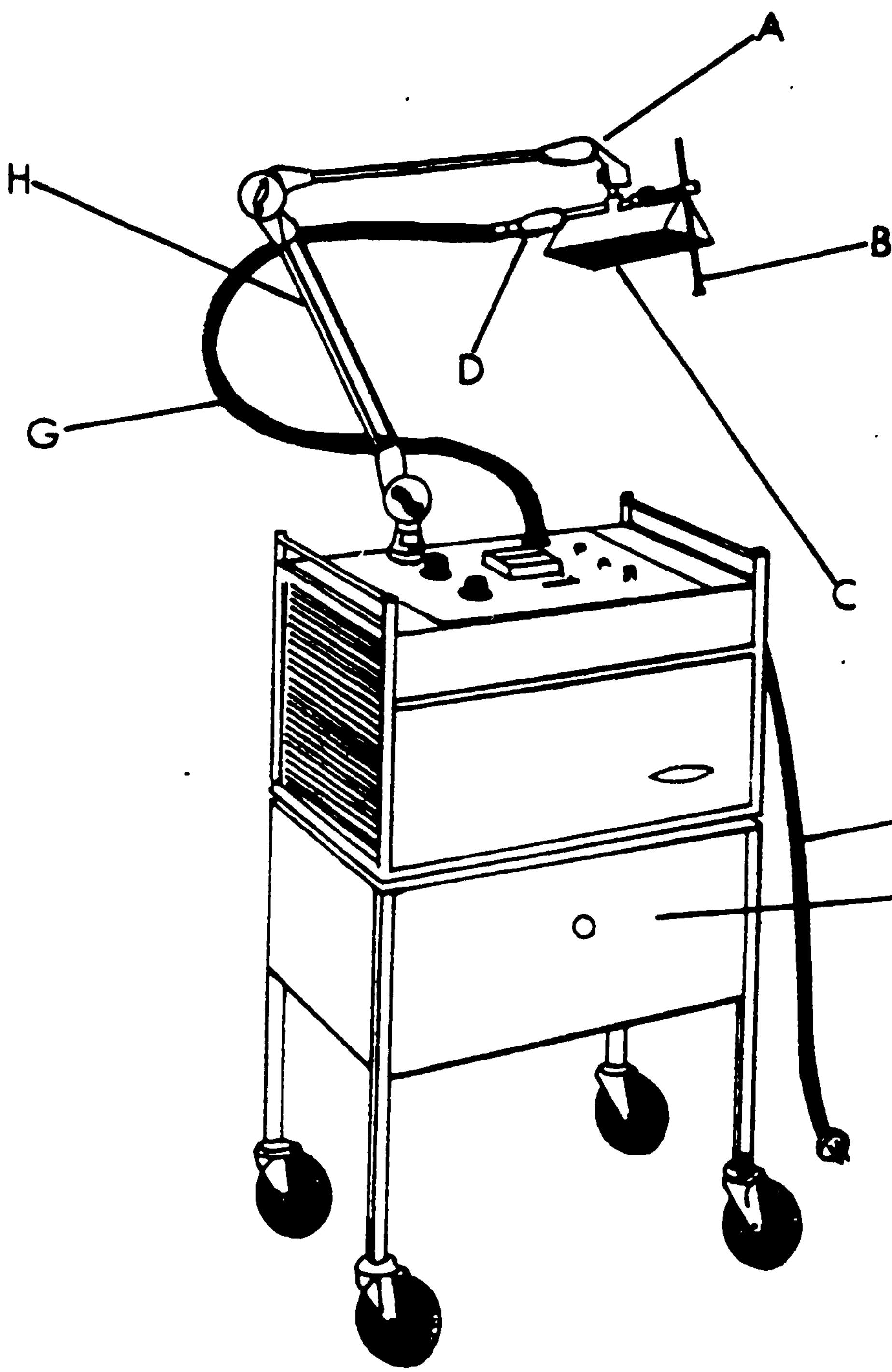

Figure 9. Microwave Diathermy Machine

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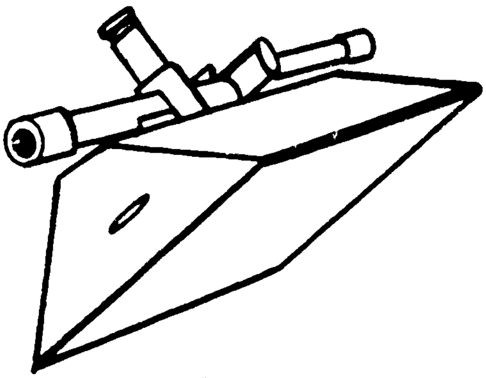
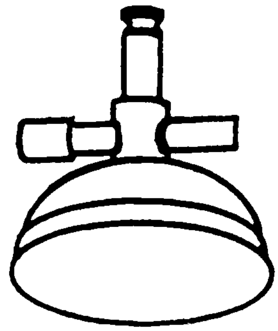


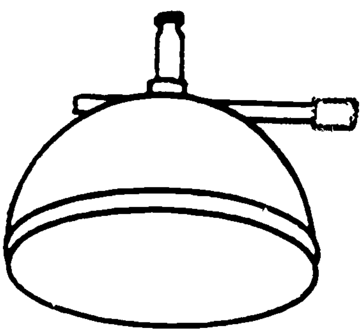
E DIRECTOR



A DIRECTOR

DIRECTORS

B DIRECTOR



C DIRECTOR

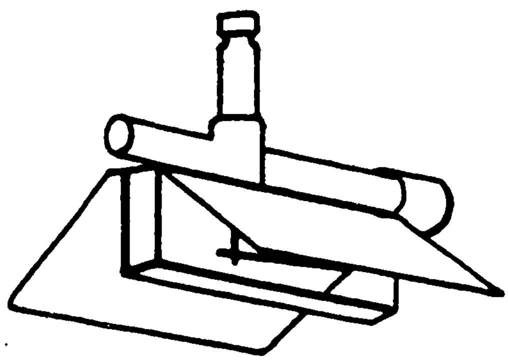


Figure 10

(4). "E" Director. This director is rectangular in shape measuring about 5-3/4 inches by 7 inches. The beam of radiation is similar to that of the "C" director although much larger.

4. Panel. The panel consists of an intensity indicator, intensity control dial, and three lights which indicates when the machine is ready for operation. (See Figure 11.)

a. Red Light. When the red light is glowing it indicates that the main power switch is turned on and the power is being supplied to the machine.

b. Amber Light. When this light glows, the machine is ready for operation. The machine has warmed-up.

c. White Light. When the white light glows, a safety switch is closed so that power may be supplied to the magnetron. If the therapeutic application is interrupted, a safety switch will open and the power to the magnetron will stop. This is indicated on the panel when the white light is extinguished. To restart the power, the power control dial has to be returned to zero and then increased to the desired setting.

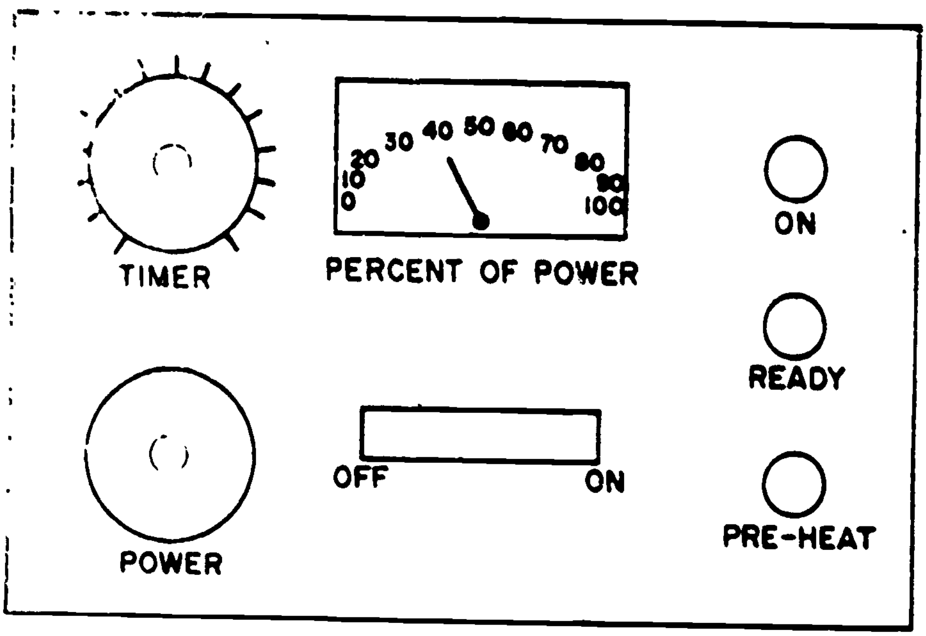


Figure 11. Microwave Diathermy Control Panel

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Dosimetry

MEASUREMENT. It is impossible to measure the amount of energy entering the patient's tissues. This information is not given by the meter on the panel of the machine. The meter only indicates the amount of power the machine is producing. There are two guidelines for determining dosage.

1. On each of the four directors the recommended treatment distance and power output is given.

2. The second way for determining dosimetry is guided by the feeling of warmth the patient has.

   a. High Dose. The patient's feeling of warmth goes up to tolerance.

   b. Medium Dose. The patient feels confortably warm.

   c. Minimal Dose. The patient feels only a slightly warm sensation.

Unrealistic Guidelines. These two guidelines for dosimetry are unrealistic because they depend on intact sensation and alertness on the part of the patient.

Physiological Effects of Microwave Diathermy

LOCAL AND SYSTEMIC EFFECTS. Most, if not all of the therapeutically desirable physiological effects which occur as a result of microwave diathermy application are due to heating. Some local and systemic effects will occur as a result of this heating.

1. Local Effects

   a. Increase in tissue temperature

   b. Increase in blood flow

   c. Increase in tissue metabolism

   d. Increase clearing of metabolites and heat

   e. Increase in supply of oxygen, nutrients, antibodies, and leukocytes.

   f. Increased phagocytosis

   g. Analgesia

2. Systemic Effects

   a. General sedation

   b. Increased pulmonary ventilation

Application of Microwave Diathermy

INDICATIONS. The depth of heating in muscle tissues by 2450 megahertz microwave diathermy is poor beyond the depth of 1 centimeter. In most applications the highest tissue temperatures will be in the subcutaneous tissues or sometimes in the more superficial musculature. A large amount of microwave energy may be reflected at the interfaces between the subcutaneous fat and muscle tissue and this results in a large amount of microwave energy being converted to heat at this point. At the skin's surface it is possible to lose, by reflection more than 50 percent of the energy irradiated from the director during therapeutic application. Heating of deeper tissues, in most situations, is not adequately achieved with microwave due to these factors. It is easy to see that vigorous heating of joints cannot be achieved with microwave diathermy if the joint is covered with thick layers of soft tissue. For this reason, MWD cannot heat the hip joint to any degree of therapeutic significance and is less effective than ultrasound in treatment of the shoulder joint. Microwave diathermy is indicated for treatment of the following.

1. Since microwave has relatively poor depth of penetration, it is frequently used in subacute or subchronic processes which respond to a mild type of heating and the associated reflex effects.

2. The following musculoskeletal conditions:

a. Joint diseases ranging from degenerative joint disease (DJD) to rheumatoid arthritis (RA).

b. Calcific bursitis.

c. Tendinitis

d. Periarthritis of the shoulder

e. Sprains, especially if they are located in superficial tissues.

3. The following superficial inflammatory reactions.

a. Furuncles (Boils).

b. Axillary sweat gland abscesses.

c. Tenosynovitis.

4. If mild heating is indicated, microwave diathermy is an effective heat modality.

CONTRAINDICATIONS. The following contraindications are to be observed.

1. Sensory Impairment. Ca. on should be exercised where sensation is not normal.

2. Debilitated Patients. ; ase patients are not fully alert at all times.

3. Metal Implants or Edematous Tissue. Selective heating may occur resulting in tissue necrosis. Microwave should not be used in the presence of metal implants such as pins, nails, screws, and wires.

4. Exposure to the Eye. Direct exposure to the eyes should be avoided. The thermal effects are cummulative in nature and may lead to cataract formation.

5. Ischemic Areas. These are areas of impaired circulation. Application of microwave will cause an increased metabolic demand which may not be satisfied by the vascular system resulting in pain and tissue necrosis.

6. Cardiac Pacemakers. Never apply microwave diathermy to the area containing the pacemaker or its electric wires.

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7. Its not advisable to apply microwave to the following:

a. Malignancies

b. Thrombophlebitis

c. Patients with a predisposition to hemorrhagic disease (hemorrhagic diathesis)

d. Bony prominences. Reflection may cause an uncontrolled increase in temperature resulting in "hot spots."

e. General contraindications for heat.

PRECAUTIONS. When using any of the four available directors for applying microwave diathermy, the following special precautions must be followed.

1. Expose the Treatment Area.

a. No clothing of any type.

b. No bandages or dressings.

c. No surgical or adhesive tape.

2. Metal Objects Removed.

a. Jewelry. (Watches, rings, necklaces, earrings.)

b. Snaps, hooks, stays, and coins.

3. Sweat Beads. When there is an accumulation of moisture in the area being treated, the problem of selective heating may occur. Wiping the moisture from the area will prevent the small surface burns which can result from selective heating.

TECHNIQUE OF APPLICATION. One of the main advantages of microwave diathermy is that it is easily applied. The technique of application is about as simple as shining a luminous light on the area to be treated. The technique for applying microwave diathermy is determined by the area to be treated and the selection of one of the four available directors. Use the following techniques.

1. When treating joints, a multiple field method of application should be used which will expose the joint from all sides.

2. When a mild heat application is desired, the output of the machine may be reduced or the distance between the director and the skin may be increased.

3. For a larger area to be treated the distance between the director and the skin may be increased. If this is done, the output of the machine will have to be increased to maintain the desired intensity.

STEPS OF APPLICATION. The following steps should be followed when operating a microwave diathermy machine.

1. Turn the main power switch on after the line cord is plugged into the wall outlet.

2. Select and position the director over the area to be treated.

3. After the amber light is glowing, the following steps are to be taken.

   a. Turn the timer to the required setting. Normally, the treatment time is 20 minutes.

   b. Turn the power-output knobs counter-clockwise until the white glow light turns on. This action resets the machine and closes the safety switch.

   c. Turn the power output knob clockwise until the needle on the power meter on the panel is to the required output.

4. Check the patient periodically for comfort and safety.

QUESTIONS

1. Therapeutic application of radar waves is termed ____________ ______________.

2. Microwaves are emitted in the form of ______________________________.

3. Microwave diathermy is considered to be a ________________ heat even though penetration is limited.

4. Describe two factors affecting absorption and reflexion of microwaves.

   a. ____

   b. ____

5. List the three basic components of circuity in the microwave diathermy machine.

   a. ____

   b. ____

   c. ____

6. High frequency ____________ are generated in the ___________ ___________.

7. Wall current (A.C.) is changed to direct current in the __________ __________.

8. Three parts which make up the antenna are:

   a. ____

   b. ____

   c. ____

9. How many applicators (directors) are commercially available? ____________

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10. The smallest director is the _________ while the largest is the _________.

11. What is the main difference between the "A" and the "B" directors? ____________

12. Which light on the panel indicates the machine has warmed-up? ______________

13. Which light on the panel indicates that power is being supplied to the magnetron?

____

14. If the treatment is interrupted, a ____________ __________ ___ opens to stop power to the ____________ ____________.

15. Describe two guidelines for measuring dosimetry.

a. ____

b. ____

16. Why are the dosimetry guidelines unrealistic? ______________________________

____

____

17. Most of the desirable physiological effects of MWD are due to ____________ of the tissues.

18. Penetration of microwave energy is poor beyond ______ centimeters.

19. The highest temperatures are achieved in the ____________ ____________ or in the ____________ ____________.

20. It is possible to lose more than ______ percent of the energy emitted from the director at the skin's surface.

21. Large amounts of microwave energy are ____________ at the skin surface.

22. List two joints where microwave is ineffective due to tissue interference.

a. ____

b. ____

23. Microwave is effective in treating ____________ and ____________ processes where mild heating is indicated.

24. List six specific indications for MWD.

    a. ____

    b. ____

    c. ____

    d. ____

    e. ____

    f. ____

25. List six general contraindications for MWD.

    a. ____

    b. ____

    c. ____

    d. ____

    e. ____

    f. ____

26. Constant exposure to the eye may result in ____ formation.

27. Microwave should never be applied over ____ objects.

28. Sweat beads may result in ____ ____ ____ due to ____ ____.

29. A multiple field application should be used when treating ____.

30. Two methods of reducing the amount of heat to be applied are:

    a. ____

    b. ____

31. Larger areas can be treated by ____ the distance of the ____ from the skin.

32. Treatment time is normally ____ minutes.

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SHORTWAVE DIATHERMY

Characteristics

DESCRIPTION. Shortwave diathermy (SWD) is the therapeutic application of high frequency currents. The energy of the shortwave diathermy is transferred into the deeper layers of tissue by the high frequency currents where it is converted into heat. A shortwave diathermy machine is shown in Figure 12.

Equipment

CIRCUITRY. Not all shortwave diathermy machines are exactly the same due to manufacturers modifications. There are three basic components of circuitry which are common to all shortwave diathermy machines; the power supply, oscillating circuit, and patient circuit.

1. POWER SUPPLY. It is in this circuit that the 110 volt, 60 hertz, alternating current is transformed into a high voltage direct current for the plates of the oscillator tubes and a low voltage alternating current which lights the filaments of the oscillator tubes.

2. OSCILLATING CIRCUIT. This circuit produces the high frequency oscillations. The frequency of the oscillating circuit is controlled by the Federal Communications Commission. Three frequencies are allowed for shortwave diathermy operations.

a. 13.66 megahertz with a wavelength of 22 meters.

b. 27.33 megahertz with a wavelength of 11 meters.

c. 40.98 megahertz with a wavelength of 7.5 meters.

Most commercially available shortwave diathermy machines operates at a frequency of 27.33 megahertz with a wavelength of 11 meters.

3. PATIENT CIRCUIT. This circuit contains electronic apparatus and electrodes which conducts the high frequency oscillations from the oscillator circuit to the patient. Within the patient circuit is a tuning device which is used to bring the patient circuit into tune or resonance with the frequency of the oscillator circuit.

The following considerations apply to the patient circuit.

a. Every person has a certain amount of electrical impedance.

b. When a patient is put into the patient circuit, the patients' electrical impedance become part of the impedance of the entire circuit.

c. For a therapeutic application of shortwave diathermy, it is necessary to "tune" the machine after the patient is put into the patient circuit. This "tuning" procedure makes the frequency of the patient circuit equal to the frequency of the oscillating circuit.

d. Tuning is done by adjusting a variable capacitor which is controlled by the "tuning knob" on the panel.

e. The power meter on the panel of the machine will indicate maximal flow of current when the patient circuit and oscillating circuit are in resonance (tuned).

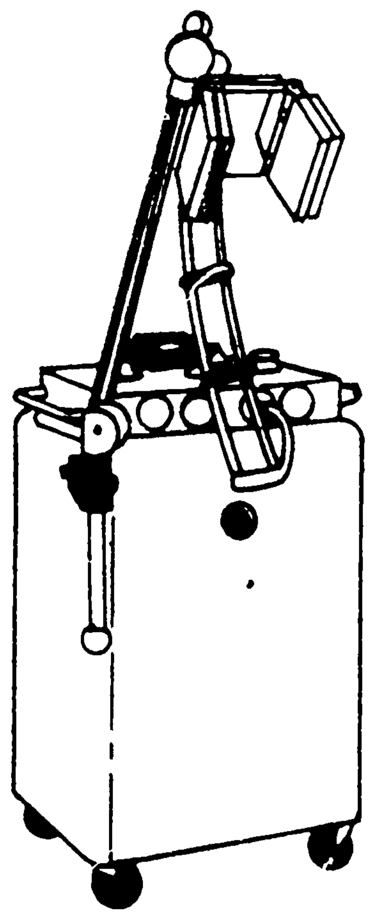

Figure 12 Shortwave Diathermy Machine

f. Some machines don't require tuning because there is an automatic tuning device on the machine. This has been designed so the patient's electrical impedance has very little affect on the impedance of the patient circuit.

g. The current flow through the patient circuit can be regulated after the patient circuit and oscillating circuit are in tune. This is done by varying the coupling of a coil of the patient circuit with another coil of the oscillating circuit. The "output knob" on the panel controls this. (See Figure 13.)

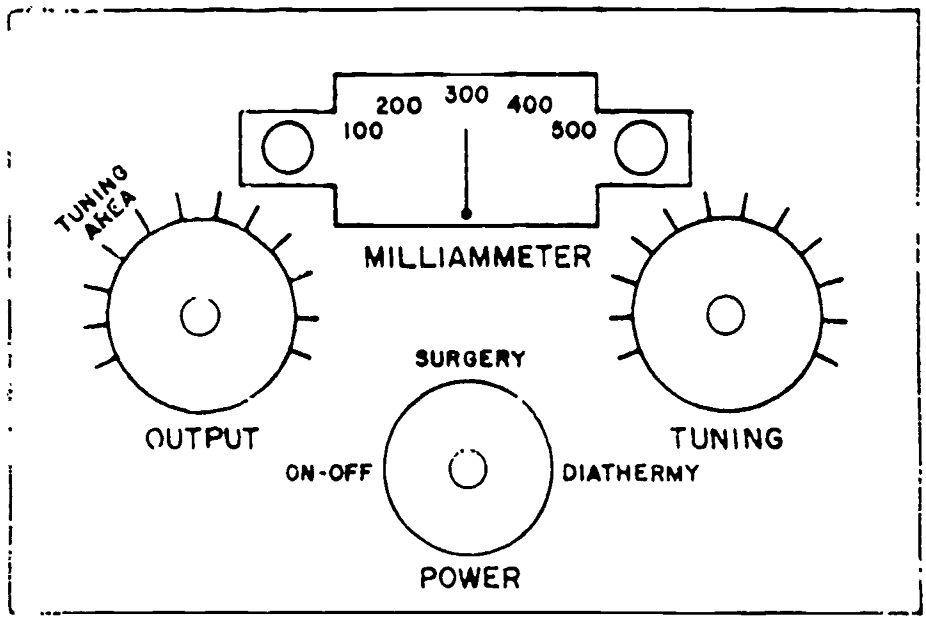

Figure 13. Short Wave Diathermy Control Panel

Dosimetry

MEASUREMENT. It is not possible to measure the high frequency current flow through the body of the patient. The information given to us by the meter on the control panel only indicates the amount of current leaving the machine. When applying shortwave, the dosimetry is guided by the feeling of warmth the patient has. Three guidelines are given.

1. High Dose. The patient's feeling of warmth goes up to tolerance.

2. Medium Dose. The patient feels comfortably warm.

3. Minimal Dose. The patient feels slight warmth.

These guidelines for dosimetry are unreliable because they depend on intact sensation and alertness on the part of the patient.

Application of Shortwave Diathermy

TECHNIQUES. There are two techniques of application for shortwave diathermy. Each of these techniques has some modifications.

1. Condenser Technique. When using this technique, the part to be treated is placed between two condenser plates. Four modifications to the condenser technique are available.

a. Space Plates. Condenser plates are enclosed in a rigid plastic material. Proper spacing between the skin and the condenser plate is maintained by an adjustable plastic ring. (See Figure 14.)

b. Glass Envelope. A glass envelope encloses the condenser plates. The position of the condenser plate inside the glass envelope is adjustable which permits proper spacing between the skin and the condenser plates.

c. Condenser Pad. Some condenser plates are enclosed in rubber or pliable plastic, permitting flexibility. These are called condenser pads and proper spacing is maintained by a 1 or 2 inch layer of terry cloth (bath towel). (See Figure 15.)

d. Internal Metal Electrodes. These are inserted into the vagina or rectum and a large belt-like electrode is placed over the abdomen. This technique is seldom used.

2. Induction Coil Technique. When using this technique, the part to be treated is covered by the induction coil. Three modifications to this technique are used.

a. Drum. The induction coil is enclosed in a plastic container. Three containers or sections are hinged together permitting the unit to be molded to the body. This three part unit is often called a "drum." Proper spacing between the skin and the induction coil is maintained by the plastic container enclosing the induction coil. (See Figure 16.)

b. Monode. This application operates on the same principle as the drum; however, it is not flexible and cannot be molded to the part. Proper spacing between the skin and the induction coil is maintained by the plastic housing of the "Monode."

c. Insulated Cable. This applicator is in the form of a heavily insulated cable. Its flexibility permits shaping to any desired form. Two methods of applying this cable are the "pancake" or "wraparound" application. The pancake method involves curling the cable in the shape of a pancake and laying it on the part to be treated while the wraparound method is accomplished by wrapping the cable around the part to be treated. Proper spacing between the skin and cable is maintained by one or two inches of bath towel. (See Figures 17 and 18.)

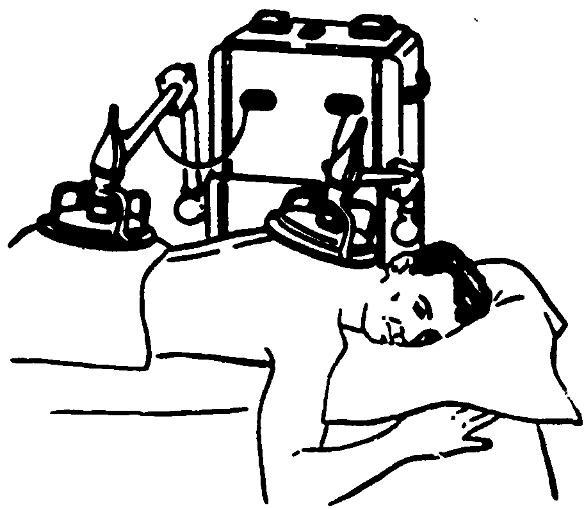

Figure 14. Space Plate Application

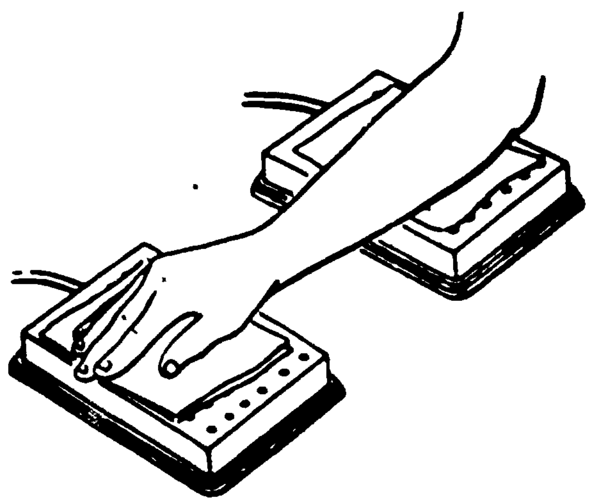

Figure 15. Example of Condenser Pad Application

Figure 16. Drum Method

Figure 17. Pancake Coil

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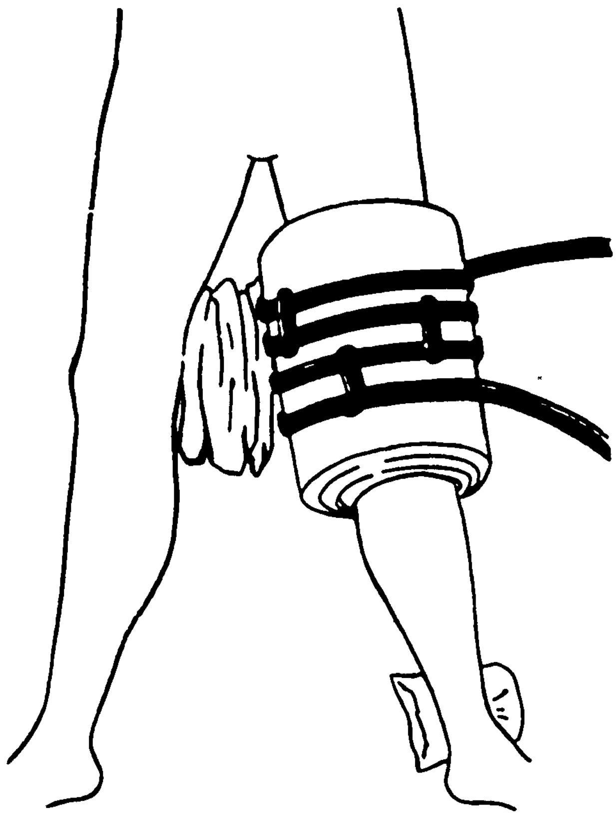

Figure 18. Wraparound Coil

PHYSIOLOGICAL EFFECTS OF SWD. Most of the physiological effects which occur as a result of SWD are due to heating. The following local and systemic effects may occur.

1. Local effects.

   a. Increase in tissue temperature.

   b. Increase in tissue metabolism.

   c. Increase in blood flow.

   d. Increase in clearing of metabolites and heat.

   e. Increase in supply of oxygen, nutrients, antibodies and leukocytes.

   f. Analgesia.

   g. Increased phagocytosis.

2. Systemic effects.

   a. Sedation.

   b. Increased Cardiac output.

   c. Increased pulmonary ventilation.

INDICATIONS. The depth of heating by shortwave diathermy is between microwave and ultrasound. In most applications, the highest tissue temperatures will be achieved in the subcutaneous tissues and the superficial musculature. This is especially true in applications to the neck, back, and joints; such as the hip, which are covered with a thick soft tissue layer. In applications to joints which have a thin covering of soft tissue, the highest temperature will be achieved within the joint. Usually shortwave diathermy is applied to the musculoskeletal system to relieve secondary muscle spasm and pain when it occurs as a result of one of the following.

1. Protruded intervertebral disks.

2. Degenerative joint disease (DJD).

3. Sacroiliac strains.

4. Bursitis.

5. Rheumatoid spondylitis.

6. Any disease process where a subacute or chronic inflammatory reaction is present in a joint.

7. Chronic pelvic inflammatory disease. When using the internal electrodes, shortwave diathermy is the ideal way to apply deep heat to the pelvic organs.

CONTRAINDICATIONS. The following are contraindications for using SWD.

1. Sensory Impairment. Use with caution over these areas.

2. Debilitated Patients.

3. Metal Implants.

4. Contact Lenses. Exposure to the eye while wearing contact lenses may cause localized burning through selective heating.

5. Ischemic Tissues.

6. Cardiac Disease. Use pelvic shortwave diathermy with caution while treating this type of patient.

7. Pregnancy. Do not apply shortwave to the abdominal or low back areas of pregnant patients.

8. Pacemakers.

9. It is not advisable to give shortwave to the following:

   a. Malignancies

   b. Thrombophlebitis

   c. Hemorrhagic Disease

   d. General contraindications for heat therapy.

PRECAUTIONS. When using any modification of the condenser plates or the induction coil for applying shortwave diathermy the following special precautions must be followed.

1. The area to be treated must be completely undressed.

   a. No clothing of any type.

   b. No casts.

   c. No bandages, dressings, surgical or adhesive tape.

2. All metal objects in the area to be treated must be removed.

   a. Jewelry, watches, rings and necklaces.

   b. Metal on clothes. Zippers, snaps, hooks, girdle stays, and coins.

3. Position patients on a "wooden" chair or plinth only.

4. Prevent the accumulation of sweat beads by covering the area with a bath towel. Sweat beads may be selectively heated and cause spot burning of the patient.

STEPS OF APPLICATION. For therapeutic value and safety of the patient, the following steps must be observed.

1. Position and drape the patient properly.

2. Turn on the machine. Some machines may have a warm-up switch while others may have a dial marked surgery and diathermy. Turning the dial to diathermy supplies power to the machine for warm-up.

3. Choose a method of application and adjust the applicator to the part to be treated. A towel should cover the skin to prevent skin surface burns.

4. Tuning. When tuning the patient circuit and adjusting the output of the machine, the following steps must be followed to avoid endangering the patient.

a. Always tune the patient circuit at a low output level. This will prevent excessive heating from an uncontrolled surge of current through the patient.

b. Always tune the patient circuit to its optimum. The power meter on the panel of the machine will indicate maximal flow of current when the patient circuit is tuned to its optimum.

c. Adjust the output of the machine to the desired level. This should be done only after the patient circuit has been properly tuned. Always recheck the machine to make sure it remains in tune with the patient.

d. If the above steps are not followed, the small movements of the patient may change the impedance of the patient circuit in such a way that tuning occurs. This may greatly increase the current flow without the Physical Therapy staff members being aware of it. This situation could result in a severe burn.

QUESTIONS

1. Therapeutic application of high frequency currents is termed ________ ________.

2. All shortwave diathermy machines have three basic componenent parts, ________ ________, ________ ________, and ________ ________.

3. High frequency currents are produced in the ________ ________.

4. Each patient has a certain amount of ________ ________ which becomes part of the ________ of the patient circuit.

5. To "tune" the body and machine, it is necessary to make the ________ of the ________ ________ equal to the ________ of the ________ ________.

6. Tuning is achieved by adjusting the ________ ________ on the panel.

7. Maximal flow of current is achieved when the patient and machine are in ________.

8. Not tuning the patient and machine can cause severe ________ if the patient moves and causes tuning to occur.

9. The ________ ________ controls current flow.

10. Current flow should be adjusted only after the patient and machine are in ________.

11. Dosimetry is guided by the patients ________ of ________.

12. List and describe three doses of shortwave.

a. ____

b. ____

c. ____

13. Two techniques of application for shortwave are the ____________ and ____________
____________ technique.

14. The part to be treated is placed between two plates when using the ____________
technique.

15. The part to be treated is covered by a drum or cable when using the ____________
____________ technique.

16. List four modifications to the condenser technique.
   a. ____________
   b. ____________
   c. ____________
   d. ____________

17. List three modifications to the induction coil technique.
   a. ____________
   b. ____________
   c. ____________

18. Two methods of applying the insulated cable are the ____________ and ____________
applications.

19. Most physiological effects occurring as a result of Shortwave are due to ____________
of the local tissues.

20. The highest temperatures are achieved in the ____________ ____________ and
____________ ____________ in most applications.

21. Shortwave has a depth of heating between ____________ and ____________
diathermy.

22. High tissue temperatures can be achieved within ____________ provided they are
not covered with a thick layer of ____________ ____________.

23. Shortwave is given most often to relieve ____________ ____________ ____________ and
____________ in the musculoskeletal system.

24. List five specific indications for shortwave.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

25. List eight contraindications for shortwave.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

26. Always position patients on __________ chairs or plinths.

27. The accumulation of __________ __________ should be prevented by covering the skin with a __________ __________.

28. Always tune the patient circuit at a __________ __________ __________.

29. Always tune the patient circuit to its ____________________.

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ULTRASOUND

Characteristics

DESCRIPTION. Ultrasound diathermy (US) is the therapeutic application of a form of acoustic vibration at frequencies too high to be heard by the human ear. The sound waves spread through the tissues where they are absorbed and converted into heat. This is heating by conversion. The following features of ultrasound are to be considered.

1. Acoustic vibrations below 17,000 cycles per second are called sound.

2. Acoustic vibrations above 17,000 cycles per second are called ultrasound. This frequency is inaudible.

3. The physics of ultrasound is the same as that of audible sound except for the differences in frequency.

4. For therapeutic purposes, the ultrasound frequencies range from 0.8 to 1 megahertz.

Equipment

CIRCUITRY. Three basic components of circuitry are found in all therapeutic ultrasound machines. These components are the power supply, oscillating circuit, and transducer circuit.

1. Power Supply. The power supply circuit transforms the alternating wall current into a high voltage direct current for the plates of the oscillator tubes and a low voltage alternating current for the filaments of the oscillator tubes. The power supply circuit is constructed so the 110 volt, 60 hertz, alternating line current will not noticeably modify the steady output of the power supply circuit.

2. Oscillating Circuit. An alternating current having a high frequency of about 0.8 to 1 megahertz is produced here. The frequency of the oscillating circuit equals the mechanical frequency of the crystal in the transducer. It is possible to adjust the frequency of this alternating current by tuning unless the manufacturer has installed a devise for controlling the oscillating frequency. The oscillating circuit is also called the generator.

3. Transducer Circuit. The high frequency alternating current produced by the oscillating circuit is then supplied to a crystal located within the transducer circuit. This crystal converts the electrical current into mechanical (acoustic) vibrations. This conversion happens by a reversal of the piezo-electric effect. The transducer circuit is also known as the transducer, applicator, or sound head. The transducer circuit is attached to the machine by means of a coaxial cable. This coaxial cable transmits the high frequency alternating current from the generator to the crystal housed within the sound head (transducer circuit).

Dosimetry

FACTORS. Clinically we cannot measure the three factors which determine the biologic response to ultrasound.

1. Temperature obtained in the tissues.

2. The duration of the temperature elevation.

3. The rate of temperature use within the tissues.

MEASUREMENT. We can, however, measure the amount of energy entering the tissues and also the duration of application of ultrasonic energy. Measurement of energy (intensity) is expressed in terms of watts per centimeter squared (W/cm^2) which refers to the average intensity of the field. On most ultrasound machines this information can be obtained from the meter on the panel. The intensities of ultrasound for therapeutic purposes range from 0.5 to 4 W/cm^2. For most applications the duration varies from 3 to 10 minutes for each field in the area of application. For therapeutic purposes the transducer should have a radiating surface of 7 to 13 cm^2 for effective application.

Application of Ultrasound

TECHNIQUES. Two types of application have been developed for applying ultrasound diathermy, the stroking and stationary techniques.

1. Stroking Technique (see Figure 19). The stroking technique can be administered by either a circular or back and forth motion. The circular technique is accomplished by moving the applicator in a small circular pattern and overlapping each circle. This technique is more difficult to control and is therefore used less often than the back and forth stroke. The back and forth stroke is short and straight. These strokes are parallel and overlap each other. Two modifications to the stroking technique are used frequently.

a. Direct Contact. For this method of application a viscous fluid is used as a coupling agent between the applicator and the skin. Mineral oil and an aqueous gel are the most frequently used coupling agents. The direct contact method is used to apply ultrasonic energy to areas of the body which are relatively smooth and have few bony prominences.

b. Indirect Contact. Water is used as the coupling agent between the applicator and the skin when using this method. The applicator is held 1/2 to 1 inch away from the skin. This is the ideal way for applying ultrasonic energy to irregular surfaces and bony prominences. (See Figure 20.)

2. Stationary Technique. For this method the applicator is held in a stationary position throughout the entire treatment. This technique is not used often due to "hot spots." Hot spots are produced when there is a rapid rise in tissue temperature in a very small area. Hot spots result in pain and possible tissue damage. To avoid hot spots, the intensity should be lowered or a pulsed setting, as opposed to a continuous setting, used. The direct or indirect methods of application can also be used with the stationary technique.

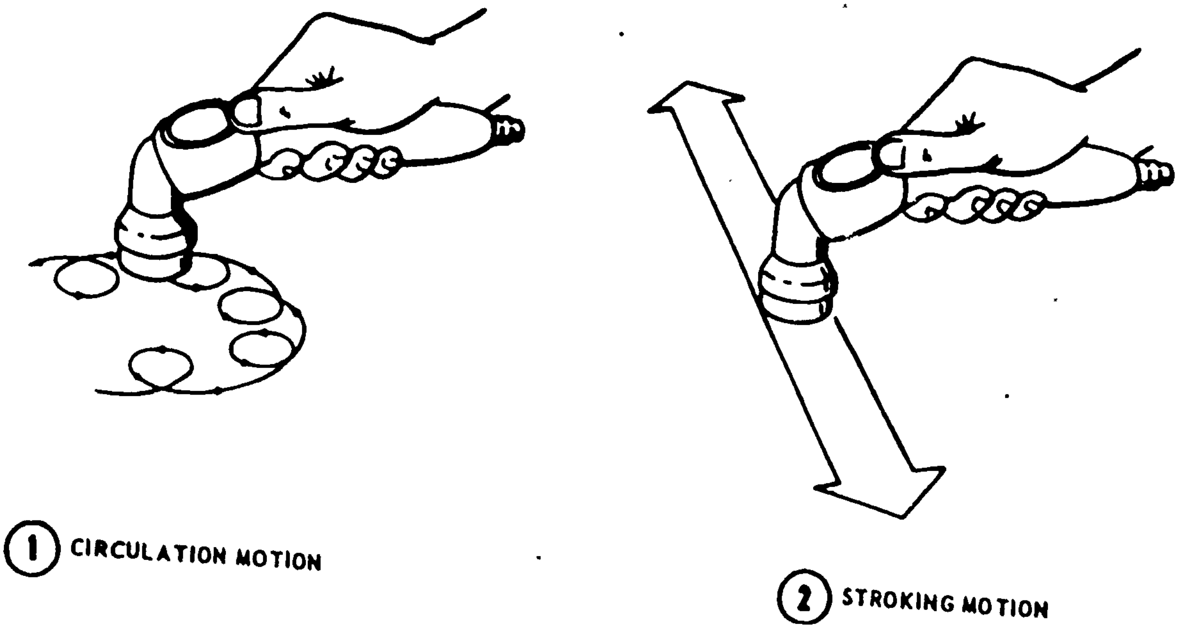

Figure 19. Stroking Technique

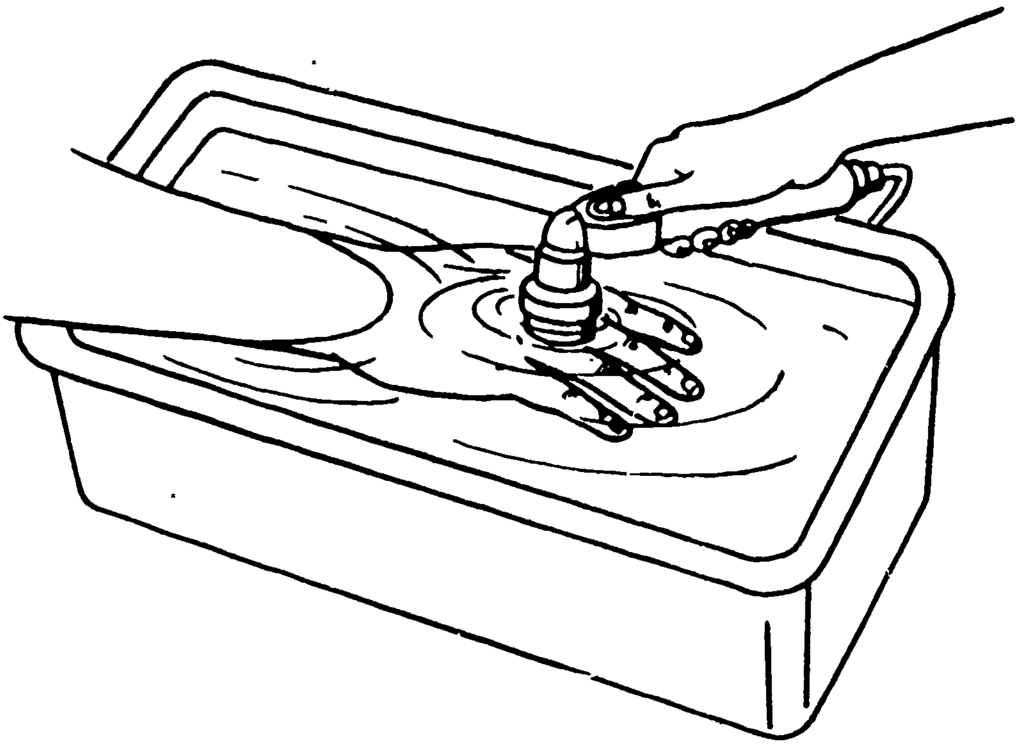

Figure 20. Application of Ultrasound Using Indirect Contact

PHYSIOLOGICAL EFFECTS. Most of the physiological effects which are of potential therapeutic value are a result of the increase in tissue temperature resulting from absorption of ultrasonic energy. The following local and systemic effects occur.

1. Local Effects.

   a. Increase in tissue temperature.

   b. Increase in tissue metabolism.

   c. Increase in blood flow.

   d. Increase in clearing of metabolites and heat.

   e. Increase in supply of oxygen, nutrients, antibodies, and leukocytes.

   f. Analgesia.

   g. Increased phagocytosis.

2. Systemic Effects.

   a. Sedation.

   b. Increased cardiac output.

   c. Increased pulmonary ventilation.

INDICATIONS. The depth of heating of ultrasound is the deepest of the three diathermics available for use. At a depth of 3 cm., one half of the intensity of the ultrasonic energy is still available at the surface of the muscle which indicates that ultrasound is an effective deep heating agent. It is possible to produce higher temperatures in bone than either the fatty or muscular tissues even when the bone is covered by more than 6 cm of soft tissue. Unlike the other diathermics, ultrasound can be used safely in the presence of metal implants. The metal implants have a very high thermal conductivity so that the heat is removed from the area more rapidly than it is absorbed. The conditions for which ultrasound is indicated have been divided into three groups on the basis of the amount of value afforded to each group of conditions.

1. Conditions of Established Value.

   a. Joint contractures resulting from any of the following:

      (1) Immobilization

      (2) Rheumatic processes

      (3) Degenerative Joint Disease (DJD)

      (4) Trauma

   b. Relieve pain and muscle spasm.

   c. Periarthritis of the shoulder when given in conjunction with other forms of physical therapy.

   d. Joints covered with a thick layer of soft tissue. Neither shortwave or microwave can heat these structures to a therapeutic level and produce results comparable to ultrasound.

2. Conditions of Suggested Value.

a. Joint contractures which develop as a result of shortening and fibrosis of muscles or from scarring of the skin and subcutaneous tissues which may be caused by some of the following:

(1) Polymyositis.

(2) Paralysis due to polymyositis.

(3) Trauma.

(4) Burns.

(5) Diseases such as scleraderma (hardening of the skin).

b. Calcific bursitis and tendinitis of the shoulder.

c. Pain and painful phantom limbs occurring in postoperative neurofibromas (tumors of the nerves and connective tissue).

d. Rheumatoid spondylitis.

e. Subchronic and chronic rheumatoid arthritis.

f. Plantar warts.

3. Conditions of Potential but Questionable Value.

a. Sciatica and other forms of radiculitis.

b. Herpes zoster (inflamed nodule on the nerve trunk caused by a virus).

c. Peripheral arterial insufficiency.

d. Rheumatic disease.

e. Myofascial pain syndrome.

ULTRASOUND-ELECTRICAL STIMULATION. The use of ultrasound and electrical stimulation together has been advocated. The sound applicator is used as the stimulating electrode also. There is no clearly established physiologic basis for this treatment. No clinical evidence is available to demonstrate that this type of treatment is better than either ultrasound or electrical stimulation alone or used consecutively.

CONTRAINDICATIONS. The following contraindications are to be observed.

1. Ultrasound should not be applied to the following.

a. The eyes.

b. Patients with a predisposition to hemorrhagic disease (hemorrhagic diatheses).

c. Malignancies.

d. Ischemic areas.

e. Over a pregnant uterus.

2. Ultrasound may be applied with caution to areas of sensory impairment.

3. When applying ultrasound to a laminectomy use special precautions in adjusting the dosage. The protective tissue covering has been removed and higher energy levels may be obtained in the spinal cord.

4. Observe the general contraindications for heat.

STEPS OF APPLICATION. The following steps are to be followed when applying US.

1. Turn the intensity control to zero.

2. Turn the main power switch on so the generator can warm-up.

3. Select the technique of application and coupling agent to be used. The temperature of the coupling agent and the surface of the metal applicator will modify the temperatures in the tissues. Research studies show that the deeper tissues are more effectively and efficiently heated if the coupling agent and applicator surface are kept as cool as possible.

4. Wash the area to be treated with a mild detergent and rinse well to prevent a rash. This helps remove tiny gas bubbles in the skin which can produce a large amount of reflection of ultrasonic energy. It has been demonstrated that up to 30 percent of the ultrasonic energy may be reflected by these tiny gas bubbles on the skin's surface.

5. Select the output (intensity in W/cm^2).

6. Determine the length of the treatment by the size of the area to be treated. If treating a large area, divide it into small sections and treat each section individually

7. Once the applicator makes contact with the patient do not arbitrarily break contact with the skin.

8. When using the stroking technique keep the applicator moving to prevent development of "hot spots."

9. At completion of the treatment insure that all the coupling agent is wiped from the skin.

QUESTIONS

1. Ultrasound diathermy is the ____________ application of __________ __________.

2. Ultrasound heats by ____.

3. Acoustic vibrations above 17,000 cycles per second are called ______________.

4. For therapeutic purposes, ultrasound frequencies range from ________ to ________ megahertz.

5. List the three basic components of circuitry found in all ultrasound machines.

a. ____

b. ____

c. ____

6. The oscillating circuit is also called the ____________ because a ____________ ____________ current is produced here.

7. Acoustic vibrations are produced in the ____________ ____________ by a ____________ ____________.

8. Other names for the transducer circuit are ____________, ____________, or ____________ ____________

9. A ____________ ____________ transmits the high frequency current to the sound head.

10. Measurement of energy (intensity) is expressed as ____________.

11. The intensities of ultrasound for therapeutic purposes range from ____________ to ____________ W/cm^2.

12. For most applications, duration of treatment varies from _____ to _____ minutes.

13. For effective application, transducers should vary in size from ____________ to ____________.

14. List and briefly describe two techniques of application and their two modifications.

a. ____________
b. ____________
c. ____________

15. Two common types of coupling agents are ____________ ____________ and ____________ ____________ ____________.

16. Most physiological effects from ultrasound are a result of an increase in ____________ ____________.

17. Ultrasound has the ____________ penetration of the three diathermics.

18. The highest temperatures may be produced in ____________.

19. Ultrasound can be used safely in the presence of ____________ ____________.

20. There are ____________ groups of conditions for which ultrasound is indicated.

21. List four conditions of established value.

a. ____________
b. ____________
c. ____________
d. ____________

22. List three conditions of suggested value.

a. ____________________

b. ____________________

c. ____________________

23. If a combination of ultrasound and electrical stimulation are used, the sound head is also the ____________ ____________.

24. Ultrasound may be applied with caution to areas of ____________ ____________.

25. The temperatures of coupling agents and the surface of the applicator should be as ____________ as possible for effective heating.

26. ____________ ____________ may cause up to ______ percent reflection of ultrasonic energy.

27. Large areas should be divided into small sections and treated ________________.

28. ____________ ____________ can develop if the intensity is too high.

29. Failure to move the applicator while using the stroking technique may result in ____________ ____________ causing ____________ to the patient.

ELECTRICAL STIMULATION

Low Frequency Electrical Currents

USES. Low frequency electrical currents are used for many purposes in medicine such as electrodiagnosis. Electrodiagnosis is the study of functional states of different parts of the body either by studying the electrical potentials (currents) which they spontaneously produce or by studying their responses to electrical stimulation. The heart muscle produces currents which are recorded on the electrocardiogram (EKG) and the brain's currents are recorded on the electroencephalogram (EEG). Recording and studying the action potentials of skeletal muscles is known as electromyography (EMG). Physical Therapy does not perform these particular procedures; however, extensive electrical stimulation is used for other purposes. In Physical Therapy, a low frequency electromedical current is used to stimulate skeletal muscles for various reasons.

Definition of Terms

ELECTRICAL STIMULATION. The use of low frequency electromedical currents to stimulate skeletal muscles either through the nerve if it is present or directly through the muscle.

GALVANIC OR DC CURRENTS. A direct or unidirectional current produced from low voltage which is used in stimulating denervated muscles.

FARRADIC OR AC CURRENTS. An alternating current which changes direction. This type of current is used in the stimulation of innervated muscle by therapists and technicians or specialists.

SURGING CURRENT. Gradually increasing the current intensity to maximum value, then decreasing it again to zero.

TETANIZING CURRENT. A current producing a constant contraction.

IONTOPHORESIS. Utilization of galvanic current to drive selected medications into the human tissues. This is a procedure administered only by therapists.

ACTIVE ELECTRODE. The electrode used to produce a response within the body. An electrode is an instrument used to apply currents to the body.

DISPERSIVE ELECTRODE. The ground electrode. Current dispersed throughout the body parts is picked up by the dispersive electrode.

MOTOR POINT. That area of the muscle where optimum stimulation occurs with the least amount of current, usually where the nerve enters the muscle.

Application of Electrical Stimulation

INDICATIONS. The following are indications for electrical stimulation.

1. Exercise weak and denervated muscles. Exercising the muscle by this method retards the progression of atrophy and improves the circulation and nutrition of the muscle. Contraction of the muscle also has the effect of emptying the muscle of venous blood and lymphatic fluid.

2. Reeducate weak muscles. The ability to use a muscle is sometimes lost for various reasons. Paresis or disuse from surgery or trauma can result in the patient "forgetting" how to use a muscle. Electrical stimulation to that muscle will help reeducate the patient toward correct muscle function.

3. Reduce muscle spasm and spastacity. Fatiguing the muscle with electrical stimulation will aid in its relaxing.

4. Test for peripheral nerve injuries (PNI).

METHODS OF APPLICATION. There are two methods for applying electrical stimulation.

1. Unipolar Application. Use of an active electrode to stimulate a muscle and a dispersive electrode placed some distance away to complete the circuit. This application is used for electrical testing and muscle stimulation and requires manual operation. By regulation, AFR 160-12, the physical therapy technician is not authorized to use this method of application.

2. Bipolar Application. Use of two equal size electrodes placed at opposite ends of the muscle belly or group of muscles. This application is used for exercising a muscle. The pads can be applied and held in place by straps or sandbags.

TECHNIQUES. The following techniques of application are to be followed for effective and safe application.

1. Electrodes must be thoroughly and evenly moistened. Warm salt water will provide good conduction.

2. Electrodes must make firm and even contact with the skin.

3. Connecting wires must be checked for proper insulation and contact with the electrode.

4. The line cord must be in good contact with the machine and the wall receptacle.

5. Insure that the intensity controls are turned to zero before turning on the machine.

6. Do not position patient on a metal surface.

7. Determine the type of current to be used.

8. Explain the treatment and its effects to the patient.

Control Panel

TIMER (see Figure 21). On the medcollator the timer acts as an OFF-ON switch as well as timer for timing the length of the treatment. Should mechanical failure of the timer develop, it may still be used as an OFF-ON switch. Before placing the pads in their proper position on the patient, be sure that the volume controls are turned to zero, then move the timer knob to the time desired. Select the type of current to be used and gradually turn the volume to the desired intensity. Before changing current frequency settings it is advisable to return the volume to zero and then readjust the volume control to the desired intensity.

RIGHT VOLUME CONTROL (see Figure 21). The right and left volume controls operate independently of each other, permitting desired intensities to be established independent of the other circuit. For example, if the black cords are in cord outlet on the right side of the machine and are being used on the extensors, the right volume control will be used to adjust the volume to the desired stimulation needed for the extensor muscles.

LEFT VOLUME CONTROL (see Figure 21). The left volume control operates independent of the right volume control. For example, if the red cords are in the left cord outlet and are being used on the flexors, the left volume control will be used to adjust the volume to the desired degree of stimulation for the flexor muscles.

RED AND BLACK CORDS. The red lead cords may be inserted in either the right or left cord outlets on the lower half of the panel under the words "volume." The red or black cords constitute a completed circuit and a treatment may be given with either set or they may be used simultaneously; the color is used for identity only. The black cords are also a completed circuit and may be used in the other cord outlet when treatment in more than one area is desired; for example, both arms, both legs or when flexor and extensor muscles are to be treated simultaneously or alternately.

WET PADS. The successful operation of the medcollator depends upon properly moistened pads. Water acts as a perfect conductor for electrical current; therefore, it is necessary that the pads be thoroughly moistened while in use to obtain satisfactory conduction of the electrical current.

SELECTOR SWITCH (see Figure 21). This switch allows you to select the type of current you desire for the treatment. The following selection of currents are available.

1. Tetanize. This type of current produces a constant contraction.

2. Surge. This type of current is just as the name implies, a rhythmic beat similar to that of a heart beat.

PULSE RATE KNOB (see Figure 21). This adjusts the rate of the pulse from a very slow beat to a very fast beat.

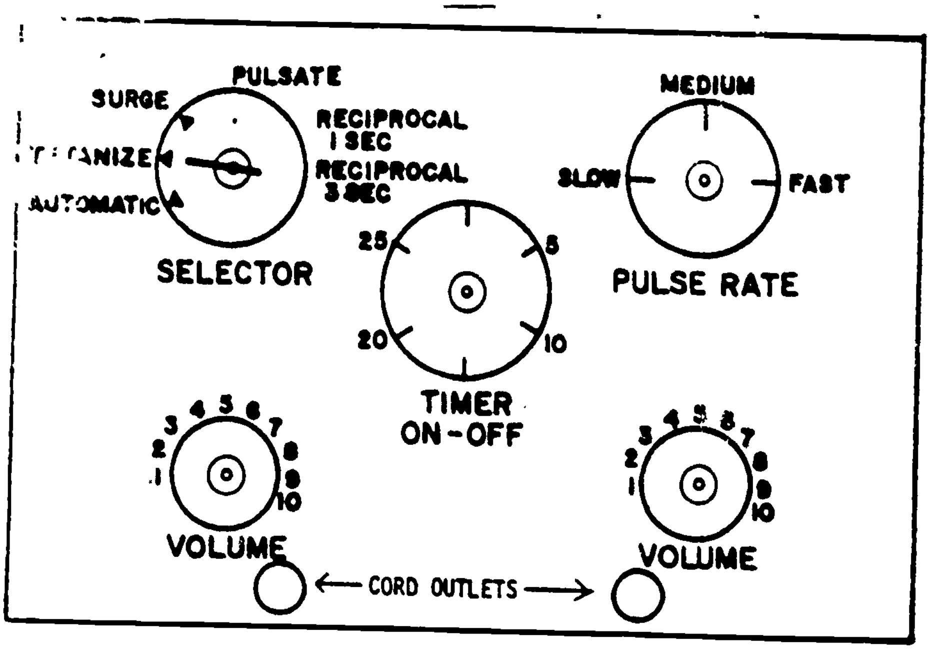

Figure 21. Control Panel, Medcollator, Model K

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QUESTIONS

1. Heart muscle currents are recorded on an ____________ and the brain's currents on an ____________.

2. Recording action potentials of skeletal muscles is known as ____________.

3. List four indications for electrical stimulation.

   a. ____________.

   b. ____________.

   c. ____________.

   d. ____________.

4. Electrical stimulation retards progression of ____________ and increases ____________ and ____________, within the muscle.

5. Electrical stimulation reduces ____________ ____________ and ____________.

6. A muscle can be stimulated either through the ____________ or the ____________ directly.

7. Denervated muscles are stimulated by ____________ current.

8. Innervated muscle is stimulated by ____________ current.

9. Only a physical therapist is authorized to use the ____________ method.

10. A constant muscle contraction is accomplished with a ____________ setting.

11. Gradual increases in current intensity followed by relaxation is known as a ____________ ____________.

12. List and briefly describe the two types of electrodes.

    a. ____________

    b. ____________

13. Driving selected medications into human tissues by electrical current is known as ____________.

14. Optimum stimulation occurs at the muscles ____________ ____________.

15. An active and a dispersive electrode are used in the ____________ application.

16. Exercising a muscle is best accomplished by a ____________ application.

TRACTION

Application of Traction

CONSIDERATIONS. In physical therapy traction may be applied to either the cervical or pelvic (lumbar) regions. In order to insure success with these treatments, the following considerations must be observed.

1. Angle of Pull. The movement that takas place at the anterior and posterior aspects of the vertebral bodies with resulting changes on the intervertebral disks and in the foramina are a result of the angle of the spine.

a. In a position of flexion, the vertebral bodies shift anteriorly. The intervertebral disks compress anteriorly and elongates posteriorly, resulting in foramina enlargement.

b. In a position of extension or hyperextension, the vertebral bodies shift posteriorly. The intervertebral disks will compress posteriorly and anteriorly. The cervical spine is not placed in extension except by specific directions from a physician. Normally all traction is administered with the cervical spine in a partially flexed position.

2. Amount of Force. Intervertebral widening should be achieved using the minimum amount traction necessary to increase the posterior elongation of the intervertebral disks, with little or no anterior compression.

a. In cervical traction the normal curvature of the cervical spine is straightened with 20-25 pounds of force. Measurable separation of the posterior vertebrae will occur with a force of 30 pounds applied for minimum of seven seconds. The greatest intervertebral separation can be expected at levels C4-5, C5-6, and C6-7.

b. In pelvic traction, with little or no surface resistance present, 100 pounds of force will result in posterior elongation of intervertebral disks and enlargement of the foramina of the lumbar area. The greatest intervertebral separation can be expected at levels L3-4, L4-5 and L5-S1.

c. The amount of force required for intervertebral separation will vary with each individual as a result of muscle bulks and tolerance.

For instance, a young male athelete will normally tolerate more traction than an elderly woman.

TYPES AND POSITIONS. The following are the two types traction used in physical therapy and the basic positions used.

1. Cervical Traction. Cervical traction is administered in either the sitting or supine position with the head flexed from 25° to 30°. In the supine position, a pillow or towel may be placed beneath the head for support. The patient's knees should be slightly flexed and supported with pillows or a small step stool. (See Figures 22 and 23.)

2. Pelvic Traction. The patient is placed in a supine position with the knees flexed and supported. The traction machine will be placed at the foot of the traction table.

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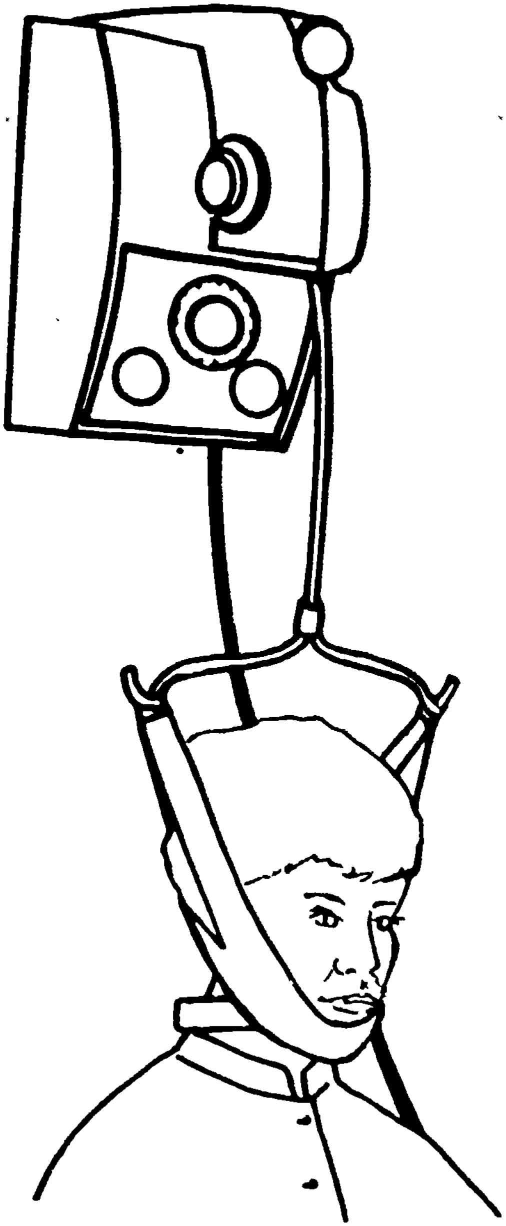

Figure 22. Cervi·) Traction-Sitting Position)

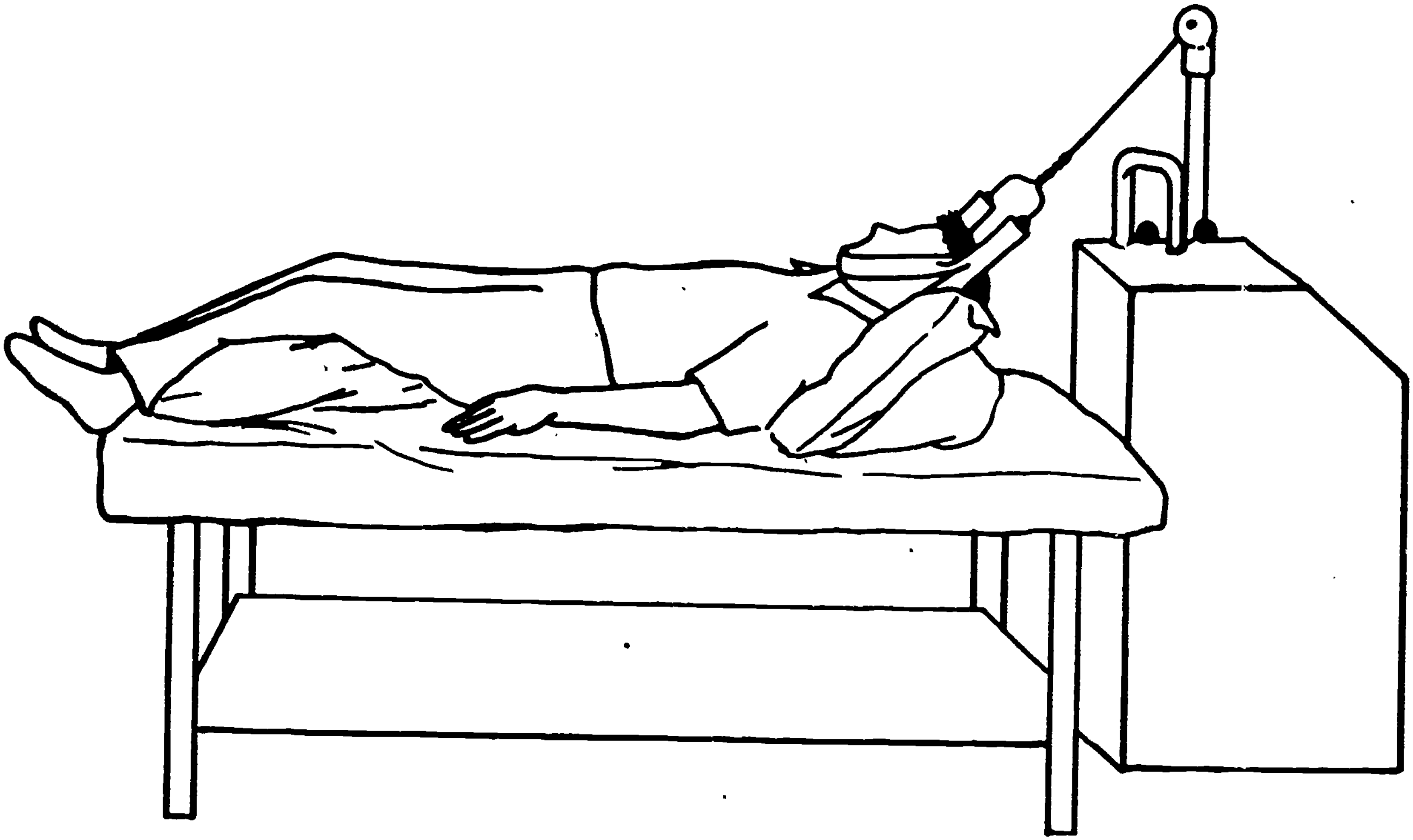

Figure 23. Cervical Traction-Supine Position

METHODS OF APPLICATION. Two methods of application are used in physical therapy for both cervical and pelvic traction.

1. Intermittent Traction. This type of traction is given most often. Intermittent traction consists of a period of pull followed by a period of relaxation. The technician will determine the length of these periods according to the patient's tolerance. This traction - relaxation cycle continues until the treatment is completed. Intermittent traction has two advantages over a steady traction.

a. Comfort. The relaxation phase allows the musculature to relax periodically and it also relieves pressure on the jaw and temporomandibular joints.

b. Maximum Traction. The maximum amount of pull can be applied due to the relaxation period. This advantage allows for the greatest amount of intervertebral separation.

2. Steady Traction. A steady traction is the application of a constant pull with few or no relaxation periods. Steady traction is used less frequently than intermittent due to its discomfort. The limited amount of pull applied by steady traction restricts its effects to stretching of the musculature with no real intervertebral separation. Pelvic traction is often more comfortable with the application of a steady traction. When selecting the method of application, intermittent or steady, patient tolerance should be the primary consideration.

PHYSIOLOGICAL EFFECTS. Two important effects occur with the application of traction.

1. Stretching of the muscles and ligaments to relieve muscle spasm.

2. Widening of the intervertebral spaces, with resulting relief of nerve root compression.

INDICATIONS. Traction is usually indicated in symptoms arising from pressure on nerve roots, whether due to disk protrusion, osteoarthritis, osteophytes, or cervical or lumbar injury.

1. Spondylosis. A condition resulting in narrowing of the intervertebral spaces causing nerve root impingement.

2. Spondylolisthesis. Forward displacement of a vertebrae over another. Usually L-5 over S-1.

3. Disk rupture.

4. Whiplash injuries of neck.

5. Torticollis. Contracture of a sternocleidomastoid muscle.

CONTRAINDICATIONS. The following contraindications are to be observed.

1. Spinal Infections. Osteomyelitis and tuberculosis.

2. Osteoporosis. A condition of the bone resulting in weakening due to replacement of bone tissue with fat cells.

3. Malignant diseases of the spinal column.

4. Evidence of cord pressure.

5. Hypertensive or cardiovascular disease.

6. Old and frail patients.

7. Pregnancy (Pelvic).

8. Rheumatoid Arthritis

CONTROL PANEL. The technician must have a knowledge of the following features of the control panel on the traction machine. See Figures 24 and 25.

1. ON-OFF Switch. This is the main power switch for the machine.

2. Remote ON-OFF Switch. Attached to the control panel by means of a long cord. This allows the patient the freedom to turn machine off for any reason.

3. Timer. When the timer stops, the pull is shut off and placed in a relaxed position. The machine will however, continue to run.

4. Pull Setting. This dial controls the duration of pull in seconds.

5. Release Setting. This dial controls the duration of relaxation in seconds.

6. Traction Setting. The dial regulates the pull in terms of pounds.

7. Intermittent-Static Switch. Located on the control panel. Regulates which type of traction to be used.

TECHNIQUES FOR ADMINISTERING TRACTION. The following techniques are to be observed.

1. Determine the position to be used, sitting or supine.

2. Explain the procedure to be used. Most patients are apprehensive with this treatment and need to know what they should expect.

3. Explain what the patient should feel.

    a. It should not be uncomfortable.

    b. The patient should feel most of the pull in the occipital area, not on the chin.

4. Determine the method of pull to be used, static or intermittent.

5. Have the patient remove glasses, headwear or obstructive earrings. If the patient has dentures, precautions should be taken. They do not necessarily have to be removed as gauze pads may be provided.

6. Position the head halter. Correct placement of the halter is important for a comfortable treatment. It should exert minimal pressure on the chin and maximum pressure on the occipital area of the skull. Adjustment of the chin straps insure correct distribution of pull on the head. Be sure that ears and hair are free of halter pull.

7. Check the angle of pull. (25° - 30°)

8. Determine the patient's tolerance to the pull (10-35 lbs.). Stretching of muscles and ligaments does not necessarily require high poundage.

9. The patient should experience no increase in pain, radiating pain, dizziness, or other sensory changes.

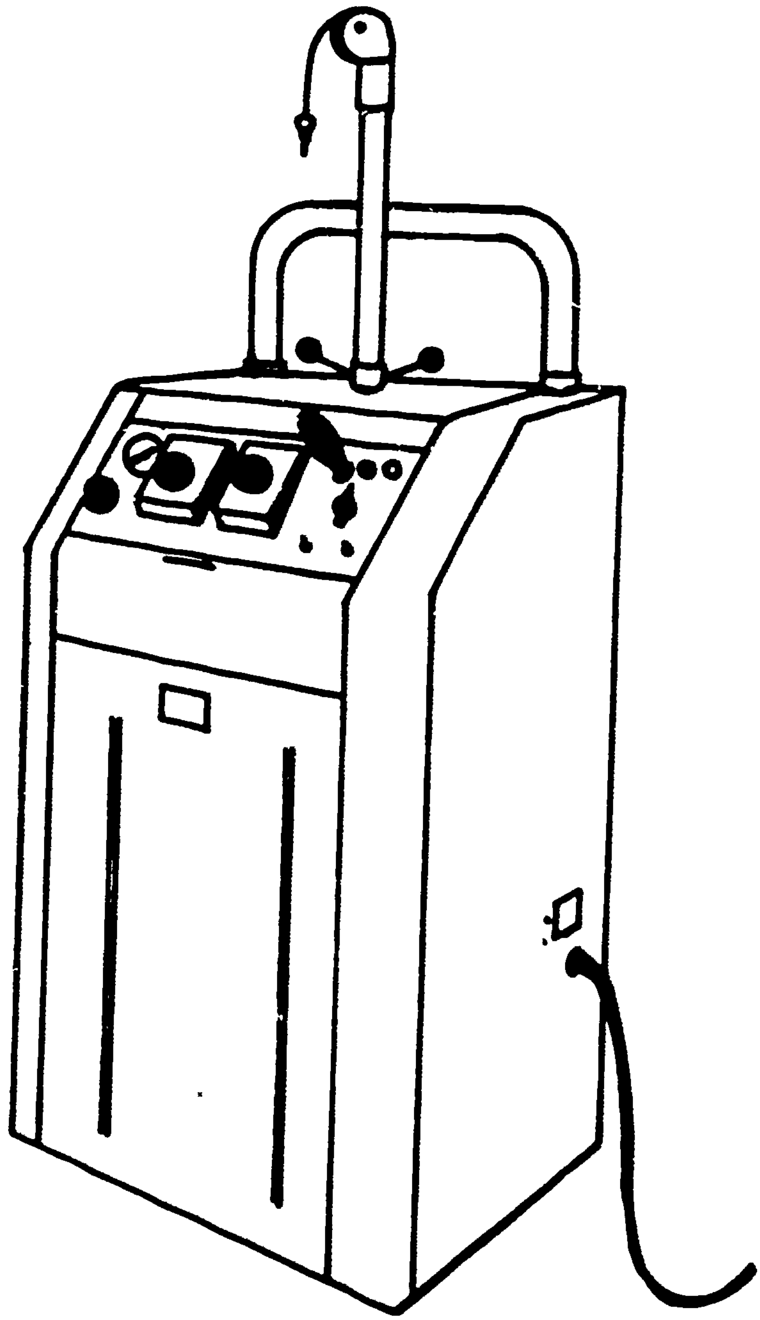

Figure 24. Traction Machine

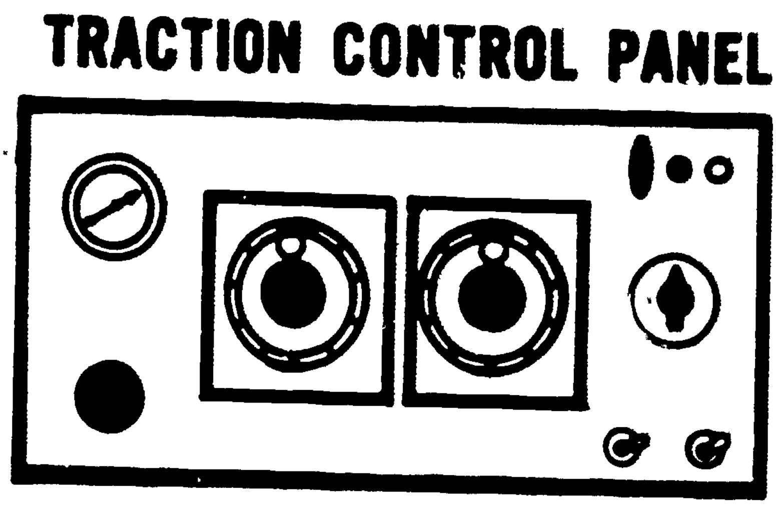

Figure 25. Control Panel

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10. Moist heat may be used along with traction to reduce muscle spasm and increase circulation.

11. Treatment time varies from 10-20 minutes.

12. Instruct the patient in the use of the remote ON-OFF switch.

13. While the patient is on traction, the technician should remain within easy calling distance.

QUESTIONS

1. List the two physiological effects of traction.

   a. ______________________________

   b. ______________________________

2. Traction may be applied to either the __________ or __________ regions of the body.

3. The position of the spine during traction refers to the ______________ of ______________.

4. Posterior foramina enlargement is best attained with the neck in a __________ position.

5. Elongation foramina enlargement anteriorly is accomplished with the neck in ______________.

6. Unless specifically directed by a physician, all traction is given with the neck in a ____________ position.

7. Normal curvature of the spine is straightened with _________ to ________ pounds.

8. Intervertebral separation of the cervical vertebrae is attained when a force of ________ pounds is applied for a minimum of ______ seconds.

9. Posterior elongation of foramina should be achieved using a ______________ of traction.

10. The greatest intervertebral separation in the cervical spine is between ________, ________, and ________.

11. Pelvic traction requires ______ pounds of force for intervertebral separation.

12. Two methods of traction are ____________ and ____________.

13. The greatest amount of posterior separation in pelvic traction is between _______, ________, and ________.

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14. A constant tension or pull is termed ______________ traction.
15. A pull followed by relaxation is typical of ______________ traction.
16. Two advantages of intermittent traction are:
    a. ____.
    b. ____.
17. Intervertebral separation is accomplished best by ______________ traction.
18. The most confortable type of traction is an ______________ traction due to its ______________ ______________.
19. The primary consideration in selecting which method of traction is used is ______________.
20. When administering pelvic traction, the patient is in the ______________ position.
21. Two positions for cervical traction are ______________ and ______________.
22. Most indications for traction result from ______________ ______________ ______________.
23. List four indications for traction.
    a. ____
    b. ____
    c. ____
    d. ____
24. List five contraindications for traction.
    a. ____
    b. ____
    c. ____
    d. ____
    e. ____
25. Most pressure from the halter should be felt on the ______________ area.
26. The angle of pull should be from ______° to ______°.
[illegible] is often given with traction to reduce ______________ ______________.
28. Treatment time may range from ______ to ______ minutes.

ULTRAVIOLET

Purpose

TREATMENT. Ultraviolet or artificial sunlight is used in the Physical Therapy Clinic to treat certain skin conditions. This type of treatment can be very dangerous not only to the patient but also to the technician. You will be administering this type of treatment. Therefore, it behooves you to study this section diligently.

Terminology

ULTRAVIOLET. Ultraviolet radiation is commonly referred to as artificial sunlight. This radiant energy is generated by special lamps called mercury vapor arc or cold quartz lamps.

ACTINOTHERAPY. Actinotherapy refers to the treatment of disease by rays of light, especially ultraviolet light.

ERYTHEMA. Eythema is an inflammatory condition of the skin resulting in redness from exposture to ultraviolet radiation.

Sources of Ultraviolet Radiation

HOT QUARTZ LAMPS (see Figure 26). These lamps consist of a mercury vapor encased in a quartz tube. An electric current is passed through this vapor activating it to produce and emit ultraviolet rays. Production of ultraviolet rays in a hot quartz lamp causes erythema and tanning.

COLD QUARTZ LAMPS (see Figure 27). This lamp also contains a mercury vapor encased in a quartz tube. In addition to mercury vapor, argon or neon gas is added to provide a less intense emission of ultraviolet rays. This lamp is used primarily for bactericidal treatment.

BLACK LIGHT LAMPS. These lamps are used for diagnostic procedures along with a glass filter to observe the florescence of ringworms.

Physiological Effects

ERYTHEMA. Ultraviolet rays interact with the innermost layer of the epidermis. This exposure causes damage to the skin cells resulting in the release of substances called histimines. Histimines are vasodilators and when they diffuse to the subdermal tissues, vasodilation results. This inflammatory process causes reddening of the skin commonly referred to as sunburn.

DESQUAMATION. Erythema stimulates the production of skin cells. This reaction causes the outer layer of epidermis (stratum corneum) to thicken which helps protect deeper cells from exposure to ultraviolet rays. Desquamation occurs when these excess epithelial cells begin to shed in scabs or sheets. This process is often referred to as peeling.

PIGMENTATION. As a result of photochemical changes following erythema, the melanin, responsible for skin color, migrates from the deep layers of the skin towards the surface. Melanin protects the skin from sunburn but is found too deep in white skin to be of any value.

PRODUCTION OF VITAMIN D. Vitamin D is produced in the superficial layers of the skin and is activated by ultraviolet radiation.

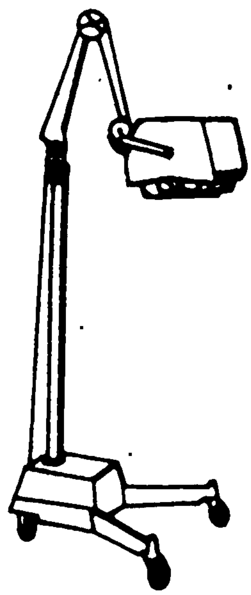

Figure 26. Hot Quartz Lamp

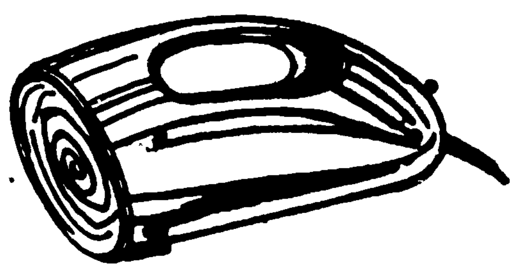

Figure 27. Cold Quartz Lamp

Precautions

PHOTO-OPTHALMIA. These adverse effects are the result of ultraviolet radiation on the unshielded eye. Conjunctivitis, an inflammation of the mucous membrance lining the eyelid, and eroding of the cornea are photo-opthalmic effects. Eye protection can be accomplished by wearing spectacles of ordinary glass or wet cotton gauze may be placed over the patient's eyes. Both the patient and technician should protect themselves from photo-opthalmic effects.

PHOTOSENSITIZING DRUGS. Certain medications and chemicals are known to make the skin more sensitive to ultraviolet radiation. Chemicals such as sulfonomides, tetracyclines and even green soap can produce a higher degree of erythemia then expected. Coal tar derivatives, a medication used in the treatment of certain skin conditions, can also cause an increased sensitivity to ultraviolet radiation.

REGIONS OF SENSITIVITY. Pigmentation in white skin is located too deeply in the skin to afford any protection from the erythemal effects of ultraviolet radiation. Protection from erythema is determined largely by the thickness of the stratum corneum. Ultraviolet rays, including those occurring in natural sunlight, stimulate the thickening of the stratum corneum resulting in an increased tolerance level. Certain regions of the body are normally not exposed to sunlight and therefore have a thinner layer of skin. Regions such as the buttocks, breasts and genitals should be considered for their sensitivity.

Indications

DERMATITIS. Dermatitis is any inflammatory condition of the skin which results in itching, redness and various skin lesions which may be maculor (different colored), papulor (pimple) or pustular.

FUNGUS. Fungus infections are a form of dermatitis.

PSORIASIS. Ultraviolet radiation is probably more frequently used in treatment of this disease than any other condition. This condition appears in the form of dry, grayish-white lesions which may cover the entire body. Much shedding of epithelial skin cells occurs and bleeding points may be seen beneath the scales. The cause of psoriasis is unknown. Its incidence is greater in colder climates than warmer climates and is characterized by recurrant episodes, (usually occurring in cooler seasons) with subsequent gradual remissions. Application of ultraviolet radiation stimulates new skin cell production and promotes further scaling.

ULCERS. Ulcers such as indolent and decubitis (bed sores) ulcers are occasionally treated with ultraviolet radiation. An application of cold quartz radiation is particularly valuable as an antibacterial treatment.

PITYRIASIS ROSEA. This skin disease is characterized by macules (discolored spots) which are light red or rose colored covering the extremities. At first the macules are solid and covered with rose or fawn colored scales. Later, the center of the macule clears and a hollow ring is formed. The cause of this condition remains unknown. This condition will usually disappear spontaneously within three to four weeks, although it may last several months.

ACNE. Acne is an inflammatory condition of the skin caused by the narrowing of the mouths of sebaceous glands. Application of ultraviolet radiation assists in resolving [illegible]mation by causing shedding of the epithelial cells, allowing the blockages easy exit.

Contraindications

SCAR TISSUE. Scar tissue is more sensitive to ultraviolet radiation, leading to an undesirable erythema.

NEW SKIN GRAFTS. New skin grafts must not be encouraged to slough. Application of ultraviolet radiation results in desquamation which may cause the skin graft to fall off.

LIGHT SENSITIVE DISEASES. The skin may become overly sensitive to irradiation with the presence of certain diseases. Psoriasis or Excema or normally treated with ultraviolet; however, if these conditions become severe or acute, they may become too sensitive for irradiation.

General Treatment Times and Distances

INITIAL TREATMENT. The amount of superficial pigmentation (melanin) and thickness of the stratum corneum determine the sensitivity of skin to ultraviolet radiation. Assigning a starting point for treatment is sometimes difficult due to variations in sensitivities. Exposure to ultraviolet radiation should be long enough to produce a slight reddening of the skin within a few hours. The general treatment time for a hot quartz lamp is fifteen seconds at a distance of thirty inches from the skin. These figures represent the average exposure required to achieve a minimal erythemal dose. They do not reflect individual sensitivities and consequently an (MED) is not always achieved using this method. If no erythema is produced, the technician should increase the exposure time by one (MED) with each succeeding treatment until minimal erythema is produced. A minimal erythema should be maintained throughout the treatment program. Five or ten second increases are usually sufficient to maintain the minimal erythema. The general treatment time for cold quartz is 5 seconds at a distance of two inches from the skin.

INDIVIDUAL MED. Variances in sensitivity may allow some individuals a tolerance four or five times greater then the general starting dosage before an MED is produced. Reddish blondes tend to be more sensitive then blondes while brunettes can tolerate a higher dosage then either. Hair color along with skin pigmentation are factors which should be considered in determining the initial dosage. If a patient is suspected of having a high tolerance, the technician may perform a simple test to determine that individuals initial MED. This test is administered on the first visit with an exposure of four small areas usually on the volar aspect of the forearm. A paper towel or 5 by 7 inch card with four, evenly, spaced one inch holes cut in it is used to cover the test area. All areas surrounding the test card and also three of the four holes should be draped. Exposure to the first hole begins and each succeeding hole is uncovered in fifteen seconds increments. The test is completed when the first hole has received 60 seconds exposure time and the last hole has received 15 seconds. The test sites should be labeled and the patient instructed to observe any erythemal effect. It may take eight hours or more for the lightest pink area to appear. The lightest pink area will be the starting MED to begin on the next treatment.

Techniques Utilized in Application

PROCEDURE. An effective application of ultraviolet radiation is determined by following correct procedures. These procedures or considerations are necessary to provide not only quality but safety in the treatment program.

1. Allow the lamp to warm up for ten minutes.

2. Make sure the <u>patient</u> and <u>technician</u> have proper eye protection.

3. Position the patient. Pillows are not used in positioning patients for ultraviolet.

4. Center the lamp over the area to be treated.

5. Check for the proper lamp angle (cosine law). The greatest absorption occurs when the rays strike the skin surface at right angles.

6. Measure the distance from the lamp to the patient. The distance should be thirty inches to the center of the treatment area.

7. Drape all areas not being treated.

8. Start the treatment with one MED or an individual test to determine the MED.

9. Change all linen following treatment.

10. Wash goggles following the treatment.

Care of Equipment

PROCEDURES. The following procedures are to be observed.

1. Do not touch the quartz element with your hands. Oil on the fingers will etch the surface and ruin the element.

2. Unplug the machine when not in use.

3. Clean the machine once a week with soap and water. The element should be cleaned with ether or alcohol only.

4. Age and continued use will cause the element to deteriorate. The lamp's intensity should be checked at least every six months.

QUESTIONS

1. The treatment of disease by rays of light, especially ultraviolet light, is known as ________________.

2. Ultraviolet radiation is commonly referred to as ____________ ____________.

3. Exposure to ultraviolet radiation causes ________________, an inflammatory condition of the skin.

4. Erythema and tanning are produced by a ____________ ____________ lamp.

5. A bactericidal effect is produced by the ____________ ____________ lamp.

6. Exposure to ultraviolet results in destruction of the cell membranes and the release of ________________.

7. Peeling or shedding is also known as ____________ and follows thickening of the ____________ ____________.

8. ____________ is responsible for pigmentation.

9. Migration of melanin from the deep layers of skin toward the surface is called ________________.

10. Conjunctivitis and erosion of the cornea are examples of adverse ______________ ______________ effects.

11. Sulfonomides, tetracyclines and coal tar derivatives can cause an increased ______________ to ultraviolet radiation.

12. The most frequent indication for the use of ultraviolet is probably ______________.

13. Three contraindications for ultraviolet are ______________, ______________, and ______________ ______________.

14. Sensitivity to ultraviolet is determined by the amount of ______________ in the superficial tissues and also the thickness of the ______________ ______________.

15. The average exposure required to produce a minimal erythmal dose (MED) is ______ seconds with the lamp ______ inches from the skin.

16. The general treatment time for cold quartz is ________ seconds with the lamp at a distance of ______ inches from the skin.

17. It may take more than ______________ hours for a slight erythema to appear.

18. Eye protection is essential to both the ______________ and ______________.

19. Positioning is accomplished without the use of ______________.

20. Cosine law involves the proper lamp ______________.

21. The lamp element should not be touched with the fingers and either ____________ or ______________ should be used to clean the element.

22. Deterioration of the element is caused by ____________ and ______________.

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STUDY GUIDE AND WORKBOOK 3ABR91330-II-2f

DEPARTMENT OF BIOMEDICAL SCIENCES

PHYSICAL THERAPY SPECIALIST

THERAPEUTIC EXERCISE

June 1975

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

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Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

SW 3ABR91330-II-2f
June 1975

THERAPEUTIC EXERCISE

OBJECTIVE

After completing this studyguide and workbook you will be able to recognize and explain the classification, physiological effects, indications, contraindications, and the principles of application of therapeutic exercise.

INTRODUCTION

Therapeutic exercises are exercises which are prescribed by a physician, supervised or administered by a physical therapist or physical therapy technician, for the express purpose of maintaining or restoring function to a segment of the body. In physical therapy a large number of the patients that we see will require some form of therapeutic exercise in their treatment program; therefore, it is essential that you have a thorough understanding of all the aspects of therapeutic exercise.

INFORMATION

CLASSIFICATION

Passive Exercise

During passive exercise the therapist or technician moves the patient's joint through the range of motion. This type of exercise is used when the patient is unable to move the joint himself or for some reason the physician may not want him to do it himself. Generally this type of exercise is given to maintain function in a joint.

Active Assistive Exercise

In this type of exercise the patient moves the joint through the range of motion with the assistance of the therapist or technician. This type of exercise is used when the patient is able to do part of the work but must have assistance to complete the range of motion.

Active Exercise

In active exercise the patient moves the joint through its range of motion with his own voluntary muscle power. In this situation you become an instructor, the patient gets no physical assistance or resistance from you. Here you must think of the plane of movement as well as the position of the patient. If he is in a position where gravity is assisting him through the range of motion, it is not active exercise. It should always be against gravity so the patient will work at his maximum.

This supersedes SW 3ABR91330-II-2f, November 1974

Resistive Exercise

In this type of exercise the patient moves the joint through the range of motion against resistance offered by you (manual) or weights (mechanical). The amount of resistance given should be enough to cause the patient to work at his maximum. However, he should be able to move through the full range of motion with resistance.

TERMINOLOGY

Resistance

This is the opposition given to a muscular movement. The resistance offered may be manual or mechanical.

Repetitions

The number of muscular contractions. When you instruct a patient to extend his knee ten (10) times, this would be ten (10) repetitions.

Muscle Strength

The ability of a muscle to work against resistance.

Muscle Endurance

The ability of a muscle to perform repetitions.

Muscle Coordination

The united action of groups of muscles to produce a well adjusted action.

Stretching

The passive movement of a muscle to lengthen its fibers. Stretching of the muscle fibers may be accomplished by the technician or the patient.

MUSCULAR CONTRACTIONS

Types

ISOMETRIC. The contraction of a muscle which produces little or no joint motion. A contraction in which the fibers of the muscle neither lengthen or shorten.

ISOTONIC. A contraction which produces motion at the joint. There are two types of isotonic contractions:

1. Concentric. The contraction of a muscle with the fibers shortening.
2. Eccentric. The contraction of a muscle with the fiber lengthening.

PHYSIOLOGICAL EFFECTS

1. Increased local circulation.
2. Increased lactic acid levels within the muscle.
3. Muscle hypertrophy depending upon the degree of exercise.

4. Improved neuromuscular coordination.

INDICATIONS

1. Loss of muscle tone or strength.
2. Loss of joint range of motion.
3. Postural defects.
4. General reconditioning.
   a. Debilitating conditions.
   b. Diversional activities.
5. Certain respiratory conditions.
6. Certain vascular disorders.

CONTRAINDICATIONS

1. Advanced cardiovascular disease.
2. Non-union fractures.
3. Dislocations or joint disorders requiring immobilization.

GENERAL CONSIDERATIONS

1. Proper environment.
   a. Room temperature approximately 70°F.
   b. Adequate ventilation and lighting.
2. Patient needs proper clothing which is not restrictive.
3. Clear, concise instructions.
4. Patient motivation.
5. Sufficient rest periods.

TECHNIQUE FOR MANUAL THERAPEUTIC EXERCISE

1. Patient position. Supine (except for extension of shoulder and hip - prone) with body in good anatomical alignment.

2. Technician position. The technician should assume a position which is stable, comfortable, and permits ease of movement as the patient's joint is carried through its range of motion. A step stool may be used if the technician is short.

3. Provide firm support above and below the joint being exercised.

4. During passive exercise keep the movement well within the limits of pain.

5. During resistive exercise administer only enough pressure to cause the patient to work to his maximum.

BASIC PRINCIPLES OF GOOD INSTRUCTION

1. Plan instruction in advance. Have a handout or know what you are going to teach him.

2. Tell the patient what you want him to do. Now you assume the role of an instructor; tell him what you want him to do and how it is to be done.

3. Give step-by-step breakdown of the task. Keep each step simple and give them in small steps.

4. Demonstrate activity for the patient. Show him the correct way to do each step.

5. Have patient perform step-by-step. Make sure he can do each step. Have him demonstrate each one to you before moving on to the next.

6. Correct errors immediately. If he makes an error, stop him and correct him. Don't let him do it half right. Make sure he is doing it correctly the first time.

7. Keep instructions and steps simple. Let the patient know what his goal is and give him simple steps to accomplish it.

8. Be sure established goals are feasible and attainable by the patient. If not, patient will lose his motivation and desire.

EXERCISE ROUTINES

Passive Stretching

TECHNIQUES

1. Select the optimum position for exercising the patient.
2. Give support above and below the joint being exercised.
3. Move the joint to the point of pain.
4. Hold the joint at the point of pain for a short period of time to allow the muscles and soft tissue joint structures to stretch.

INDICATIONS

1. Muscle contractures
2. Muscle spasticity
3. Joint capsule adhesions
4. Tendon capsule adhesions

CONTRAINDICATIONS

1. Non-union or healing fractures

2. Osteoporosis

3. Bone diseases

MUSCLE GROUPS MOST FREQUENTLY STRETCHED

1. Gastrocsoleus

2. Hamstrings

3. Thigh adductors

4. Hip external rotators

5. Arm extensors, adductors, and internal rotators

6. Hand and finger flexors

Progressive Resistive Exercise

TERMINOLOGY. You need to know the following terms.

1. Set. A given number of repetitions with an assigned weight. There are usually ten (10) repetitions per set and three sets per treatment period.

2. Load. The resistance used for a given set.

3. Progressive Resistive Exercise. A program designed to improve a patients functional ability (strength and endurance) through resistive exercise. The program begins at the patient's tolerance and is progressive in resistance offered until the desired goal is reached.

4. Repetitive Maximum. The maximum weight a muscle can lift through its full range of motion ten (10) times. The muscle should be fatigued by the tenth contraction.

TECHNIQUE. A basic technique for administering progressive resistive exercises follows.

1. Establish the repetitive maximum for the patient by approximating muscle strength.

2. Administer the program once daily or twice daily depending on whether the patient is an in-patient or an out-patient.

a. The first set consists of 10 repetitions with a load of 1/2 of the repetitive maximum.

b. The second set consists of 10 repetitions with a load of 3/4 of the repetitive maximum.

c. During the third and final set, the patient lifts the repetitive maximum ten times.

d. The repetitive maximum is increased as the patient's strength and tolerance increases.

KNEE ROUTINE

Purpose

PRE-OP. To build up strength and increase range of motion prior to surgery.

POST-OP. Getting the quadriceps to function, regaining normal range of motion, increase strength and endurance of the quadriceps to protect the knee during ambulation.

PRE-OP CLINIC. During the initial pre-op visit the following will be accomplished.

1. Explain the purpose and objectives of the physical therapy treatment.

2. Measure and record the range of motion of both the affected knee and the unaffected knee.

3. Test for the repetitive maximum on both knees when possible.

4. Instruct the patient in static quadriceps setting and SLR (straight leg raise) exercises.

5. When possible, fit a pair of crutches and instruct patient in the proper crutch gait.

POST-OP WARD. The following procedure is generally followed.

1. Patient is usually seen on the ward the same day of surgery.

2. Patient is instructed to start on quad setting immediately and to perform a set number every hour. The number will vary, up to 50 per hour.

3. Patient instructed to start performing SLR every hour. The number of SLR's will vary, to 30 per hour.

POST-OP CLINIC. The length of time between surgery and the initial visit to the clinic will vary from hospital to hospital, doctor to doctor, and patient to patient. When the patient does come to the clinic the following procedures are generally followed.

1. Routine begins with 30 quad sets.

2. Fifteen SLR's

3. Fifteen repetitions through the last 15° of extension.

4. Active flexion and extension to gain range of motion. Number of repetitions will vary depending on the patient, generally about 30 repetitions per visit is sufficient.

5. Begin PRE at the point established by local guide lines.

6. Ambulation begins at point established by local guidelines. When patient begins ambulation stress the following:

   a. Tighten the quads.

   b. Have the heel contact the ground first.

c. Keep the knee straight as the heel makes contact with the ground.

ANKLE ROUTINE

Post-op (or post-injury)

The following procedure may be followed.

1. Gentle active range of motion.
2. Graduate to ankle exerciser.
3. Use PRE for building strength and endurance.
4. Begin ambulation at the point established by local guidelines.

CODMAN'S AND PENDULUM EXERCISE

Purpose

To maintain or gain range of motion at the shoulder joint with minimal muscular contraction. This exercise routine is used after most surgical procedures to the shoulder and when there is limited motion as the result of some conditions such as bursitis, etc.

Procedure

The following procedure is generally followed. (See figure 1)

1. Stand with knees straight and feet apart.
2. Bend forward at the hips and maintain this position by leaning on the plinthe or table with the unaffected arm.
3. Involved shoulder hangs relaxed like a pendulum.
4. Swing arm forward and backward (pendulum exercise).
5. Swing arm across the front of the body and out to the side (pendulum exercise).
6. Swing arm in circumduction (Codman's exercise).
7. Program may be done with a light weight held in the hand of the affected arm.
8. Program is usually done twice a day with 15 minute exercise periods.

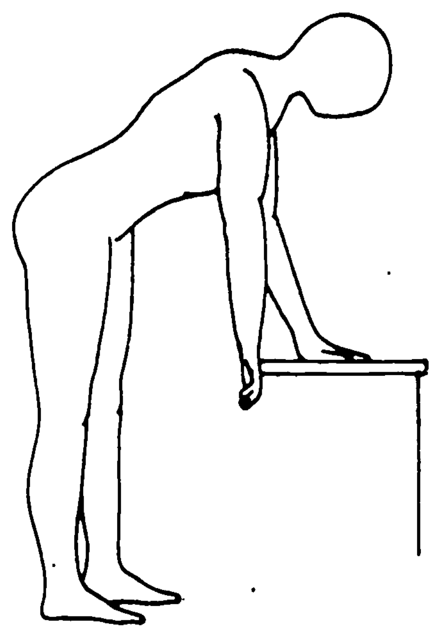


FIGURE 1

Position for Codman's and Pendulum Exercise

WILLIAM'S FLEXION EXERCISE

Purpose

The purpose of William's Flexion Exercises is to relieve chronic low back strain by:

1. Strengthening abdominal muscles.
2. Stretching tight low back and posterior thigh muscles.
3. Increasing general flexibility.
4. Improving posture.

Technique

The following set of exercises is referred to as William's Flexion Exercises and are used in all the physical therapy clinics throughout the Air Force. They may vary slightly from clinic to clinic, but the basic principles will remain constant.

PELVIC TILT. Lie on your back with your arms at your side. Your knees should be flexed so that your feet are flat on the plinthe. Your legs should be relaxed. The following sequence should be followed.

1. Squeeze your buttocks together and pull your abdominal muscles tight to tilt your pelvis up and forward and flatten your low back against the plinthe.
2. Hold this position while breathing in and out 3 times.
3. Relax completly. Repeat the exercise five (5) times. (See figure 2)

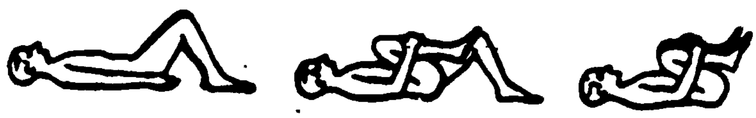
a. Fig. 2 b.

a. Starting position for doing the pelvic tilt. b. Position with the pelvis tilted.

SINGLE AND DOUBLE KNEE TO SHOULDER (Knees-to-chest). The position for this exercise is supine with a pillow under your head, both knees are bent and the soles of the feet are flat on the plinthe. The following sequence should be followed.

1. Lift your right knee, grasp it with both hands and pull it toward your right shoulder, then gently pull with five (5) easy, bouncing movements.
2. Return to starting position. Repeat the same procedure with the left knee. Continue, alternating knees for a total of ten (10) repetitions.
3. Lift both knees, grasping one knee with each hand and pull them toward your shoulders, then gently pull with five (5) easy, bouncing movements.

4. Return to the starting position and repeat the procedure for a total of five (5) repetitions. If this exercise is done correctly, you will feel the stretch in your low back and the back of your hips will come off the plinthe with each pull. (See figure 3.)



a. Fig 3 b. c.

a. Starting position. b. Single knee to shoulder. c. Double knee to shoulder.

CURL UPS (Partial-to-full sit ups). Lie on your back, pillow under your head, knees bent and feet flat on the plinthe. Cross your arms over your chest with your right hand touching your left shoulder and your left hand touching your right shoulder. The following sequence should be followed.

1. Tuck your chin to your chest and "Curl Up" toward a sitting position, raising your shoulders as far off the plinthe as possible (Do not perform a full sit-up).

2. Uncurl and return to the starting position. Repeat the exercise five (5) times. Remember - your knees must be bent!

Do not have anyone hold your knees or feet. You are not expected to come to a full sitting position. Just "curl up" and lift your shoulders as far as you can off the plinthe. (See figure 4)

Fig 4

HAMSTRINGS STRETCH. The starting position for this exercise is on your back with your legs straight. The following sequence will be followed.

1. Flex the right hip to 90° and let the knee bend. The thigh should be pointing toward the ceiling.

2. Using both hands support the thigh to maintain this position.

3. Extend the right knee using a very strong contraction of the quadriceps muscles. Hold the knee straight for at least five (5) seconds, then let the quadriceps muscles relax and the knee flex and rest a few seconds. Repeat this movement five (5) times.

4. Return to the starting position and repeat steps 1, 2, and 3 using the left leg.

5. When doing this exercise a stretching pull should be felt at the back of the knee and the thigh. (See figure 5)

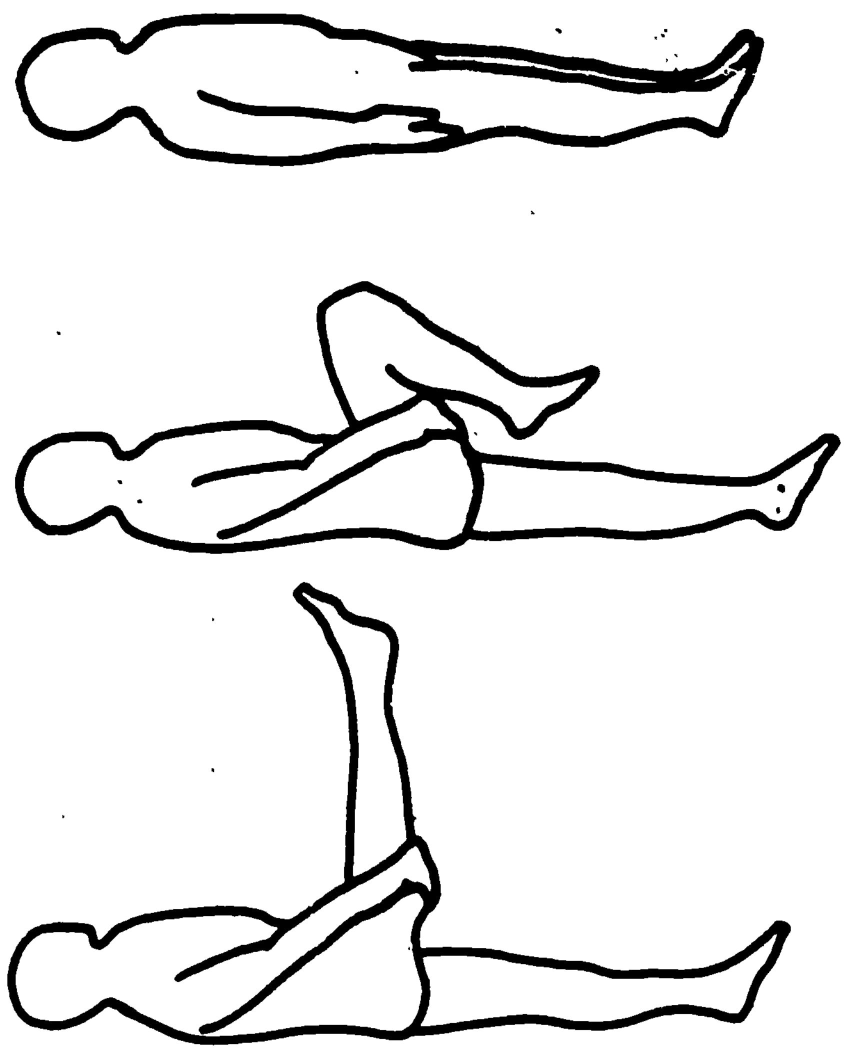


FIGURE 5

Positions for Hamstrings Stretch

FLEXION REST POSITION. This is just what it says, a rest position. Lie on your back with a pillow doubled under your head. Your hips and knees should be at 90° with your feet on a chair or couch (in a sitting position lying down). The reason for this exercise is to straighten out the lumbar curve and to relax the back muscles. (See figure 6)

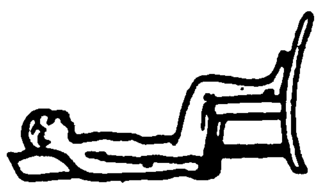


FIGURE 6

BASIC RULES. Go over these rules with the patient.

1. Learn to live 24 hours a day without a hollow in the lower part of your back.

2. Never bend backwards. Demonstrate to patient.

3. Squat. Don't bend back. Demonstrate.

4. Do not lift loads in front of you above waist.

5. <u>When lying down on back</u>: Place pillow under knees. <u>When on side</u>: Place pillow between knees. <u>When on abdomen</u>: Place pillow under abdomen.

REVIEW EXERCISE

1. When the therapist or technician moves the patient's joint through the range of motion, this is called ______________________.

2. Active-Assistive exercise is when ______________________
____
______________________.

3. Exercise is considered Active when ______________________
____
______________________.

4. Resistive Exercise is when ______________________
______________________.

5. Opposition given to a muscular movement is called ______________________.

6. Repetitions are defined as ______________________
______________________.

7. The ability to work against resistance is ______________________.

8. Muscle coordination is ______________________
____
______________________.

9. Stretching is defined as ______________________
____
______________________.

10. Define Isometric Contraction ______________________
____
______________________.

11. Define Isotonic Contraction ______________________
____
______________________.

12. Define Concentric Contraction ______________________
____
______________________.

13. Define Eccentric Contraction ____
____.

14. List three (3) of the physiological effects of exercise ____________________
____
____
____.

15. List four (4) indications for therapeutic exercise
____
____
____
____

16. List three (3) contraindications for therapeutic exercise __________________
____
____.

17. When administering manual therapeutic exercise, the patient will usually be in ____________________________________ position.

18. When administering manual therapeutic exercise, provide firm support ____________
____
____.

19. During passive exercise keep the movements well within ____________________
____.

20. During resistive exercise administer only enough pressure ____________________
____.

21. When instructing the patient in exercise, be sure to establish goals that are
____
____
____.

22. During passive stretching, move the joint to the ____________________________.

23. List three (3) indications for passive stretching ______________________

____

____

____.

24. List two (2) contraindications for passive stretching ______________________

____

____.

25. What are three (3) of the muscle groups most frequently stretched?

____

____

____

26. A set is defined as ____

____.

27. Repetitive Maximum is defined as ______________________________________

____

____.

28. The second set of a Progressive Resistive Exercise program is ______________

____.

29. The purpose of a Pre-Op knee program is __________________________________

____

____.

30. The purpose of a Post-Op knee program is _________________________________

____

____

____.

31. The purpose of Codman's and pendulum exercises is _________________________

____

____

____.

32. The purpose of William's Flexion Exercise is to ______________________________

____

by ____

____

____

____.

PREPARE THE MAN

STUDY GUIDE AND WORKBOOK 3ABR91330-II-2e

42 32

DEPARTMENT OF BIOMEDICAL SCIENCES

PHYSICAL THERAPY SPECIALIST

THERAPEUTIC TESTS AND MEASUREMENTS

September 1974

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

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Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

SW 3ABR91330-II-2e
September 1974

THERAPEUTIC TESTS AND MEASUREMENTS

OBJECTIVE

After completing this study guide and workbook you will be able to recognize and explain the principles of joint range of motion, extremity girth, and leg length measurement.

INTRODUCTION

In physical therapy, as in other medical fields, there have to be methods by which we evaluate patients both for diagnosis and determining patients' progress. We use a variety of tests and measurements to evaluate the condition and the progress of the patients and their treatment programs. Therefore, it is necessary that you come familiar with the tests and measurements that you will be using in the physical therapy clinic.

INFORMATION

Tests and Measurements

TYPES. The first thing we must do is to make the distinction between tests and measurements. Tests are designed to measure knowledge, strength of a muscle, or the muscles reaction to a given stimulus. As you know, tests are assigned some form of grade to measure the degree of knowledge or performance possessed by the object or person being tested. Tests then are vehicles of measurement, and as such are subject to interpretation with the possibility of error. Measurements are not tests in the true sense of the word; in measurements you apply a calibrated device to a given object and read the differences in the extremes of the scale. With this in mind, let us list the tests and measurements most commonly used in physical therapy.

1. Manual Muscle Test: This test is administered to the patient by the physical therapist. It is the evaluation of muscle function to determine muscle weakness. While testing the muscle function, the therapist assigns a grade to the muscle according to its ability to perform (poor, fair, good, etc.). The grading system will be discussed in a later objective.

This supersedes SW 3ABR91330-III-5, May 1972

2. Joint Range of Motion: In this procedure the physical therapist or the physical therapy technician measures the amount of motion present at a joint using a device known as a goniometer.

3. Leg Length Measurement: This is the measurement of the bony length of the lower extremity using a tape measure and certain bony topographical landmarks on the patient's lower extremities.

4. Girth Measurement: The use of a linear tape to measure the circumference of a given area of the extremity. The purpose here is to measure the muscle bulk to compare it with the opposite leg.

5. Chest Measurement: The measurement of the chest with a linear tape to determine the amount of expansion.

There are other tests and measurements that are used in physical therapy such as electrical diagnostic tests, but the five that we mentioned will be the most commonly used tests and measurements.

USES.

1. Evaluation of ROM at a given joint. Here the measurement answers the question: How much motion is present in the joint?

2. They serve to evaluate the patient's progress. Is he gaining or losing motion?

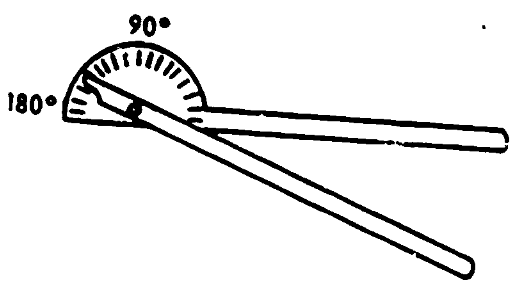
3. They serve to evaluate the patient's program. If the present program is not adequate, another approach may have to be tried.

4. They serve as a basis for exercise programs by describing the amount of motion at a joint for the muscles to work with and indicate the type of exercise to be used.

5. ROM measurements also provide a graphic record of the functional ability of a joint.

Goniometer

PARTS. The goniometer is an instrument designed to measure the angle and movements of joints. It will be easier to use the goniometer if you are familiar with the following parts.



1. Protractor: The protractor contains the degree scale, usually from 0° to 180°; however, it may be round and contain 360°.

2. Stationary arm: The stationary arm is an extension of the horizontal or 0° to 180° line.

3. Movable arm: The movable arm is attached to the protractor at a point called the axis and has a pointer which is used to indicate the degrees on the scale of the protractor.

Measuring and Recording

TECHNIQUE. For measuring and recording the following steps may be used.

1. In making a joint range of motion measurement, the first step is to locate the pertinent landmarks and to align the arms of the goniometer carefully so that the axis of the goniometer falls naturally in the region of the axis of motion of the joint. Either arm of the goniometer may be considered the stationary one, depending upon the position in which it must be placed to take specific measurements.

2. Consider the established zero starting position to be zero degree. In the measurement of most joint motions the arrow on the arm will point to 0° position on the protractor when the body part is in the zero starting position. But, in measuring the motion of some joints such as the ankle, the arm arrow will point to 90° position on the protractor when the joint is in the zero starting position. In these cases the 90° is read as zero degree, and the degrees of motion present are calculated accordingly.

3. In recording **degrees of motion**, use the word minus to indicate that the patient cannot move an affected part as far as the neutral zero degree starting position in the direction in which the measurement is being made.

4. Determine and record the normal limit of motion or standard for the patient. If the patient has a normal opposite joint, measure and record the motion of this joint. If it is applicable, you should record any pertinent facts related to the patient's age and physical characteristics.

5. Measure and record the degrees of motion in the affected part. Goniometric measurements are calculated from a neutral zero degree starting position or from a fully extended zero degree starting point.

From a Neutral Zero Degree Starting Position. With the affected part placed in the neutral zero degree starting position, move the part as far as possible in one direction and then in the other direction in a single plane of movement. Measure and record the number of degrees which the part can move in each direction. For example, assume that a patient's normal hip abduction is 45° and his normal hip adduction is 45° and that the hip moves 45° from the neutral zero degree starting position in the direction of abduction and 15° from the neutral zero degree starting position in the direction of adduction, he has normal abduction and a loss of 30° (45° - 15°) adduction. This is recorded as follows:

Abduction - Normal: 45°, abnormal part: 45°.

Adduction - Normal: 45°, abnormal part: 15°.

If a patient's joint motion impairment prevents movement of the affected part into the zero degree starting position, indicate this when measuring motion in the direction in which the impairment prevents movement, not in both directions. For example, when the part cannot be placed in the neutral zero degree starting position because the joint impairment prevents movement of the part in the direction of abduction, measure the number of degrees which the part lacks in reaching the neutral zero degree starting position. Use the word "minus" when recording this loss. If the patient lacks 10° reaching this neutral position and his normal hip abduction is 45°, he has lost 55° (10° + 45°) of abduction. This is recorded as follows:

Abduction - Normal: 45°, abnormal part: Minus 10°, Total Loss 55°.

In measuring adduction of this same hip, disregard the fact that the affected part is not in the neutral zero degree starting position and measure the position to which the part can be moved. If his normal adduction is 45° and the part can be moved to a 30° position, this is recorded as follows:

Adduction - Normal: 45°, abnormal part: 30°.

From a Fully Extended Zero Degree Starting Position. First, with the affected part extended to the zero degree starting position or as close as possible to this anatomical position, if impairment prevents full extension, measure the position of the joint. Second, with the affected part flexed to the maximum extent, measure the position of the joint. Assuming that the patient's knee, on the affected side, has a 10° flexion deformity which prevents the knee from being placed in the fully extended zero degree position, and that maximum flexion of the affected knee is 100°, he has a motion from 10° to 100° (a range of 90°). This is recorded as follows:

Extension to flexion: Normal knee joint: 0° to 135° (Range 135°).

Abnormal knee joint: 10° to 100° (Range 90°).

Measurement of Specific Joints

THE HIP JOINT. The zero degree starting position for measuring the motions of the hip is a neutral position. This neutral position is the anatomical position except for internal and external rotation measurements which require a special neutral position.

In assessment of hip movement, differentiation is carefully made between true hip joint movements and movements occurring in the pelvis and low back. Changes in the lumbar curve and in the level of the anterior superior iliac spines of the ilium indicate that movement is occurring in the back or pelvis.

During the measurement process an assistant supports the weight of the lower limb.

When there is a hip flexion contracture, movement in the direction of extension is also measured, with the pelvis and back firmly stabilized by flexion of the unaffected hip and knee.

THE KNEE JOINT. The zero degree starting position for measuring motion of the knee is a fully extended position which is the anatomical position for the knee.

Active knee extension is measured with the thigh supported and the hip flexed slightly.

Tightness of the quadriceps or the hamstrings is noted only when their lengths in the affected limb are less than those in the unaffected one.

Extension beyond the zero degree starting position (hyperextension), abduction, and adduction are noted as hypermobility, since these are excessive motions regardless of whether they occur in the affected or the unaffected extremity.

Fixed deformities, such as genu valgum or genu varum, are measured and recorded in degrees under remarks on SF 527a.

THE ANKLE JOINT. The zero degree starting position for measuring motion of the ankle is a neutral position which is the anatomical position of the ankle.

Measurement of the ankle joint will, of necessity, include some movement occurring at the midtarsal joints.

Tightness or contracture of the gastrocnemius is determined by measuring dorsiflexion with the knee flexed and by observing whether more motion is present in this position than with the knee extended.

The moving arm of the goniometer carefully aligned along the edge of the heel and with the head of the fifth metatarsal.

JOINTS OF THE FOOT. The zero degree starting position for measuring motion of the foot is a neutral position which is the anatomical position for the foot.

Movements of the foot are difficult to measure accurately with a goniometer because any motion of the foot represents the combined simultaneous movement of a number of tarsal joints. Furthermore, it is difficult to measure the slight but often important motions of the joints in the foot because the bony prominences interfere with alignment of the goniometer.

Estimation of motion by an experienced examiner may be the method of choice in assessing motion of certain joints. Care must be taken to differentiate movements occurring in the ankle, subtalar, and midtarsal joints. Each movement in the affected part should be compared with its unaffected counterpart.

THE SHOULDER JOINT. The zero degree starting position for measuring the shoulder is a neutral position. This neutral position is the anatomical position except for internal and external rotation measurements which require a special neutral position.

Clinical measurements of the shoulder refer to the arm-trunk angle rather than the scapulohumeral angle. Thus, completion of the motions requires that three bones, the humerus, the scapula, and the clavicle, be free to move. If the normal arm-trunk angle, the result of the combined movement of the three bones, is decreased, it becomes necessary for the examiner to observe the relationship between the movements of the clavicle, scapula, and the humerus to locate and identify the nature of the movement disorder. For example, in shoulder abduction above 30°, the humerus normally moves about 2° for every 1° the scapula moves. A contracture of the teres major muscle will limit the movement of the humerus and will alter the normal relationship so that the scapula moves more freely than the humerus.

The shoulder is capable of movement about a number of oblique axes. Terms coined to describe other movements of which the shoulder is capable are frequently encountered. They include--

Horizontal adduction or horizontal flexion. The movement of the humerus in a horizontal plane from posterior to anterior.

Horizontal abduction or horizontal extension. The movement of the humerus in a horizontal plane from anterior to posterior.

THE ELBOW JOINT. The zero degree starting position for measuring motion of the elbow is a fully extended position which is the anatomical position for this joint.

Extension beyond the zero degree starting position is called hyperextension, since this is excessive motion regardless of whether it occurs in the affected or the unaffected extremity.

THE RADIO-ULNAR JOINTS. The zero degree starting position for measuring the supination and pronation is a special neutral position.

In order to obtain a true measurement of supination and pronation, shoulder internal and external rotation must be prevented by keeping the elbow flexed and held closely to the side.

The palm of the hand may move more than the forearm because of movement in the radiocarpal or intercarpal joints. The measurement should reflect, if possible, only the motion of the forearm. Excessive motion at the wrist may be noted.

THE WRIST JOINT. The zero degree starting position for measuring the wrist is a neutral position. This neutral position is the anatomical position.

When measuring wrist extension and flexion, the fingers should be relaxed as the movements proceed. From normal tendon action, the fingers will assume a slightly flexed position as the wrist is extended and an extended position as the wrist is flexed. If these movements of the relaxed fingers occur sooner or to a greater degree on the affected side than they do on the unaffected side, this should be noted, as it is usually an indication of abnormal shortening of either the long finger flexors or the extensors.

JOINTS OF THE HAND AND FINGERS. The zero degree starting position for measuring the movements of the metacarpophalangeal joints of the fingers is a neutral position.

The zero degree starting position for measuring the movements of the interphalangeal joints of the fingers is a fully extended position which is the anatomical position of these joints.

The mobility of the carpometacarpal joints of the hand should be examined. The second and third metacarpals normally are somewhat fixed, but the fourth and fifth metacarpals have considerable mobility on the carpus (hamate). This mobility gives strength to the hand when grasping a cylindrical or round object such as a handle or a doorknob. A loss of the ability to make a metacarpal arch is a serious deficit to hand function.

A deformity of the wrist, particularly flexion, will limit range of motion in the fingers because of tendon stretch.

The fingers usually are referred to as index, middle, ring, and little to avoid confusion.

JOINTS OF THE THUMB. The carpometacarpal joint of the thumb is a unique joint in the human body both in structure and function.

The zero degree starting position for measuring the movements of the metacarpophalangeal and interphalangeal joints of the thumb is a fully extended position which is the anatomical position for these joints.

Normally, the metacarpophalangeal joint of the thumb has a slight ability to abduct, to adduct, and to rotate in the direction of thumb opposition. Passive movement in these directions can readily be demonstrated in the normal thumb if the metacarpophalangeal joint is slightly flexed and the first metacarpal stabilized to prevent movement at the carpometacarpal joint.

Hyperextension of the distal interphalangeal joint is frequently present, thus allowing one to position his thumb as if he were pushing in a thumb tack.

When measuring the active motion of opposition, the position of the thumb nail at the completion of the motion should be observed to assure that the muscles of the thumb are functioning properly. When the muscles of the thumb are relaxed and the thumb is at the side of the hand, the thumb nail normally assumes a position at right angle to the palm. At the completion of the normal movement of opposition, the thumb nail is held parallel to the palm of the hand by the thumb musculature.

Extremity Girth Measurement

METHODS. Girth measurements are always taken bilaterally for the purpose of comparison. They reveal any difference or changes in the size of the muscles. In order for the comparison to reveal any difference the measurements must be taken carefully and systematically. Bony landmarks and distances are used to measure the girth in the same area each time. The following methods of girth measurements are most frequently used to provide uniform data.

1. Thigh measurements are taken by measuring a specified distance above the base of the patella. The distance that is used will vary slightly from clinic to clinic, but within each clinic the same distance must be used when making the measurement. In this course we will use 5 inches above the base of the patella for our measurements.

2. Leg measurements are taken by measuring a specified distance below the apex of the patella. Again, the distance that is used will vary slightly from clinic to clinic, but within each clinic the same distance must be used when making the measurement. In this course we will use 5 inches below the apex of the patella for our measurements.

3. Arm and forearm girth measurements are performed similar to those in the lower extremity. In this course we use 4 inches above the olecranon process for arm girth measurements and 4 inches below the olecranon process for the forearm girth measurements.

RULES. Application of the tape measure must be done precisely to obtain uniform results. The following techniques should be observed when applying the tape measure.

1. Never apply the tape over clothing.

2. Apply the tape over relaxed and undistorted muscles.

3. Apply the tape with even pressure so it will fit snugly against the part.

4. Apply the tape at right angles to the surface of the area.

Leg Length Measurement

TECHNIQUE. Leg length measurements are taken to reveal differences in leg length. Therefore, it is necessary to take a measurement of both legs for comparison. The technique for leg length measurement is listed below.

1. Have patient remove appropriate clothing (trousers, dress, etc., drape as necessary).

2. Measurement is taken with the patient in the supine position.

   a. Align body in a straight line.

   b. Knees should be extended.

   c. No hip rotation, knees in neutral position.

   d. Measure from ASIS to the medial malleolus.

   e. Measure both legs and record findings on AF 1412.

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Chest Measurements

TECHNIQUE. Taking chest measurements are similar to taking girth measurements. The same principles in applying the tape measure are used and the bony landmark is the xiphoid process. In chest measurements we are interested primarily in the amount of expansion of the chest and not the size of the chest. Therefore, we must measure the chest during inspiration and expiration and the difference in the measurement will be the amount of expansion. When taking chest measurements use the following steps.

1. Measure the patient sitting or standing with his arms at his side.

2. Measure forced inspiration.

3. Measure forced expiration.

4. Take the measurement at least twice.

5. Record measurement.

Standard Form 527-A
Rev. August 1954
Bureau of the Budget
Circular A-32

CLINICAL RECORD — JOINT MOTION MEASUREMENTS

DIAGNOSIS AND BRIEF CLINICAL HISTORY

Arthritis

REMARKS:

Please do total body ROM

LEFT								RIGHT				
					EXAMINER'S INITIALS							
					DATE							
				HIP	Flexion	0–125	HIP					
				HIP	Extension	0–10	HIP					
				HIP	Adduction	0	HIP					
				HIP	Abduction	0–45	HIP					
				HIP	Int. Rotation	0–45	HIP					
				HIP	Ext. Rotation	0–45	HIP					
				KNEE	Extension	0	KNEE					
				KNEE	Flexion	0–140	KNEE					
				ANKLE	Plant. Flexion	0–45	ANKLE					
				ANKLE	Dorsi Flexion	0–20	ANKLE					
				FOOT	Inversion	0–40	FOOT					
				FOOT	Eversion	0–20	FOOT					
				SHOULDER	Extension	0–45	SHOULDER					
				SHOULDER	Flexion	0–180	SHOULDER					
				SHOULDER	Adduction	0	SHOULDER					
				SHOULDER	Abduction	0–180	SHOULDER					
				SHOULDER	Int. Rotation	0–90	SHOULDER					
				SHOULDER	Ext. Rotation	0–90	SHOULDER					
				ELBOW	Extension	0	ELBOW					
				ELBOW	Flexion	0–145	ELBOW					
				FORE-ARM	Supination	0–90	FORE-ARM					
				FORE-ARM	Pronation	0–90	FORE-ARM					
				WRIST	Extension	0–70	WRIST					
				WRIST	Flexion	0–80	WRIST					
				WRIST	Ulnar Dev.	0–45	WRIST					
				WRIST	Radial Dev.	0–20	WRIST					

NOTE: The anatomical position is considered zero, and is the starting position with the exception of:
1. Shoulder rotation (shoulder abducted to 90°); 2. Supination and pronation (elbow flexed to 90°)

PATIENT'S IDENTIFICATION (For typed or written entries give: Name—last, first, middle; grade; date; hospital or medical facility)

Doe, John J. MSgt
4 May 197X SAFBMSS

REGISTER NO. | WARD NO.

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JOINT MOTION MEASUREMENTS
Standard Form 527-A
527-305

LEFT						RIGHT			
				EXAMINER'S INITIALS					
				DATE					
				HALLUX	HALLUX				
				TOES	TOES				
				THUMB	THUMB				
				FINGERS	FINGERS				

NOTE: For above measurements, insert joint and motion measured.

GIRTH MEASUREMENTS

				Thigh: ____ inches above Prox. Patellar Border Calf: ____ inches below Distal Patellar Border				

SIGNATURE OF PHYSICIAN

DATE

U.S. GOVERNMENT PRINTING OFFICE: [illegible]—O-[illegible]4744

[illegible]-130

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THERAPEUTIC TEST AND MEASUREMENTS

Procedure for Joint Measurement

1. The hip

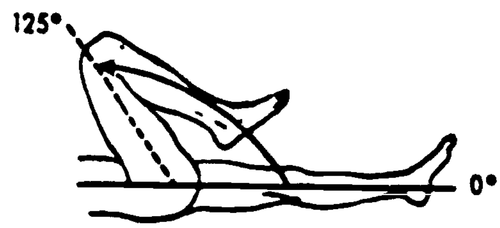

Figure 1 - Flexion

a. POSITION - Supine, knee flexed; opposite knee and hip straight

b. STATIONARY ARM - Parallel to long axis of trunk

c. MOVING ARM - In line with lateral midline of femur

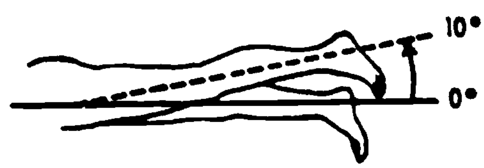

Figure 2 - Extension

a. POSITION - Prone

b. STATIONARY ARM - Par[illegible]l to long axis of trunk

c. MOVING ARM - In line with lateral midline of femur

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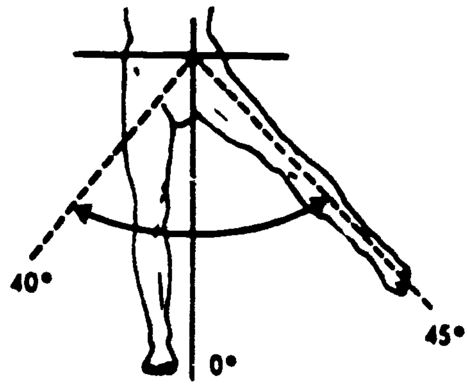


Figure 3 - Adduction and Abduction

a. POSITION - Supine

b. STATIONARY ARM - Perpendicular to a line connecting anterior superior iliac spines

c. MOVING ARM - In line with anterior midline of femur

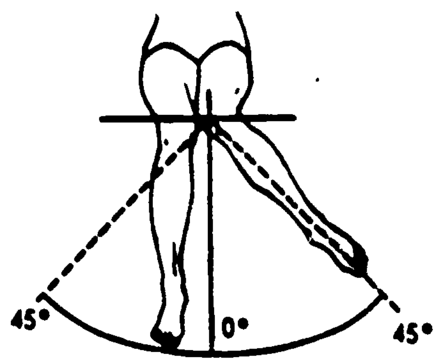


Figure 4 - Internal and External Rotation

a. POSITION - Sitting with knees flexed to 90°

b. STATIONARY ARM - Parallel to table top

c. MOVING ARM - In line with tibial crest

2. The knee

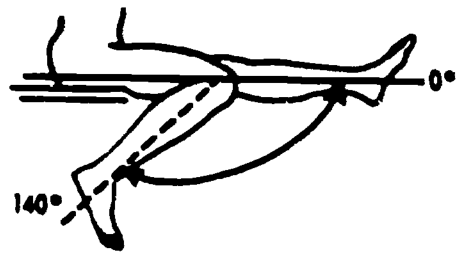


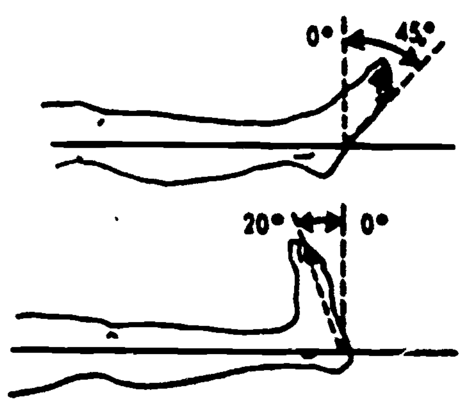
Figure 5 - Extension and Flexion

a. POSITION - Sitting with knee flexed

b. STATIONARY ARM - Parallel to femur on a line from the lateral condyle to greater trochanter

c. MOVING ARM - Parallel to fibula on a line with lateral malleolus

3. The ankle



Plantar Flexion and Dorsiflexion (Figures 6 & 7)

a. POSITION - Supine with heel over edge of table and knee extended

b. STATIONARY ARM - Parallel to fibula

c. MOVING ARM - In line with the lateral edge of the heel and the head of the 5th metatarsal

4. The shoulder

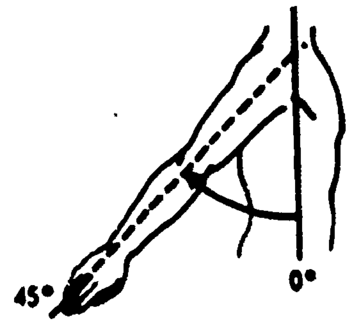


Figure 8 - Extension

a. POSITION - Standing, sitting, or prone, with elbow extended. Palm facing medially. Measure from lateral aspect of body.

b. STATIONARY ARM - Along midaxillary line of trunk

c. MOVING ARM - Along lateral midline of humerus

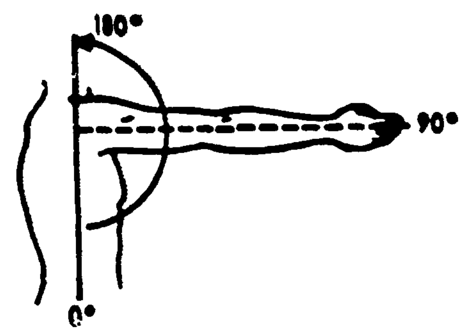


Figure 9 - Flexion

a. POSITION - Standing, sitting or supine with elbow extended. Palm facing medially. Measure from lateral aspect of body.

b. STATIONARY ARM - Along midaxillary line of trunk

c. MOVING ARM - Along lateral midline of humerus

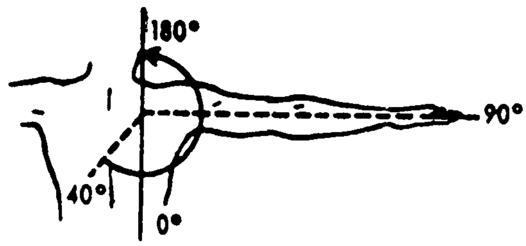


Figure 10 - Abduction and Adduction

a. POSITION - Standing or sitting

b. STATIONARY ARM - Parallel to spine, but at lateral aspect of body

c. MOVING ARM - Parallel to midline of humerus toward olecranon process

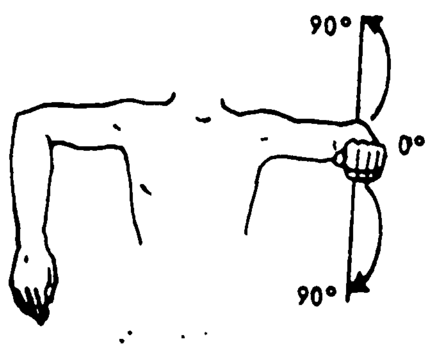


Figure 11 - Internal and External Rotation

a. POSITION - Patient supine. Arm abducted to 90°, elbow flexed to 90°, forearm in mid-position between supination and pronation, and perpendicular to table top. Humerus in contact with table top.

b. STATIONARY ARM - Parallel to table top with axis on olecranon process

c. MOVING ARM - On line with styloid process of ulna

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5. The elbow

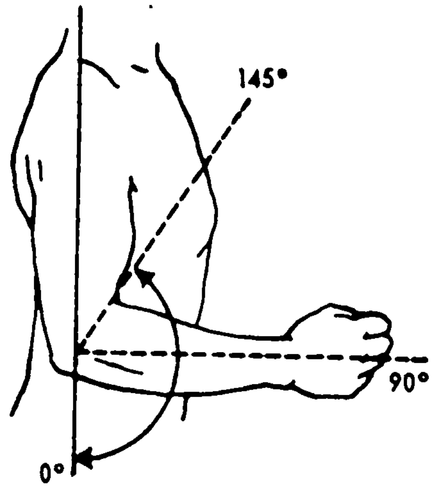

Figure 12 - Extension and Flexion

a. POSITION - Standing, sitting, or supine. Forearm in mid-position between supination and pronation.

b. STATIONARY ARM - Along midline of humerus

c. MOVING ARM - Along midline of dorsal aspect of forearm

6. The forearm

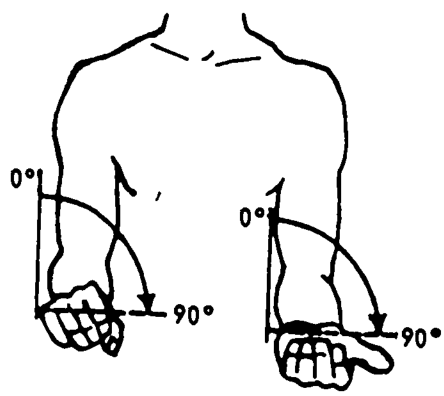

Figure 13 - Supination and Pronation

a. POSITION - Sitting or standing, with elbow flexed to 90°, forearm in mid-position between supination and pronation. Elbow held close to body.

b. STATIONARY ARM - Parallel to long axis of humerus with protractor medial to wrist

c. MOVING ARM - Placed across wrist on level between styloid processes of radius and ulna, at end of executed motion

Pronation (Figure 13)

a. POSITION - Same as for supination

b. STATIONARY ARM - Parallel to long axis of humerus with protractor lateral to wrist

c. MOVING ARM - Same as for supination

7. The wrist

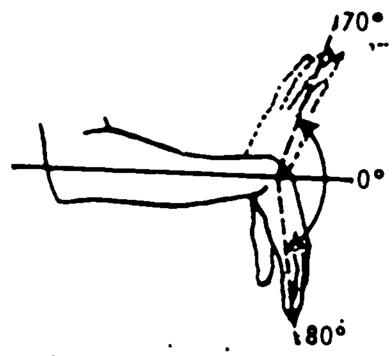

Figure 14- Extension and Flexion

a. POSITION - Sitting or standing with elbow flexed and forearm in pronation

b. STATIONARY ARM - Along lateral midline of forearm

c. MOVING ARM - Parallel to 5th metacarpal

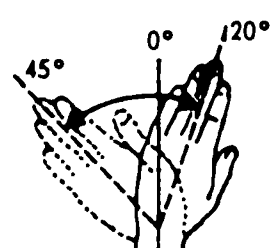

Figure 15 - Ulnar and Radial Deviation

a. POSITION - Third metacarpal in line with midline of the forearm

b. STATIONARY ARM - Along dorsal midline of forearm

c. MOVING ARM - In line with 3rd metacarpal

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8. The fingers

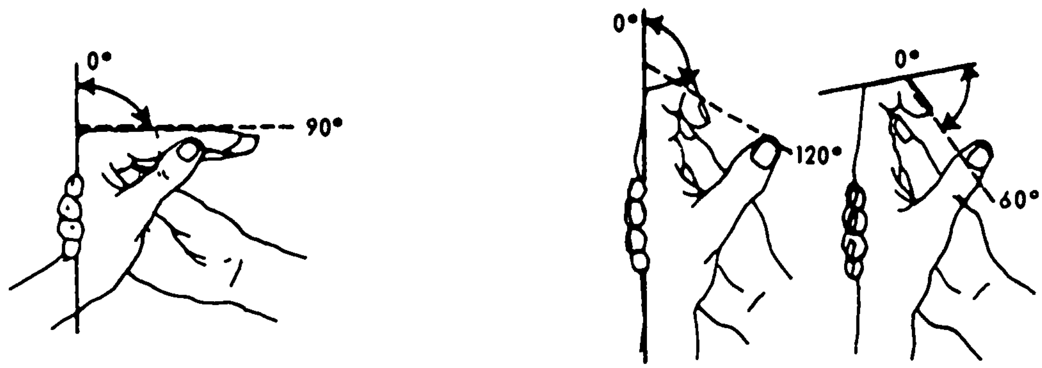

Figure 16 - Flexion and Extension

a. POSITION - Wrist in extended or neutral position

b. STATIONARY ARM - Along midline of dorsal surface of metacarpal or phalanx

c. MOVING ARM - Along dorsal surface of phalanx distal to joint being measured

9. Joint Motion & Range

	Joint	Movement	Range of Motion in Degrees
a.	Hip	Flexion	0-125
		Extension	0-10
		Adduction	0-40
		Abduction	0-45
		Internal Rotation	0-45
		External Rotation	0-45
b.	Knee	Extension	0
		Flexion	0-140
c.	Ankle	Plantar Flexion	0-45
		Dorsi Flexion	0-20
d.	Foot	Inversion	0-40
		Eversion	0-20
e.	Shoulder	Extension	0-45
		Flexion	0-180
		Adduction	0-40
		Abduction	0-180
		Internal Rotation	0-90
		External Rotation	0-90
f.	Elbow	Extension	0
		Flexion	0-145
g.	Forearm	Supination	0-90
		Pronation	0-90
h.	Wrist	Extension	0-70
		Flexion	0-80
		Ulnar Deviation	0-45
		Radial Deviation	0-20
i.	Finger	Flexion	
		Metacarpophalangeal	0-90
		Proximal Interphalangeal	0-120
		Extension	
		Metacarpophalangeal	0
		Proximal Interphalangeal	0
		Distal Interphalangeal	0
		Abduction	0-30

REVIEW EXERCISE

1. Manual Muscle Tests are administered to the patient by the ______________________ ____________________________.

2. On a Manual Muscle Test, muscles are graded according to ______________________ ____________________________.

3. The device used to measure joint range of motion is called a ______________.

4. Leg length measurement is the measurement of the ______________________ of the lower extremity.

5. Measuring the circumference of an extremity is called a ______________________ measurement.

6. Chest measurements are made to determine the amount of ______________________.

7. List the five uses for Range of Motion measurements.

   a.

   b.

   c.

   d.

   e.

8. The ______________________ of the goniometer usually has a scale of 0° to 180°.

9. The ______________________ arm is an extension of the horizontal or 0° to 180° line.

10. The first step in making a range of motion measurement is to ______________ ______________________________ and to ______________________ ____.

11. The starting position for most joint measurements is considered to be ________ degrees.

12. In recording degrees of motion, the word minus is used to indicate __________ ____ ____.

13. To determine what the patient's normal range of motion should be in the affected leg you would measure ______________________________ ____.

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14. Goniometric measurements are calculated from a ____________________
____
____.

15. For most measurements the normal anatomical position is considered the
____
____.

16. Movements occurring in the ________________ and ________________
__________________ will affect measurements made at the hip joint.

17. Active knee extension is measured with the thigh supported and the hip
____.

18. Extension beyond the zero degree starting position are termed ____________.

19. Measurements of the ankle will include some movement in the ____________
______________________ joints.

20. In measurements of the shoulder joint the neutral position is the anatomical position except for __________________ and __________________.

21. To obtain a true measurement of supination and pronation, ______________
____
must be prevented.

22. When measuring wrist extension and flexion the __________________ should be relaxed.

23. To measure the girth of the thigh, the tape is placed 5 inches above the
__________________________ of the patella.

24. In measuring the girth of the upper extremity, the measurement is made 4 inches above or below the _______________________________.

25. The landmarks for leg length measurement are the ____________________ and the ______________________________.

26. The bony landmark for chest measurements is the ____________________.

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PREPARE THE MAN

STUDY GUIDE AND WORKBOOK 3ABR91330-II-~~2d~~ 4e

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DEPARTMENT OF BIOMEDICAL SCIENCES

PHYSICAL THERAPY SPECIALIST

TRANSFER ACTIVITIES AND GAIT TRAINING

September 1974

10-9

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

DO NOT USE ON THE JOB

377

PURPOSE OF STUDY GUIDES, WORKBOOKS, PROGRAMMED TEXTS AND HANDOUTS

Study Guides, Workbooks, Programmed Texts and Handouts are training publications authorized by Air Training Command (ATC) for student use in ATC courses.

The STUDY GUIDE (SG) presents the information you need to complete the unit of instruction, or makes assignments for you to read in other publications which contain the required information.

The WORKBOOK (WB) contains work procedures designed to help you achieve the learning objectives of the unit of instruction. Knowledge acquired from using the study guide will help you perform the missions or exercises, solve the problems, or answer questions presented in the workbook.

The STUDY GUIDE AND WORKBOOK (SW) contains both SG and WB material under one cover. The two training publications are combined when the WB is not designed for you to write in, or when both SG and WB are issued for you to keep.

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Training publications are designed for ATC course use only. They are updated as necessary for training purposes, but are NOT to be used on the job as authoritative references in preference to Technical Orders or other official publications.

Department of Biomedical Sciences
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

SW 3ABR91330-II-2d
September 1974

TRANSFER ACTIVITIES AND GAIT TRAINING

OBJECTIVE

Upon completing this unit of instruction you will be able to recognize and explain the principles of transfer activities and gaits.

INTRODUCTION

Many patients referred to the physical therapy clinic are unable to move themselves from the bed to chairs or from room to room because of their medical condition. For these patients it will be necessary for the physical therapy staff members to transfer or assist in transferring them. Other patients will not be able to walk independently and the physical therapy clinic will teach them to use assistive devices such as crutches and canes.

INFORMATION

TRANSFER METHODS

Wheelchairs

UNIVERSAL MODEL. This is the most common and popular type. It has the large wheels in the rear and is used for outdoor travel. It is a stable chair and is good to work out of. It can be moved up to a desk or table easily because of the large wheels in the rear. When the patient is wheeling himself, he is in an erect position. This wheelchair may be ordered in various sizes to fit a child or adult. There are two versions of the Universal model which are designed for two types of patients.

Amputee Wheelchair. This wheelchair is designed for individuals who have single or double lower extremity amputations. To compensate for the transfer of weight, due to the loss of the amputated extremities, the rear wheels are set back to maintain balance. The wheelchair is constructed without footrests but may be modified if the patient is going to use artificial limbs.

One-Arm-Drive Wheelchairs. This wheelchair is designed so individuals with a disabled hand or arm may propel and guide the wheelchair by using the non-disabled arm. Two handrims of different size are located on one side of the wheelchair. The outer handrim controls the opposite wheel. To move the wheelchair forward or backward in a straight line both handrims are grasped together. To turn the wheelchair to either the left or the right either handrim is moved independently.

Negotiating Curbs. The Universal model is the most convenient wheelchair to use when in rough terrain and negotiating curbs.

Down the Curb Forward. When going down the curb, roll the chair forward until the small front wheels are at the edge of curb. Now tip the chair up on the large rear wheels and let it slowly roll down the curb. When the chair is on the street level, tip the chair forward until the small front wheels are in contact with the street.

This supersedes SW 3ABR91330-II-2d, dated June 1970

Climb the Curb Forward. Roll the chair up to the curb, tip the chair back on rear wheels, roll chair forward on rear wheels until small front wheels are over the curb. Now let the chair tip forward until the small wheels are in contact with sidewalk, now lift chair until large wheels are over the curb and on the sidewalk level.

TRAVELLER MODEL. The Traveller has the large wheels in the front and is used indoors. However it is hard to get over obstacles but it is easier for the patient to control indoors since it can be turned in limited space.

Negotiating Curbs. The Traveller model is very inconvenient to use when in rough terrain or negotiating curbs.

Back Down the Curb. Back the chair to the curb until the small wheels in the rear are at the edge of the curb. Now let the chair roll back while supporting the weight of patient on chair until the small wheels roll down the curb to the street.

Back Up the Curb. When backing up the curb, bring the chair back to the curb until the small wheels are against the curb. Caution must be employed when lifting the chair and patient over the curb; you must stabilize the patient with a strap or by hand to prevent the patient from falling forward out of the chair. After lifting the small rear wheels to the sidewalk level, pull the large front wheels up the sidewalk level.

ACCESSORIES. When a wheel chair is ordered for a patient, it can be made to fit the needs of the patient by adding accessories which are available. From a safety stand point, the most important accessory is the brakes. Some of the other accessories available are detachable arms, swinging detachable elevating legrests, adjustable desk arms, detachable back, upholstered arm rests, heel and toe loops and motorization.

Transfer Techniques

PRINCIPLES. There are many different transfer techniques available, but there is not just "one correct" way for each technique available. Certain principles of transfer are to be followed for the safety of the patients and the physical therapy staff members working with the patients. The patients' medical condition, size of the room, placement of furniture in the room, and the amount of furniture in the room may make it impossible to transfer the patient using what may have been described as the "one correct" transfer technique. Most transfers are made toward the patient's uninvolved or stronger side, regardless of the cause of the patient's medical condition. For their personal safety and the patients safety, the physical therapy staff members are to use the body mechanics of lifting which are most suitable for the lifting situation they are in.

WHEELCHAIR TO PLINTH. To transfer the patient from a wheelchair to a plinth or bed, the following steps should be followed as closely as the situation and safety dictate.

1. Transfer is made toward the patients normal side.

2. Place the wheelchair at the head of the plinth or bed.

3. Lock the brakes.

4. Be sure the patient's feet are removed from the footrests on the wheelchair and [illegible] footrests.

5. The patient moves to the forward edge of the wheelchair.

6. Have the patient hold onto the wheelchair armrest with the uninvolved hand, place the uninvolved foot back beneath the forward edge of the seat of the wheelchair, lean forward, and push up with the uninvolved arm and leg to come to a standing position.

7. Move the uninvolved hand from the armrest of the wheelchair to the plinth or bed to maintain standing balance.

8. Pivot on the uninvolved foot into position to sit on the edge of the plinth or bed.

9. While leaning back, lift and swing the lower extremities onto the plinth or bed.

To transfer from the plinth or bed to the wheelchair the preceding steps maybe reversed. The wheelchair should be placed at the foot of the plinth or bed or on the opposite side at the head of the plinth or bed.

LITTER TO PLINTH. To transfer the patient from a litter to a plinth or bed, the following steps should be followed as the situation and safety dictate.

1. Place the litter next to the plinth or bed and hold them together during the transfer.

2. Insure that the plinth or bed and the litter will not move. Lock the brakes if they are available.

3. Have the patient roll or slide from the litter to the plinth or bed giving the assistance required to assure the patients safety.

The preceding steps may be followed when transferring the patient from a plinth or bed to a litter by reversing the patients direction of movement.

REVIEW EXERCISES

1. Which wheelchair is the most common and popular? ______________________

2. Which wheelchair has the large wheels in the front? ______________________

3. The ________________ wheelchair has the rear wheels set back to maintain ________________ and is constructed without ______________________.

4. The Universal Model is the most convenient wheelchair for ________________ travel.

5. The ________________ wheelchair is designed for persons with a disabled upper extremity.

6. When negotiating curbs the ________________ model wheelchair goes up and down curbs in the __________ position while the __________ model wheelchair is tipped ________ to go down the curb and tipped __________ to go up the curb.

7. The __________ are the most important accessory for all wheelchairs.

8. Most transfers are made__________ the patients __________ side.

9. It may be impossible to ____________ the patient using what may have been described as the ______________________________ transfer technique.

10. For the safety of ____________ and ____________ certain ____________ of transfer are to be followed.

11. When transferring a patient from a wheelchair to a plinth, place the ____________ at the ____________ of the ____________.

12. When transferring a patient from a litter to a plinth, the ________________ is placed ________________ to the ________________.

13. In patient transfer from litter to plinth insure that the ________________ and ________________ will not ________________.

GAIT TRAINING

Crutches

WOODEN AXILLARY, ADJUSTABLE. This is the crutch most frequently used in the physical therapy clinic. Most of them are made of selected hardwood which is laminated to assure strength and resilience. All the edges are rounded and the crutches have a smooth finish. The wood is protected with varnish. To adjust and fit a patient with a pair of wooden axillary crutches, you should become familiar with the following parts.

1. Axillary Bar. This is the part of the crutch which fits under the arm in the axilla providing underarm support.

2. Uprights. These are attached to the axillary bar and extend down to provide support for the handpiece and extension rod (centerpiece).

3. Handpiece. This is a round piece of wood which fits between the uprights providing a means for the patient to hold onto and control the crutches. The handpiece is adjustable either up or down the upright so the elbow may be positioned properly.

4. Extension Rod. This is also called a centerpiece. It is a long piece of wood which fits between the lower ends of the uprights. There are several holes in the extension rod making it possible to either lengthen or shorten the height of the crutch to fit the patient.

5. Crutch Tip. Made from rubber with a base of varying diameters, the crutch tip helps keep the crutch from slipping out from under the weight of the patient.

ACCESSORIES. The accessories include various sizes of crutch tips, pads or cushions for the axillary bar and handpiece, forearm support, crutch tip, ice grippers and a utility bag.

SIZES. These crutches are available in four different sizes: baby, child, youth and adult.

DESIGNS. There are several different designs of axillary crutches and most of these are constructed from aluminum tubing and are adjustable.

ADJUSTMENT AND FITTING. There are several ways in which axillary crutches may be adjusted and fitted. The following procedure for adjusting and fitting has been used successfully, but is not the only procedure available for use.

1. Find out how tall the patient is.

2. Refer to crutch adjustment chart for approximate adjusted size of the crutch for the patient's height. (Chart follows step 15).

3. Remove extension rod nut and bolt closest to tip of crutch.

4. Remove extension rod nut and bolt closest to crutch handpiece.

5. Move crutch extension rod to desired position.

6. Replace extension rod bolt and nut closest to handpiece. Do not tighten.

7. Replace extension rod bolt and nut closest to crutch tip. Do not tighten.

8. Check for correct fit.

   a. Tip of crutch at a 45° angles about 6 inches from toes.

   b. Axillary bar two finger widths below the axillary fold.

   c. If fit is not correct, repeat steps 3 through 8 to make adjustment and recheck for correct fit.

9. Tighten nuts of both entension rod bolts.

10. Check handpiece for correct height, not to exceed 30° elbow flexion.

   a. If height is not correct, go to step 11 through 14.

   b. If height is correct, go to step 15.

11. Remove handpiece nut and bolt.

12. Slide handpiece up or down to correct position.

13. Replace handpiece bolt and nut. Do not tighten.

14. Recheck handpiece for correct height.

   a. If correct, go to step 15.

   b. If incorrect, repeat steps 11 through 14.

15. Tighten handpiece nut.

CRUTCH ADJUSTMENT CHART

Patient Height	Number of Holes Showing
5' 2"	0
5' 3"	0
5' 4"	1
5' 5"	2
5' 6"	3
5' 7"	3 or 4
5' 8"	4
5' 9"	5
5' 10"	6
5' 11"	7
6'	8
6' 1"	9
6' 2"	9

NOTE: The crutch adjustment chart only gives the approximate size of the crutch for the patient's height. Always check for correct fit.

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METAL FOREARM, ADJUSTABLE. This type of crutch is most frequently referred to as the Lofstrand or Canadian crutch. These crutches are used infrequently in the physical therapy clinic. They are constructed from lightweight aluminum tubing. The forearm crutch is designed for patients who do not require any underarm support. To adjust and fit a patient with a pair of metal forearm crutches you should become familiar with the following parts.

1. Forearm Cuff. This is a metal cuff which is contoured to fit around the forearm. The cuff is designed to allow the patient greater use of his hands since the cuff keeps the crutch from dropping when the handpieces are released. The forearm cuff is attached to the top of the upright and its height may be adjustable.

2. Handpiece. This is a structure attached to the upright providing a means for the patient to hold onto and control the crutches. Most of the handpieces are contoured to fit the hand. The handpiece is not adjustable.

3. Upright. The upright is constructed from aluminum tubing. It has the forearm cuff, handpiece and extension rod attached to it. There are a series of holes in the lower end which are used for height adjustment.

4. Extension Rod. The extension rod is constructed from aluminum tubing having a series of holes in its upper end which are used for height adjustment. Some extension rods are equipped with a push-button mechanism which is used for height adjustment instead of the series of holes.

5. Crutch Tips. Made from rubber with a base of varying diameters, the crutch tip helps keep the crutch from slipping out from under the weight of the patient.

ACCESSORIES. The accessories include various sizes of crutch tips, rubber covered arm cuffs, handpiece cushions and crutch tip ice grippers.

SIZES. These crutches are available in six different sizes: Extra long, adult, adult short, junior long, child short and kiddie.

DESIGNS. There are various designs of forearm crutches most of which are constructed from aluminum tubing; however, a few are constructed from wood.

ADJUSTMENT AND FITTING. There are several ways in which forearm crutches may be adjusted and fitted. The following procedure for adjusting and fitting has been used successfully, but is not the only procedure available for use. With the patient in a standing position, the following steps may be followed.

1. Remove the extension rod nuts and bolts.

2. Have the patient hold the crutch by the handpiece while keeping his arm and the crutch parallel to his body.

3. Position the extension rod so the patient's elbow flexion will not exceed 30°.

4. Replace the extension rod bolts and nuts.

5. Remove crutch from the patient.

6. Remove forearm cuff nuts and bolts.

7. Repeat Step #2.

8. Position the forearm cuff so the top edge of the cuff is approximately two inches distal to the olecranon process.

9. Replace the forearm cuff bolts and nuts.

10. Remove crutch from the patient.

11. Tighten all the nuts on the crutch.

CRUTCH STANCE. The base of the ideal crutch stance is triangular in shape with two points formed by each crutch and one or both feet forming the third point. The body weight is maintained on the hands with the wrists slightly extended and the elbows flexed up to 30 degrees. The head is held erect and the pelvis is centered over the feet.

CRUTCH GAITS. There are different crutch gaits available for the patient's use. Some crutch gaits are very slow, but enable the patient with poor strength and balance to ambulate. Other crutch gaits are fast, but require the patient to have good strength and balance. Whenever instructing patients in crutch walking, they should be cautioned to keep their steps small which enables them to maintain good balance. If good balance is maintained the possibility of falling is lessened.

Four Point Alternate Gait. During the four point alternate gait only one extremity is moved at a time. Three points will remain in contact with the floor at all times. Crutch and leg movements will be sequenced as follows.

1. Right crutch moves forward.

2. Left leg moves forward.

3. Left crutch moves forward.

4. Right leg moves forward.

5. Repeat steps 1 to 4.

This type of gait can be used by a patient who can bear some weight on both lower extremities but lacks normal strength and balance. It is a very slow gait and difficult to teach the patient.

Two Point Alternate Gait. The two point gait is faster than the four point alternate but requires better balance and strength. This type of gait can be used to progress from the four point alternate as the patient's balance and strength improves. It is more like the normal walking gait than any other gait. Crutch and leg movements are sequenced as follows.

1. Right crutch and left leg move forward together.

2. Left crutch and right leg move forward together.

3. Repeat steps 1 and 2.

As you can see, this gait is like the normal walking gait with opposite arm and leg swinging together.

Three Point Gait. The three point gait is the most common gait seen in the physical therapy clinic. It is used when one leg is weak and unable to bear weight. Crutch and leg movements are sequenced as follows:

1. Move both crutches and the affected leg together at the same time.

2. Step to or through the crutches.

3. Repeat steps 1 and 2.

Drag to Gait. This is a very slow type of gait used by patients who have lost the use of their legs. Crutch and leg movements are sequenced as follows.

1. Move both crutches forward.

2. Drag legs forward to the crutches.

3. Repeat steps 1 and 2.

Swing to Gait. The swing to gait can be used to progress from the drag to as the patient develops more strength in his arms and his balance improves. Crutch and leg movements are sequenced as follows.

1. Move both crutches forward.

2. Swing lower extremities forward to crutches.

3. Repeat steps 1 and 2.

Swing Through Gait. The swing through gait is the fastest gait that a patient who has lost the use of his legs can use. Crutch and leg movements are sequenced as follows:

1. Move crutches forward.

2. Swing through the crutches.

3. When contact is made with the feet, body is tilted forward and crutches are moved forward, and the cycle is repeated.

NEGOTIATING STEPS. When a patient is taught how to walk with crutches it will be necessary to teach the patient how to go up and down steps and curbs. There is only one way to negotiate steps safely. The same principle for negotiating steps is used regardless of the number of steps encountered.

Going Down Steps. When going down one step or a series of steps, the following sequence should be followed to assure safety.

1. Start with the patient standing in a well balanced position with the tips of the crutches and his feet close to the leading edge of the step on which he is standing.

2. Have the patient balance and support his body weight on the unaffected leg while placing the crutches and the affected leg on the next lower step.

3. While supporting his body weight and balancing on the crutches, have the patient move the unaffected leg down to the step on which the crutches have been placed.

4. To negotiate the next lower step, have the patient repeat the sequence given in steps 1, 2 and 3.

5. Position yourself on the lower steps in front of the patient.

6. Remember that the "bad" always go down first. The "bad" being the crutches and the affected leg.

. Going Up Steps. When going up one step or a series of steps, the following seouence should be followed to assure safety.

1. Start with the patient standing in a well balanced position with the tips of the crutches and his feet close to the leading side of the step which he is qoing to qo uo.

2. Have the patient balance and support his body weight on the crutches while placing the unaffacted foot up on the next step.

3. Have the patient use the unaffected leg and arms to position himself up on the step which the unaffected foot was first placed.

4. While balancing and supporting his body weight on the unaffected leg have the patient position the crutches up on the step which the unaffected foot was first placed.

5. To negotiate the next higher step, have the patient repeat the sequence given in steps 1, 2, 3 and 4.

6. Position yourself on the lower steps behind the patient.

7. Remember that the "good" always go up first. The "good" being the unaffected leg.

Use of Handrails. Some steps have handrails positioned on one or both sides. The handrails may be used for going up or down steps. If the handrail is used, have the patient hold both crutches in one hand and grasp the handrail with the other hand. Have the patient use the same sequence for going up or going down steps which has been previously described.

Canes

WOODEN. The cane most frequently used is made from hardwood having different colored finishes. The handle is generally curved in an arc of about 180°. The tip is rubber, similar to the crutch tip in design only smaller.

METAL. Some canes are made from metal instead of wood. The metal most frequently used is aluminum tubing. The handle of the metal cane is generally similar in shape to that of the wooden cane. The metal cane may be adjustable or nonadjustable.

ACCESSORIES. Some accessories available for canes are different types of cane tips. ice gripper, and a cane-seat.

SIZES. Canes come in various lengths and diameters. Wooden canes are available in 36, 38, 40, 42 and 44 inch lengths. Nonadjustable metal canes are available in 34, 36, 37, 38 and 44 inch lengths. The adjustable metal canes are available in adjustable lengths from 22 to 39, 27 to 36, 29 to 36, 30-1/2 to 38-1/2 and 33 to 42 inches. The diameters of the wooden and metal canes may vary from 5/8 to 1-1/8 inches.

DESIGNS. There are several different designs of wooden and metal canes. Most of the differing designed canes are constructed from aluminum.

T-Cane. This cane gets its name from the shape of its handle which is shaped like a "T".

Spade Handle Cane. This cane is constructed from wood and has a handle similar in shape to that of the garden spade.

Quad Canes. These canes are constructed from chrome-plated lightweight tubing. The handle has the spade handle design with a hardwood handpiece. Each cane has four rubber tipped contacts with the floor. The four points of contact with the floor provide lateral support which is not possible with the standard cane. Some quad canes come with two wheels and two tips which permits the patient to move the cane without lifting it. This quad cane is also referred to as the "glider."

Tripod Canes. The shaft of these canes are constructed from aluminum tubing or hardwood. The base has three rubber tipped contacts with the floor. These three points of contact with the floor provide the patient with additional support which may increase the patient's confidence. Some tripod bases have center mounting or offset mounting capabilities. Other tripod bases may be mounted to the cane shaft by some type of swivel joint. The tripod cane with the swivel joint may also be referred to as the ball joint crab cane.

ADJUSTMENT AND FITTING. There are several ways in which the wooden cane may be adjusted and fitted successfully; however the following procedure is not the only one available for use.

1. Have the patient in the standing position.

2. Place the handle of the cane on the floor near the lateral aspect of the unaffected foot.

3. Hold the shaft of the cane parallel to the patient's body.

4. Palpate the greater trochanter.

5. Place lower end of the cane next to the greater trochanter.

6. Mark the lower end of the cane at the level of the most prominent point of the greater trochanter.

7. Remove the cane from the patient and cut off the lower end of the cane with a saw.

8. Reshape the tip of the cane with a wood rasp or sharp knife if available.

9. Place rubber tip on cane.

10. Return can to patient and check for proper fit. The highest part of the cane handle should be level with the greater trochanter.

11. If the cane is to long, repeat steps 1 through 10.

12. If the cane is to short, get a longer cane and repeat steps 1 through 10.

CANE GAIT. When walking with a cane it is used primarily for balance not support. The cane will be held in the hand on the opposite side of the affected leg. For example, if the left leg is the affected leg the cane will be held in the right hand; and if the right leg is the affected leg the cane will be held in the left hand. The following is the normal sequence used when walking with a cane.

1. The affected leg and cane move forward at the same time. As an example, the affected left leg moves forward with right arm and hand which is holding the cane.

2. The unaffected leg and free arm move forward at the same time. As an example, the unaffected right leg moves forward with the free left arm and hand which is <u>not</u> holding the cane.

REVIEW EXERCISES

1. The ______________ crutch is most frequently used in the physical therapy clinic.

2. This crutch is made of selected hardwood which is laminated to assure ____________ and __________________.

3. The __________________ fits under the arm providing underarm support.

4. The __________________ provides a means for the patient to hold onto and control the crutch.

5. The __________________ are attached to the axillary bar and provide support for two other crutch parts.

6. The extension rod is also called a ____.

7. There are several holes in the __________________ making it possible to either ______________ or ______________ the height of the crutch.

8. The __________________ helps keep the crutch from slipping out from under the weight of the patient.

9. These crutches are available in ______________ different sizes: __________________, ______________, ______________, ______________ and ______________.

10. When the handpiece is at the correct height, elbow flexion will not exceed ________.

11. When the crutch is at the correct height the ______________ will be ______________ _________ widths below the __________________.

12. The metal __________________ adjustable crutch is most frequently referred to as the __________________ or __________________ crutch.

13. The __________________ is designed for patients who do not require any __________ __________ support.

14. The _______________________ is designed to keep the crutch from dropping when the __________________ pieces are released.

15. Forearm crutches are available in _________ different sizes.

16. When fitting forearm crutches the top edge of the ______________ is approximately __________________ distal to the __________________.

17. The base of the ideal crutch stance is __________________ in shape.

18. Patients should be cautioned to keep their steps ______________ which enables them to maintain good __________________.

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19. The ____________ gait is used by patients who can lean some weight on both lower extremities but who don't have normal ________ and ________.

20. The ____________ gait is like the normal walking gait.

21. The ____________ gait is used when one leg is weak and unable to bear ____________.

22. When a patient loses the use of both legs his first crutch gait should be the ____________ gait.

23. The ____________ gait is the fastest gait a patient can use who has lost the use of his legs.

24. As the patient develops more strength in his arms and his balance improves, he may progress to the ____________ gait from the drag to gait.

25. When going down steps the ________ always go ________ first.

26. When going up steps the ________ always go ________ first.

27. The most frequently used cane is made from ____________.

28. The ________ cane is ________ or ________.

29. The ____________ provides ____________ support which is not possible with the standard cane.

30. Another name for the quad cane is ____________.

31. The ________ cane provides the patient with additional ________ which may ________ the patient's ________.

32. The cane with the swivel joint may also be referred to as the ____________.

33. Whean a cane is properly fitted, the ________ of the cane should be level with the ________.

34. The cane will be held in the ________ on the ________ side of the ________ leg.

35. The ________ leg and cane move ________ at the same time.