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AUTHOR	Olson, Carl J.; And Others
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ABSTRACT

This document, as a supplement to the final report of the Orthopaedic Training Study, presents a discussion of the rationale behind the implementation of a laboratory course in psychomotor skills development for medical students. Medical educators examined resident training in terms of 3 components of cognitive elements of learning: cognitive, affective, and psychomotor. It was determined that development of the psychomotor aspects of orthopaedic surgery in any sequenced or ordered fashion is largely ignored. Thus, the document studies and outlines a possible laboratory course in psychomotor skills in orthopaedic surgery, a psychomotor skills plaster laboratory, and an orthopaedic traction skills laboratory. See also HE 003 277 and HE 003 276. (HS)

THE ORTHOPAEDIC TRAINING STUDY
Phase II 1968 - 1972

FINAL REPORT SUPPLEMENT
PSYCHOMOTOR SKILLS
PART B

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THE ORTHOPAEDIC TRAINING STUDY

FINAL REPORT SUPPLEMENT

PSYCHOMOTOR SKILLS

Center for Educational Development
University of Illinois at the Medical Center

Supported by Research Grant Number PM 00014
Bureau of Health Professions Education
and Manpower Training

Public Health Service
Department of Health, Education and Welfare

PSYCHOMOTOR SKILLS

IV. Psychomotor Skills

A. Psychomotor Skills in Orthopaedic Surgery - Part I and II

B. Psychomotor Skills Plaster Laboratory

C. Orthopaedic Traction Skills Laboratory

The attempt here is to present a progression in the developmental process in psychomotor skills, from the basic ideas and deliberations which lead to the development of the final laboratories.

PSYCHOMOTOR SKILLS

IN

ORTHOPAEDIC SURGERY

Task Force Meeting No. 1
May 22 and 23, 1971

PART I

Edited by
H. Bates Noble, M. D.

Orthopaedic Training Study
Center for Educational Development
University of Illinois at the Medical Center

Supported by Research Grant Number PM 00014
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Public Health Service
Department of Health, Education and Welfare

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PSYCHOMOTOR SKILLS TASK FORCE
List of Participants

Michael Chapman, M.D.
Orthopaedic Surgeon
University of California
San Francisco, California

Reginald Cooper, M.D.
Orthopaedic Surgeon
University of Iowa
Iowa City, Iowa

Professor Robert Domagala
Materials Engineering
University of Illinois
Circle Campus

Louis Fry, M.D.
Orthopaedic Surgeon
University of Washington
Seattle, Washington

Jorge Galante, M.D.
Orthopaedic Surgeon
University of Illinois
Medical Center

Henry Hood, M.D.
Orthopaedic Surgeon
Wellesley Hospital
Toronto, Ontario Canada

Brian Hotchkiss, M.D.
Orthopaedic Surgeon
Blodgett Memorial Hospital
Grand Rapids, Michigan

Gerald S. Laros, M.D.
Orthopaedic Surgeon
University of Iowa
Iowa City, Iowa

Richard Maurer, M.D.
Orthopaedic Surgeon
University of California
San Francisco, California

Edward Miller, M.D.
Chief of Orthppaedic Surgery
University of Cincinnati
Cincinnati, Ohio

Steven Ross, M.D.
Radiologist
University of California
San Francisco, California

William Rostoker, Ph.D.
Professor of Metallurgy
University of Illinois
Circle Campus

Richard N. Stauffer, M.D.
Orthopaedic Surgeon
University of Iowa
Iowa City, Iowa

STAFF MEMBERS OF THE CENTER FOR EDUCATIONAL DEVELOPMENT
Orthopaedic Training Study

Thomas J. Bligh, Associate
Brian H. Huncke, M.D., Associate
Christine McGuire, Assistant Director
James Monahan, Associate
H. Bates Noble, M.D., Associate
Carl J. Olson, Ed.D., Co-ordinator

Introduction

Bates Noble, M.D.

The first phase of the Orthopaedic Training Study involved developing instruments for evaluation of competence. This primarily consisted of revamping The Board Certification Examination and concurrent development of The Orthopaedic In-Training Examination. An attempt has also been made to place the onus on Chiefs of residency programs to take more responsibility for determining when a man is competent to sit for the Board.

The second phase of the Study initially involved a descriptive analysis of orthopaedic residency training. As a part of Phase II, there was discussion and study of potential innovations which could be instituted in orthopaedic training to make the learning process more efficient and effective. Educators examined resident training in terms of three components of learning: cognitive, affective, and psychomotor. They found cognitive elements of learning stressed quite heavily in residency training. Residents selectively develop affective approaches by identifying and interacting with the personalities of their attendings. However, development of the psychomotor aspects of orthopaedic surgery in any sequenced or ordered fashion is largely ignored.

With our present teaching system, the resident observes, assists, and gradually assumes operative responsibility in the operating room. Teaching is done with a patient under anesthesia and incidental to providing surgical service. So much stress is placed on the judgement involved in surgery that we believe psychomotor training has been slighted. This lack of emphasis on psychomotor skill development led the Study Staff to consider the possibility of developing psychomotor skills laboratories for resident training.

There was a large amount of interest and some resistance when we discussed this potential innovation in the course of our most recent round of site visits to the experimental programs in The Orthopaedic Training Study. Most of those opposed to the laboratory concept felt residents already adequately learn psychomotor skills from attendings and that there was no need to develop a separate laboratory.

To provide data for decision making, we went back to the Study's descriptive data. The procedures form asked residents when and where they learned various procedures. In applying a short leg cast, applying a cylinder cast, or reducing a Colles fracture, for example, only 25% of residents said they learned these procedures from an attending. Most learned from other residents and some, in fact, said they "learned" from reading. There were a number of other procedures which residents commonly perform early in residency training but which were not learned from an attending surgeon.

This type of study information in addition to interest shown on the site visits led to the decision to develop the lab concept. We felt the best way we could proceed would be to organize interested individuals into a Task Force to discuss the development and implementation of an orthopaedic psychomotor skills laboratory.

We hope we can keep the amount of didactic presentation at an obsolute minimum during this meeting. The large amount of material we sent you prior to the meeting was intended to provide a common background for the Task Force so this meeting can be largely a working meeting.

The objectives of the meeting from this point are to:

1. Present and discuss problems encountered thus far in skills lab development.

2. Identify components for an Orthopaedic Psychomotor Skills Lab.

3. Consider techniques of factor analysis of The Components.

4. Consider Component objectives, development, and implementation.

5. Make Component development assignments.

6. Produce a time table for development, collation, and revision of Components.

As we noted in the advance materials, our first step is to develop an inventory of operative orthopaedic tasks. We have tallys of orthopaedic operative procedures (e.g.: spine fusion, Magnusen-Stack, Keller bunionectomy, etc.)

which you submitted in advance of the meeting. From the tallys, we can "arm chair" components of those procedures (e.g.: use of the osteotome, scalpel, screwdriver, sawing bone, etc.). The Components or sub-routines of operative procedures will comprise the basis for the lab.

We are interested in the development of learning situations in which basic orthopaedic psychomotor skills are taught in a complete and sequenced fashion. We shouldn't at this point, be particularly rigid about the directions this group can take. We must develop ideas here. We hope to identify components, make component development assignments, and establish a time table for production of a lab which can be put into operation. We plan to use the laboratory in as many of the 16 experimental programs as possible as an educational innovation. The lab will be tested and modified in the training environment of residency programs. It is in this mileau that its worth can ultimately be demonstrated.

* * * * * * *

Discuss.on of Task

Miss McGuire:

It seems to me the ultimate objective of this whole study is to increase the efficiency and effectiveness of orthopaedic education. The development of operative and other types of motor skills are only a portion of orthopaedic education. I think the priorities will need to be defined in terms of the total end point of orthopaedic residency. In other words, one might say if a traction laboratory or a plaster laboratory indeed reduces the time that's required to come up to a minimum exceptable level of competence in this field, then we can give the laboratory all the time it needs because we are reducing time that is otherwise used to bring the people to this level in a less effective and efficient manner.

Dr. Rostoker:

The one danger is that you can become so all encompassing in things that need to be done and need to be learned, that you come to a point where you can't fit it all in.

Dr. Huncke:

I don't think that's going to be a problem. I think that quite frankly in orthopaedic surgery you can learn all the psychomotor skills you need for the rest of your life in six weeks. If you can isolate the experience, I don't think you are talking about producing an 18 month monster.

Dr. Cooper:

I think Brian is right. I don't think we can put a time limit on this until we list the descriptive Components. I wouldn't think the list would be as long as you might believe.

Dr. Noble:

We don't really envision the lab as being the end all. We would anticipate that the laboratory would be utilized early in a resident's training when he can learn some basic skills which can then be honed to a finer degree during the remainder of his residency training and practice.

Dr. Rostoker:

I'm trying to conceptualize the laboratory in terms that we have in engineering. We have to teach skills in our

Dr. Rostoker: (Cont'd)

profession too, but we simply don't have the time to do everything. What we have to do is minaturize each experience in some way and we have to set priorities because we certainly haven't time for everything. They have to pick some things up along the road. But certain things are so vital that we can't let a man out with a professional degree without having some background experience in this area.

Dr. Noble:

Perhaps we can give you some information concerning the amount of time people already spend in this type of activity from the Residents Time Log Statistics. First year residents spend an averave of 1.2 hours a week just observing surgery. This doesn't include assisting or performing surgery. Which involves nearly 15 hours more per week. We believe this time can be utilized better if the residents have a basic familiarity with surgical skills. The lab, instead of taking more time in the resident's training can reduce the time spent learning basic surgical skills. We would like to shift the emphasis from time constraints to "competence". There is nothing in our certification procedures that we have now other than the Chief's rating that deals with competence in the psychomotor area. It might be that from this type of laboratory we can develop some idea of a standard of competence in the psychomotor domain for orthopaedic surgery.

Miss McGuire:

Bates, the summary which you distributed on the Time Log indicates that all residents, averaged throughout 4 years of training, spend over 14 hours a week either observing, assisting, or performing surgery. This is a huge, huge hunk of time over a 4 year period.

Dr. Hotchkiss:

One of the reasons all this time is spent in observing or assisting surgery instead of doing something is that if you are in the position of teaching a resident, there is a limit to what you can let him do because of his ineptitude with the instruments. He may hurt somebody. If you get an individual who's a little more experienced, who has been overseas in the Army for a couple of years, he knows what to do with a needle holder when it's in his hand. That resident

Dr. Hotchkiss: (Cont'd)

at the first year level is going to be doing things that some residents in the third year level will not be doing. If we can make the first year resident somehow more competnet with his hands, you can give him something to do without his taking all day to do it, perhaps that resident could move more quickly through the technical phases of residency.

Dr. Noble:

We have envisioned the laboratory as filling a place i quite early in the individual's training so he utilizes that portion of the learning curve that has to do with the initial rapid rate of learning a new task. The fumbling steps can be taken in the laboratory rather than on a patient under anesthesia. We've talked about the implementation of the lab and how it might be done. Should it be instituted in individual programs or should there be Centers where residents are sent for training in psychomotor skills much as we now send residents to courses for orthotics and prosthetics?

We think the laboratory can fill several roles. Initially, we believe it would come into play in learning psychomotor skills of orthopaedic surgery in residency. We also believe we could use a laboratory to develop standards for competence in the psychomotor domain and eventually be used as a tool for demonstrating that competence for certification purposes. Finally, we believe analysis of psychomotor skills can ultimately lead to improvement in existing techniques and instrumentation.

Dr. Huncke:

Another aspect of this is in terms of patient care. If you have people coming into a residency, after an experience like this, you can rely on them more. You don't go onto the ward in the morning and find some sort of disastrous traction apparatus; a horrible thing that has been set up by a third year resident who should have learned better in his first year.

Dr. Noble:

I think Brian Hotchkiss has brought up a very important point too. It is the individual who least needs instruction who has a chance to perform surgery. The man the attending feels he can trust to do the operation is the individual who is going to do it instead of the person who is more inept and who needs the practice.

I would like to ask Ed Miller if he has any comments at this point.

Dr. Miller:

None except to comment that I'm sure this task looks awesome at this particular point, because as you sit here and mull this over in your mind, you envision a hundred components for an operation. If we had listed the instruments that each orthopaedist in this room used for a triple arthrodesis no two lists would match. It's not going to be an easy job but I'm certain that we have established feasibility. An operation begins on the ward when the patient is put into bed and put into traction apparatus. It involves his transportation to the operating room, surgical personnel and what they do. I think this is an area that has been incredibly neglected and based on tradition. I think it is very exciting to participate in the first group that's ever really considered the possibility of studying this in an organized manner.

Dr. Noble:

Henry would you discuss the steps you took in developing your plaster skills laboratory.

Dr. Hood:

The planning of the motor skills laboratory and plaster technique has been based on a specific methodology of vocational course development popularized by Dr. Robert Mager. The goal of the discussion this morning is two-fold: 1) to introduce Mager's method of developing vocational instruction and 2) to recommend it as a framework for use by this Task Force in developing teaching materials. Mager's method in developing vocational instruction has three phases: separation, development, and improvement. The strength of the method lies in the preparation phase, the goal of which is the determination of what is relevant to teach. The planning is job oriented. Consequently, the first step is a job description or basic statement of the work a course graduate will do and under what conditions he works. It says nothing about what he "knows". Included are all classes of work done on the job even though seemingly unrelated to the basic skills.

Dr. Hood: (Cont'd)

For example, a job description of the orthopaedic surgeon would necessarily include a statement about the paper work he must do. A job description is not specific, but merely a sketch, a brief outline that provides a starting point for task analysis, the next step in vocational planning. By definition, as task is a logically related set of actions required for the completion of a job. Most jobs or vocations include numerous tasks. The analysis of the different tasks is a complex procedure but can be done in an orderly manner. Analysis begins by listing all the possible tasks that are included in a job. Multiple input from different sources is necessary to insure a complete listing. Some tasks eventually will not be taught, but decisions concerning priorities are not made at this time. Once the list is finished each task is then analyzed for its frequency of performance, relative importance and its difficulty of learning. Each task can then be weighted to determine future teaching priorities. The next step in task analysis is detailing. Here the steps involved in each task (or procedure as Bates put it) are described in terms of what actions or steps are carried out. For example, the task of treating the Colles fracture requires, recognition of the clinical situation by history and physical exam, selection of appropriate x-ray studies, interpretation of the x-rays, selection of a treatment modality, manipulation of the fracture, application of proper padding, application of proper plaster technique, etc.

The work of task analysis may seem enormous and shockingly complex but it is absolutely essential. When the steps of the task are identified in detail and then weighted as to frequency of performance, difficulty of learning, and relative importance it is likely that the future vocational course will be a healty balance between theory and practice since intell gent decisions about teaching priorities are assured.

Furthermore, types of teaching techniques can then be selected on a rational basis. A vocational course is influenced not only by task analysis, but also by entering students. The nature of this group determines the starting point for the course. Therefore, the more accurately this group can be described in terms of their educational level, previous surgical experience, motivation, interests, attitudes, past performance, etc., the more accurately the course content can then be defined. Task analysis and definition of the entering population leads

Dr. Hood: (Cont'd)

to the final and most important step in the planning phase, drafting course objectives. The documentation of course objectives is a blue print of student performance. It is a description of what the student is expected to be like at the time he leaves the course. In drafting course objectives, one asks the key question, "What kinds of things should the student or resident be able to do at the end of the course that will most facilitate his becoming a skilled orthopaedic surgeon in the least amount of time?"

The declaration of course objectives contains as many statements as is necessary to describe the desired behavior of the student. It differs from task analysis. Whereas task analysis describes a job or vocation, course objectives represent the clear statement of the instructional intent. They describe expected terminal behavior of the graduate. Furthermore, they describe the conditions under which the student will perform, and define the level of performance that will be considered acceptable.

The importance of course objectives is two-fold: 1) from the objectives, the measuring instrument for criterion examination, which determines the adequacy of the student performance, is prepared, and 2) when issued to the students, the objectives will allow them to organize their activities and concentrate their efforts. Once the course objectives have been settled, the second, or developmental stage of vocational course development, is initiated. This phase is based on three principles:

1. Adequate practice for students under conditions as life-like as possible. Here, performance is at a premium.

2. Assurance that the student learns the right and the wrong of each task.

3. Provision for the student to see the consequences of his actions--the accuracy of his performance. This is feedback.

The developmental phase is begun by outlining the instruction in terms of the tasks to be done by the student, so that at the end of each instructional unit he can do

Dr. Hood: (Cont'd)

something that he could not do previously. The type of instructional media for teaching is chosen on the basis of the type of performance required to establish the task. In previous descriptions, eight performance types have been identified. Dr. Robert Gagne tried to show what conditions were appropriate for facilitating the learning of each of these performance types. To simplify matters, Dr. Mager modified the eight categories into five performance types: discrimination, problem solving, recall, manipulation, and speech or communication.

Discrimination, for example, implies differentiation between two things, such as, the comparison of the normal with the abnormal during physical examination.

Problem solving is deciding what to do. Problem solving is taught by showing the student those keys or symptoms which will lead him to recognize the relationship between the symptoms and possible causes. Problem solving requires continued practice in realistic situations.

Recall is knowing what to do and why to do it from memory. A special class of recall, or sequencing, requires the memorization of precise order of steps, such as those in the surgical procedure.

Manipulation is knowing how to do. It is different from knowing what to do. Knowing what to do in no way means that the student knows how to do it. Manipulation is taught only by providing an opportunity to manipulate under those conditions as close as possible to the job itself.

Speech, or communication, is how to say it. Here, again, actual practice is necessary. It should be emphasized that one must never skip over the identification of performance when moving from objectives to choosing instructional media. The type of instructional media for teaching is chosen on the basis of the type of performance required to accomplish each task. There are four guides for choosing the most appropriate type of instructional technique: 1) choose the technique that most closely approximates the performance conditions called for by an objective. If the objective calls for the student

Dr. Hood: (Cont'd)

to do something in response to what he sees, select a technique that most closely approximates the scene to which he is to respond. 2) Choose the technique that causes the student to perform in a manner most closely approximating the performance called for on the job. 3) Choose the technique that will allow the student to make the largest number of relevant responses per unit time. 4) Select the "best" technique on the basis of administrative constrictions of time, finance, manpower, availability, etc. Once the instructional units are selected, they must be carefully sequenced in the order that is most meaningful to the student, not the instructor. The guides to sequencing include general to specific, those which sustain student motivation according to the natural order of the given subject, and according to the frequency of the job.

After the instructional units are sequenced, lesson plans for each unit are developed. The essence of lesson planning is the development of instructional units that are maximally meaningful to the student and maximally effective in the use of time, space, and personnel. The lesson plan is a guide to the way the student and the instructor will spend their time together. Once the lesson plans are developed, the course is ready for trial.

The third phase of Mager's method of vocational development is the improvement phase. This phase has three underlying considerations: 1) Any instructional course will change, since changes occur in the entering student, the job description, and the task analysis. 2) A course must have a system of evaluation or testing to see how well the instruction meets its need and to see how well graduates do in their job. 3) The system must be flexible so that change can be instituted smoothly. This method contains within it procedures for checking the course and spotting places where improvement can be made. The third phase is probably the simplest part of the whole methodology. It involves checking student performance against the objectives, and checking the objectives against the job. These two procedures must be kept separate. A course could fail to produce students who are effectively prepared for a vocation because they were taught the wrong things, or because they were taught the right things but were not

Dr. Hood: (Cont'd)

taught them well enough.

First, consider course efficiency, which is student performance measured against the stated objectives. The question is asked, "How well did the students achieve each of the objectives that were specified?" "How well did the student performance compare with the performance called for in the objectives?" A separate indicator for each objective is needed. The information obtained from analysis will demonstrate where the course needs to be changed and where more effort is warranted in course design. Furthermore, better decisions about the inadequate students can be made since it will become evident whether the inadequacy is the result of ineffective training or improperly selected objectives. Therefore, course efficiency is checked by comparing actual student performance with the objectives of the course. Course effectiveness, on the other hand, is checked by comparing the objectives with the actual job or vocation. There is good reason to keep checking the appropriateness of the objectives, for jobs do change.

There are several ways of checking effectiveness. The course graduate is the principal source of information, for he is in the best position to determine if he has been adequately prepared for his job. Other checks of course effectiveness include interviews with the graduate's peers and superiors concerning the quality of his work.

This, in brief, is a presentation of Mager's methodology for vocational course development. The procedure described is not specific to subject matter or vocations. Regardless of the intent of the instruction, the procedure for developing the course is basically the same. This is the methodology that we are presently attempting to use in the development of the plaster skills technique laboratory.

Dr. Rostoker:

Presumably you are going to be modeling the whole business, is that right?

Dr. Hood:

Well, what we have is a skills laboratory basically in three phases. The first portion is audio-visual on sound slides; the second portion is live demonstration by an instructor. The third portion is application of plaster by the residents, themselves.

Dr. Rostoker:

To what?

Dr. Hood:

To each other, and as soon as they get the basic skills, to patients.

Dr. Rostoker:

What do they have to know about plaster, for instance? Is there any value to spending a couple of hours telling the resident what plaster is and how it operates? What can be done to make it perform poorly, for instance?

Dr. Hood:

Well these are the types of decisions we try to make based on the job. If any particular piece of information is necessary for them to do the job properly, yes, we teach it. If it is not, if there is no reason they need to know that plaster has anything to do with gypsum to apply it properly, we omit it. We teach the theory behind plaster technique, application of plaster, how it laminates together, how fast you should put it on. These are important to the actual application of plaster.

Brian Huncke:

It's awfully difficult to duplicate the situation too, with anything other than another human being, this is a constant problem in learning skills.

Dr. Rostoker:

Modeling may have to be considered for certain types of Components. You can learn a lot about drilling by drilling on a piece of wood.

Dr. Hotchkiss:

We can get fresh bone from slaughter houses.

Dr. Noble:

This is the sort of thing the developers of individual components will have to work out. We plan for the component developers to discuss modeling and materials at length tomorrow after components are identified and assigned.

Dr. Maurer:

We have been talking as though when a man has completed the skills lab he will be a competent surgical technician. I don't think this is possible. In other words, putting a cast on a fellow student is not the same as putting a cast on a swollen, unstable, Colles fracture. We are going to have to define the specific areas of basic surgical skill which can be taught in a lab. We are going to prepare a resident so he can go into a clinical situation. I don't think you can learn to operate without operating on live pathology. In my own view, I think the skills lab could get residents to perform the basic operative skills in handling tissues so we can finally organize these skills into a operative procedure on a patient.

Dr. Huncke:

I think we are trying to get training here which would be relatively standard for all residents. You could be confident this individual has certain basic tasks mastered completely. If the resident learns these skills and you can rely on the fact that he has mastered any particular skill, you can then focus on all the other things that are so very important and not waste so much time on basics. The resident could probably also master the basic skills in a much shorter period of time than he presently does.

Dr. Stauffer:

The individual movements in applying a cast on a well leg are basically the same as applying a cast on an injured one. Once you have mastered the individual movements, you've gone a long way toward competence in this technique.

Dr. Noble:

This is one of the areas where we've encountered a resistance. More experienced surgeons have forgotten what it is like to lose control of the plaster and have the roll "telescope."

Dr. Ross:

I think we are talking about flying a plane in a storm in the clinical situation with the injured, swollen arm, as compared with flying the plane in fair weather with the uninjured arm. I think we can teach residents to fly the plane in fair weather and then when they encounter a storm they will be better pilots in handling that situation.

Dr. Chapman:

The time to teach a resident how to use a periosteal elevator is not in the operating room with the patient under anesthesia. That skill could be taught on a specimen in a laboratory where you are not worried about anesthesia time. Today, the operating room is where all the skills are learned. Skills are all taught on the live patient,

Dr. Noble:

We also have to overcome the old concept of the dog lab. The dog lab enjoys a rather poor reputation among students and residents. The dog lab was not used specifically to teach somebody how to carry out components of procedures but rather how to perform an experiment. Individuals who went to the dog lab were taught how to do a single experimental procedure over and over. We need to have an entirely different approach in the skills laboratory so it is a learning experience for the resident. It is not to be a place they must go in order to serve out a portion of an apprenticeship.

Professor Domagala:

We teach our metallurgy students Metallography, which is the technique of preparing metal samples for microscopic examination. I think we follow the pattern exactly outlined for your Plaster Lab. We have six training films, (8 mm film cassettes) which the student can go back at any time and review at his own leisure. Each of these cassette films covers a particular segment of the process, starting with a raw

Professor Domagala: (Cont'd)

sample and ending with the finished product. It also shows what happens if you do the wrong thing. After the films are shown, the student becomes familiar with the lab and its equipment. The next week, he brings in any sample he chooses and goes to work. We don't care if he makes mistakes the first time. There is nothing to lose so he makes all kinds of mistakes. He proceeds to do the things that he saw in the film and, with practice, learns the technique.

Dr. Rostoker:

There is always a professional in attendance but we rely heavily on the student's own inquiring mind. As he looks at it, he says, "I must be doing it wrong". Then he finds a professional to answer his questions. There is interchange, an exercise of his own inquiry, the ability to engage in a dialogue with a professional that can develop a skill quickly. This is feedback.

We must be wary of over-organizing. Very few people fit into a too tightly organized protocol. I remember learning much more from the things I did wrong than I did right. It was very important for me to do everything wrong at first.

Dr. Stauffer:

That is very precarious when you are dealing with patients.

Dr. Rostoker:

That is why I am worried about modeling.

Professor Domagala:

I have another question which is going to demonstrate my ignorance of the background that orthopaedic residents have. They finish their medical school training, they finish their internship, and then they go into orthopaedic residency. But up to the time he enters orthopaedic residency, you can not even assume that the resident may have ever held a drill in his hand? He has never had any formal training in manipulating a screw? If he has done it around the home, then that's it, but he hasn't necessarily done it before?

Dr. Noble:

That's correct.

Professor Domagala:

Why haven't you people benefitted from the Dental people? I have a friend who went to Dental School and while I was in my engineering training, I saw him making little paper clips and money clips and all kinds of finery with wire, learning to manipulate and develop very manual skills. This impressed me as being a very sensible thing. He had to learn to use his hands. But you are saying that up to the time a man enters orthopaedic residency he has not had formal training or screening in manual skills.

Dr. Noble:

We have never found out before a man came into surgery whether he had basic manual dexterity skills. The dental educators have developed a pre-test which is administered to pre-dental students. We have nothing like that, except that if the man is manually enept in medical school or when he is in his internship, perhaps he selects himself out. We have not, however, systematically examined basic dexterity requirements for surgery.

Professor Domagala:

Before a man enters residency though, he must presuppose he has certain talents with his hands.

Dr. Noble:

Hopefully, he does.

Professor Domagala:

What percentage of people wash out of orthopaedic residency then?

Dr. Noble:

Very few people wash out of orthopaedic residency. Our statistics from the descriptive phase of the study concerning

Dr. Noble: (Cont'd)

"wash outs" do not indicate that they left their residency because of a lack of psychomotor skill.

Dr. Huncke:

A lot of this, I think, is self-selecting. If a man has the proverbial "ten thumbs" when he is an intern or when he is a senior clerk or junior clerk, he is always getting negative feedback. Finally, surgery is such a traumatic experience for him that he doesn't select surgery as a career. This type of selection occurs but it's not an organized thing. It's not neat, and tidy, and intelligent. It just occurs.

Dr. Laros:

I think it may be true, too, that we don't really know if it is really important that you can screw a screw properly, because when we talk about getting feedback, I don't think we know how skill is reflected in the results the patient gets. We are talking about two different aspects of surgery. If we looked at surgery from the point of view of what's wrong with it--what's bad surgery, we'd find that problems arise not so much from how the surgeon handles tools and screws, but from matters of judgment. The Keller procedure didn't work well because it didn't take out enough bone, or the surgeon took out too big or too small a wedge for an osteotomy, or he sewed the median nerve to a tendon. He may have done it very skillfully. But that's the type of thing that leads to bad surgery. I think the reason we haven't dealt with this before is because a man can be very clumsy with his hands, but if he makes the right choice of what to put together and the right patient to do it on, he may have a very good result yet horrify his confreres in the operating room because he looks clumsy.

Dr. Rostoker:

Is there no penalty for being clumsy?

Dr. Cooper:

Not no penalty, but we need to have a better perspective as to how much of a penalty is judgment and how much is psychomotor.

Dr. Laros:

The penalty, I think, falls more upon the physician than on the patient, because it means that he's got to spend his expensive time for four hours doing a procedure he should be able to do in two hours, perhaps.

Dr. Rostoker:

He's also increasing the risk of infection.

Dr. Laros:

That's right, but the penalty is relatively small.

Dr. Chapman:

I disagree to a certain extent with what's been said. The question of residents who were not skilled operators has been brought up in our program several times. Occassionally, the attending staff has had some misgivings about turning these people out on society. But once a man is in the program and you have invested time in him, the program is organized in such a way that it is a great sacrifice to drop a man out of the program. I think there is great hesitancy to do so. Secondly, there is a lot of disagreement in our program regarding the importance of a man having these psychomotor skills. It has been said that it is not necessary for an orthopaedic surgeon to be a skilled operator. A number of orthopaedic surgeons spend most of their time in the office practice of orthopaedic surgery. Therefore, is it right to not graduate a fellow because he is technically not a good surgeon? He can still contribute to patients by practicing non-operative orthopaedics. That's an argument that has been broached. I disagree with that argument. First, if you are an orthopaedic surgeon, it is assumed that you can operate. You do operate. So if a man is to be a non-operative orthopaedic surgeon, he should not be called a "surgeon", he should have some other title. Secondly, you can be the smartest guy in the world and "know" exactly what you are doing, exactly how to do it, but if you are not capable of doing it, you are going to have bad results. The best example that I can think of is hand surgery. You can be a "smart" hand surgeon, but I think the quality of a hand surgeon can be directly measured by his technical capability. A hand surgeon must be a good technician, purely and simply. He must be a superior technician. The man who is

Dr. Chapman: (Cont'd)

not capable of technically performing a hand procedure will be a lousy hand surgeon no matter how "smart" he is. His results will be poor.

Dr. Laros:

I think we have to define what aspects of orthopaedic surgery require this fine skill. I think for sewing blood vessels together, skill is more important than with certain other procedures. There are a lot of aspects of orthopaedics which do not require this high degree of skill.

Dr. Miller:

You can take the wrong orthopaedic procedure, performed by the most skilled surgeon in the world, and it won't work. But the right operation performed by a clumsy man may, or may not work. The human being has remarkable healing capabilities.

Dr. Fry:

All the screws that you put in don't always have to be parallel. If you are doing a wood working job, to make it look right the screws must be properly placed; but in an operative field, you can put them in in almost any way. Most of the time they will hold and be adequate and the body will cover them up and they will serve their function. But if you overtorque the screw, one will break and then another will break, but rarely is instrument failure a problem. If you use the proper size and make the other proper judgments, you will have no problem.

Dr. Chapman:

I think it is wrong to allow somebody to go into surgery who doesn't have the basic capability of being a surgeon. And I think that the wrong time to find out about it is when he is three-quarters of the way through his residency and it becomes quite obvious that he is never going to become a surgeon. The educators in dental school have a comprehensive pre-test program with very strong guidelines. If a man doesn't attain a certain score when he is tested, he is not admitted to dental school. This is something we have missed in medicine. I am

Dr. Chapman: (Cont'd)

not sure the man should not be allowed to enter surgery if he doesn't pass the dexterity test, but I think we have an obligation to at least provide the information to him that he doesn't have a certain basic capability for performing surgery. As part of the skills lab, we should develop a pre-test of some sort. An examination that could be administered to the medical student or intern to let him know whether or not he does have the basic capability to be a good technical surgeon. This should, perhaps, be something which would be given routinely to all medical students. They have found in dental school that this skill is not improvable. They have taken people who have failed the test and tried to educate them without success. They have found that you either have it or you don't in terms of basic motor abilities. We have all expressed the belief that judgment is more important than technical skill, but I think it's a real mistake to de-emphasize the importance of technical skill.

Miss McGuire:

You mean there is a basic amount of co-ordination and dexterity which is indispensable.

Mr. Monahan:

I would like to make one comment here on a point that has come up a couple of times. Henry did detail it in his discussion of Mager's ideas. I disagree with Mager that negative examples should be included in teaching. The teaching should be considered as to what is to be done rather than what is not to be done.

Dr. Rostoker:

If you are concerned about the order of presentation, there is no doubt that in the beginning you show them the proper way to perform the procedure but you have to allow mistakes to be made as a part of the learning process. You should start out by telling them what is correct, but before you are finished talking, you should tell them what can go wrong and what they should do about it if it does.

Mr. Monahan:

I am not so sure about that. We have to consider very carefully the timing of our instruction.

Dr. Stauffer:

What you are saying is that positive feedback is more effective than negative feedback in the learning process and I would certainly agree with that.

Dr. Laros:

What we are talking about, really, is that there are a lot of different ways to do a certain thing right, but there are occasionally places along the line where one thing that you do is going to be wrong. I think that's what we look for in evaluating technical ability.

Dr. Cooper:

What you are getting into are two sides of educational psychology concerning negative and positive feedback. They have never met and I don't think they ever will.

Miss McGuire:

This is a matter of sequencing instruction. Once you reach phase three as described by Mager, the improvement phase, you can modify the sequencing once you see what works and what doesn't work. Throughout medical instruction we have instructors who are educated as physicians and not as educators. It is very difficult for the highly skilled man to put himself back into the position of the beginning student. He fails to break the task down into a form that's manageable for the student.

Dr. Noble:

I would like to ask Mike Chapman to discuss the organization of the AO lab which he attended in Switzerland.

Dr. Chapman:

Let me give you some background. There is a group of Swiss physicians who, in the late 50's and early 60's, started

Dr. Chapman: (Cont'd)

a study of internal fixation to develop a better system of internal fixation. They offer a course each year in Switzerland for learning the technique. It is a week-long course, which is broken into two aspects: cognitive and technical. They very definitely separate the two. They teach the indications for internal fixation and they have a laboratory where they teach motor skills, which I will talk about here. They have a large room furnished with ping-pong size tables. There are 300 participants in the course and every two participants have a set of human bones and a full set of AO instruments. At each table, which has four groups, there is a TV screen. They run through one of the procedures using video tape first to demonstrate how the procedure is to be done. You spend that time observing. Then the same people who made the video tape take you through the procedures, step by step. They had a very systemized sequence of teaching that is very similar to what has been described at this meeting for the plaster laboratory. When you go through the procedure, you are only allowed to perform one step at a time and then an instructor comes around to check each step. Then they turn you loose with a bone and let you go ahead and carry out the steps on your own. The instructor then comes around to criticize your technique. Everybody in the course did this for about four hours a day for six days. They took us through the entire AO internal fixation system. By the end of the week, just about everyone in the course was quite competent to use the system. It's a very effective means of teaching.

Dr. Noble:

When we first heard about this laboratory it sounded very much like what we intend to do with the psychomotor skills laboratory for surgical skills. We wrote to Smith Klein Surgical Specialties, the American representative for AO and they forwarded our letters to Switzerland. We had hoped we could get the video tapes and set-up to have demonstrated at this meeting but unfortunately we have not, to this date, had contact with the Swiss surgeons.

Another laboratory which has been developed is one Steve Ross pioneered at the University of California at San Francisco, dealing with learning situations for reading and interpreting radiographs. I would like to ask Steve what he developed in this laboratory.

Dr. Ross:

I am very pleased to be here and let's say I am envious of Orthopaedics as a specialty for their interest in teaching and training. Radiologists, I believe, would have more right to do this sort of thing and they have not done so yet. That's why I was pleased when Carl and Bates came to a recent meeting of the Association of University Radiologists to tell us what is happening in Orthopaedic Surgery. We hope that this feeling will be contagious and radiologists, themselves, will try to develop something like the Orthopaedic Training Study. The University of California has something I call the Radiology Learning Laboratory which resembles your proposed skills laboratory. It consists of looking at radiographs. The idea behind it was the same as your skills laboratory. First, to save time and secondly, to increase skills. It turns out that the radiologist reads 80% normal examinations to get to the 20% pathology we want him to learn. Residents say that much of the time they "work for the company" and only a little bit of their experience is a learning experience. We have tried to reverse this and create a life-like situation in which most of what they see is material that will teach them and only a little bit is normal. Of course, even the normals teach them something. I call our set a "learning file" to distinguish it from a "teaching file". Most departments have a teaching file which is for the convenience of teachers. If you are interested in showing something in a conference, you go and pull it from the teaching file but it does not help to develop your skills of problem solving.

When I was a resident and tried to teach myself, I went to our own teaching file and I scrambled the films and read them as unknowns. This is the idea behind the learning file. The learning file is the teaching file set up for the convenience of the learner. Each case is an unknown and each case helps, we hope, in developing the skills of evaluating films within a clinical context. This has a tremendous advantage over purely clinical experience, which is pot luck. In training you may have the toughest case of your life in the second week in residency. In the learning file we can gradually increase the degree of difficulty. The organization of the learning file is by systems. We have chest, GI, GU, bones, pediatric material, and skull. When the resident is assigned for four weeks to read chest films in the clinical reading room, he is also assigned for two or three weeks in the learning lab with the learning file for chest. Each day he does 20

Dr. Ross: (Cont'd)

cases with chest films and each case is an unknown. These are full sized reproductions of films because I thought it was important to not have lantern slides. You get an envelope like an x-ray envelope and printed on it is the history, (about as uninformative as is occasionally given by the clinicians) "chest pain" or "cough" or "back pain". I have developed forms on which they actually had to fill out a radiology report. After that, when he is through with the case, on the envelope printed up-side-down so he is not tempted to read it, is a description of the case and the important points to note. This is immediate feedback. To my astonishment and delight, I find that our residents love it. At first I didn't know whether they would like being assigned away from reading chores, but they like that. It became, perhaps, the most popular part of their training in the beginning. I didn't want this to replace anything in their training so this isn't, as yet, in lieu of what residents normally do, but for half-day they are downstairs reading clinical films and for the other half-day for six weeks they are upstairs on the sixteenth floor reading films in the learning file.

Dr. Rostoker:

That's an interesting point. You say that your students like it. There's a question I would like to ask, "What's the reaction going to be or your residents to this sort of thing?" "Will it appear as an imposition?"

Dr. Olson:

We have already explored this with residents to a large extent on site visits and it is one of the reasons we were encouraged to develop a laboratory setting. The attendings in many programs felt the development of something like the plaster skills laboratory was so pedestrian and plodding that it might be suitable for medical students but certainly not for orthopaedic residents. Because, after all, the residents learn at the feet of the great master. Yet, when we discussed this with residents, almost uniformly they said "I wish I had been given the opportunity to participate in a laboratory like this, because so much of what I have learned I have had to pick up incidentally." However, attendings in many cases are, at best, neutral.

Dr. Rostoker:

Who would run a course like this and what's his attitude going to be? Are you going to have a full-blown orthopaedic surgeon, professor-type guy doing this, or is it going to be run by somebody who is a non-professional.

Dr. Noble:

We would hope it would be run by someone like Steve Ross, who is very involved in teaching, who believes in the idea, and who is innovative. We are talking about a professional at least setting up the laboratory.

Dr. Ross:

The demand on our services are so great that we are already pushing saturation. In answer to your question, I'm trying to have fourth-year residents teach first-year residents. I have an ulterior motive. Radiology is next to orthopaedic surgery in terms of being a lucrative specialty, and our residents are no more eager to participate in academic areas that residents are in orthopaedics. I expose them to the joys of teaching both the residents and students. I find that they really like it.

Dr. Rostoker:

You certainly need a professional to do the administrative work and be head of the laboratory operation and the man who pioneers it. But the actual leg work you can delegate to fourth-year residents under a watchful eye. There is also going to have to be a technician somewhere in this, someone to make sure everything's there and set up, and everything works---he's really going to be more special than you might guess. Unless you have a very skilled technician who has the primary responsibility for a laboratory, you are going to have a mess.

Dr. Fry:

You are discussing an area that's right in line with setting up a plaster lab. We have a cast-room technician in many hospitals. We have been using our cast-room technician for the last three years to teach medical students, medics, or paramedical people how to put casts on. Actually, our residents seek this guy out to teach them how to put casts on because he has been in contact with all of the staff. He knows all the

Dr. Fry: (Cont'd)

variations of the way each of us put casts on. We expect people like this to do much of the teaching.

Dr. Rostoker:

Whether you use them for teaching or not, you are going to have to have such persons simply to maintain the logistics of the laboratory.

Dr. Fry:

I think this must be accepted as part of the cost of running a laboratory of this type. You must have a person to keep it up. Otherwise everything winds up in the corner and you use the room for something else.

Dr. Galante:

I think, in terms of the professional staff that you use to run the laboratory, you must start thinking not only of the academic orthopaedists, but also the people who come part-time to the Institution. In many cases, they are much better technical operators than the men who are academic orthopaedists. Quite often they are much more involved in the practice of surgery, as such, than some of the men are in functioning within the realm of the University.

Dr. Fry:

The real problem with that is that we have had residents in certain hospitals who are exposed to so many different ways of doing the same thing that they become confused. Unless we evolve a standard method that will be taught first and that they can fall back on, it can become somewhat confusing to them.

Dr. Galante:

Well you can set out the things which you wish to teach in a package. I am speaking of supervising the laboratory for a specific subject. You don't necessarily have to have one of the full-time men in the department doing this. This may make the problem of staffing not so much a problem.

Miss McGuire:

I think this is a critical issue in the total resources you need for a skills laboratory. I suspect that staffing will vary, depending on the nature of the laboratory. For example, the x-ray lab learning files will require a different type of staffing than the plaster lab, and both of those will require something different than the surgical skills lab, etc. I would hope, again, just as this might increase the efficiency of the resident's learning, that it might also increase the efficiency of the use of professional staff time. I think this is one of the critical elements. What happens is that the role of the professional changes and you get a breakdown of his tasks that enables him to use assistants in a way that is very different.

I would like to get back to Dr. Ross' description and ask just one question. You indicated that your learning files are set up in a graduated sequence of difficulty, each with a problem where the resident writes his interpretation and then gets immediate feedback as to whether he has made an appropriate interpretation or not. My question is, "What happens if he makes inappropriate interpretations? Are there additional materials there which illustrate, so to speak, the same point that he could continue with on his own or does he go next to the professional?"

Dr. Ross:

We have references from the literature for the problem at the bottom of the page and, in some cases, we have reprints in the package. Like an elderly scholar, I thought we shouldn't have to spoon-feed the residents. They should have to go down to the library to look up the references, but somebody suggested that we should have reprints of the papers. They do read the reprints and it does save time. Also, there is a professional there. I had set aside two and one-half hours, but at most, I have had less than one-half hour worth of questions, because the discussions and the reprints seem to answer many of the questions.

Dr. Noble:

I would like to ask Jim Monahan, in terms of the self-directed package idea, Do you see this as being built into the Skills Lab?

Mr. Monahan:

In Steve's case, yes. The immediacy of the feedback is important and the continued presence of the model, which is easily translatable into Steve's package. In the actual motor skills, it is a little bit different. In the cognitive phase, yes, this could be packaged, but in the middle part, which I think everybody's talking about, the actual practice may not be as adaptable to packaging. You may have to have the physical presence of an instructor there for quicker feedback. If you are practicing, you may forget exactly where you went wrong when you seek the instructor's help later.

Dr. Hotchkiss:

Someone touched on the term "criterion and values" especially when there is more than one way of doing things. I think that this is going to work in any given area. The various people involved in the training of residents have to come to some mutual agreement as to what are acceptable criteria for performance, and unless those criteria are reasonably well worked out ahead of time, this is going to be doomed to failure. The student coming out of this laboratory who has learned to do a particular technique and thinks he is very competent doing it, is going to run into an attending who is going to say, "Where in the hell did you learn that?" I think this is going to have to be more than just a little isolated segment of a residency. It is going to have to be integrated and the people on the staff are going to have to thrash these things out ahead of time. We are going to have to consider the technique of the teachers.

Dr. Noble:

Lou Fry has been involved in establishing the entire course for Orthopaedic Assistants at the University of Washington. Lou, could you give us the benefit of some of your experience in doing that?

Dr. Fry:

Three years ago we decided to start working with an assistants' program in operating room skills, plaster room technique, and office procedures. It has taken three and one-half years before we got enough money from the V. A. to get a good start on the program. Some original seed money was present though, and we were able to hire an educator who made a very wild claim when I first met him. He said, "I can package anything in an instructional package." After I had known him for a while, he proved that he could. He sat down with me for a period of time and asked me, "What do you want to teach these people?" We started working on objectives and going through the various stages of the process that Henry has already told us about. There are a couple of things we have accomplished that I would just throw out for your interest. We have established a room or an area in which we can work, both for the plaster and for the traction technique training. We bring in a bed, we set up traction equipment on it, we get a model or an ambulatory patient and we rig up traction on him. We have devised some video tapes, worked on in a very amateurish way, and I have shown them around in a couple of places and they seem to be fairly well received. We have never written a script. Dr. Wilson, who is assisting me, ran the camera, I stood in front of the camera with the bed and with the equipment and began to talk, describing what I was doing. He taped this. Occasionally I would be moving in the wrong direction and the camera would be off and the sequence wouldn't run right, but we insisted that the camera start and run all the way through rather than trying to do it in little segments. The first time around it was awful,but we just ignored that and re-recorded the same thing the second time. We discussed modifications, and usually about the third or fourth go-through, the thing ran smoothly. For a fifteen minute take, it probably took us two hours. They are not professional but they are explanatory and better than the average lecture because they are compact. We are now funded and planning to start a program of this type in September. One other most important element is an "Instructor Co-ordinator", who will do most of the leg work as far as picking the students, working our the schedules, and doing much of the organization. Objectives are divided into two parts: 1) the student should know the principles of traction, the problems associated with it, be able to apply different types of traction. 2) He should be able to recognize errors and should be able to correct the errors in traction by proper adjustment.

We, as a faculty teaching the residents, decided we would make-up a "party line". The faculty has gotten together for three or four hour stints to decide what is the "party line", the acceptable practice for taking care of certain types of fracture, for example. This whole business of producing the party line has been extremely laborious, but extremely instructive to all of us, and we have at many times agreed to disagree. We have decided that if one method is different than my method, there will be two acceptable ways of doing certain things. Residents can deviate from the "party line" if they consult a staff member. They will not get in trouble if they use the party line.

Miss McGuire:

I have a couple of questions. You developed the video tapes and got the space with the simulator, then did you develop a set of exercises that each assistant will go through?

Louis Fry:

Yes, a series of exercises, all of which start with an objective. The first objective is to learn the principles of traction. Then there are descriptions of what these are. There are then four or five different ways in which they can learn the principles.

We have video tapes, equipment catalogs, books, references from the literature, and the actual equipment for traction.

Dr. Noble:

We have set aside the next time period to give you the opportunity to express any thoughts you may have had before you came here and the ideas you have developed in the course of the morning's work.

Dr. Cooper:

I think Christine hit on the thing we are trying to do this morning--to increase the efficiency of training. I also like Mike's comment, that we probably are doing a lot of the skills training at the wrong time and in the wrong places in the residency. If we can come to some agreement about which of these things we should teach and at what times, I think it would certainly be an accomplishment. We should try to define some of these components. I think we must, at this stage, avoid getting down to too much detail. We want to establish some broad concepts. Hopefully, we can reach agreement as to their relative importance in the residency training program.

Dr. Fry:

We must be sure that whatever we come up with fits into our residency program and is not so distant from current practice that it cannot be accepted. I think we have to modify the way we are teaching now and incorporate innovations into it rather than to come up with a whole new pattern of teaching methods.

Dr. Galante:

I was surprised that we agreed on so many things this morning. We came to the conclusion that the laboratory is important. We decided you need a place for a specific laboratory and that you need a specific technician assigned to that laboratory. We decided something about the format. We agreed that you need to start with some form of audio-visual or written material and then go to an actual lab where the residents will do their practicing. I hope that we can in the rest of the meeting define the Components and then identify some developers so they can do their homework.

Dr. Hotchkiss:

I hope we have reached some agreement that surgical skills, the mechanical aspect of performing an operation, play an important role in the care of the patient and that those skills have some degree of emphasis in training. I think we may disagree as to how much emphasis it should have.

In my thinking about this, I thought that I would start at a very primitive level because I am afraid that's where we are in this concept. If you get too complicated with it, it's pretty hard to analyze the parts and make it applicable. I originally thought I would set up a simulation of a skin closure in a pig's foot so the individual resident could practice suturing, be timed doing it, and have criteria established by a plastic surgeon as to what the ideal wound closure would be. It sounds great when you begin thinking about it, but as you explore the idea more, you find there is a lot more to it than that. For one thing, there are many factors involved in wound closures that you can't necessarily isolate into a pig's foot: time under anesthesia, condition of the patient, etc. There are a lot of different wound closures. I arbitrarily decided what aspects of the technical act of suturing are truly manual, require no decisions, and what parts are manual but do require some decision making. There is a way to hold a needle holder and a way to pass a needle, but there is a decision involved as to how tight to pull the suture. This is a technical decision. In other words, there are some cognitive things that can be decided out of the operating room and some of them can be only established at the time of the operation. The factors that go into making a cognitive decision, as all of us that do operations know, are very many. If you start listing them, it is almost flabbergasting: the general condition of the patient; is bleeding present or anticipated; is swelling anticipated; degree of contamination present; previous damage to the

Dr. Hotchkiss: (Cont'd)

tissue either by operative trauma or trauma preceding the operation; local condition of the skin; an endless list. My conclusion from all this was that it would be relatively easy to break down technical surgery into the various mechanical skills. It would be similarly easy to teach the mechanical portion: holding the needle, passing it through the skin, etc. Probably, under the circumstances that you are provided in the laboratory, it would be possible to deal with "cognitive-technical" aspects of it, such as knowing how tight to pull a suture as it is being tied. But it would be very difficult to insert all of the purely cognitive aspects of surgery into the laboratory without a tremendous amount of sophistication. I don't think we are going to be able to teach the cognitive aspects of orthopaedic surgery in the laboratory.

There is one other use of this laboratory as a means of self-testing and evaluation to determine whether or not instructional objectives are being reached. This is an entirely different approach. You would give the resident a pig's foot with an incision in it and give him conditions such as, "This is a girl, a plastic surgeon's daughter, who is very worried about cosmetic appearance. The tourniquet has been on too long, however, and you must make a decision as to close fast, or close very carefully and achieve results that would make a plastic surgeon happy." You can present the resident with a situation and force him to make such decisions.

Dr. Laros:

I think that we are heirs of the surgeons fifty years ago, who placed a great premium on taking out an appendix in seven minutes through a one-inch incision, because the anesthesia wasn't very good and they couldn't afford to let the patient bleed very much. I am not sure that we are agreed concerning the importance of pure motor skill in surgery. I believe this is something we should know before we start. What is the value of the Psychomotor Skills? What are we trying to accomplish by improving them? Are we trying to familiarize the resident with his tools and make him comfortable in using them in this six-week period Brian Huncke is talking about, and thus make it easier for him to concentrate on other things while he is learning? Or are we talking about making him a more competent surgeon so his end result is going to be measurably better?

When we use a title like "Psychomotor Skills Laboratory," this immediately puts in my mind some place where you go to use

Dr. Laros: (Cont'd)

your hands and learn how to use your hands better. I am not sure whether we are all at the same starting point here. I have the feeling some of us are starting at the manual skills level, as an entree for the residents into surgery, while others see the end product as a substantially more competent surgeon.

What we should be talking about in the Psychomotor Skills Laboratory, I believe, is a learning situation where a resident can practice and develop a purely manual skill.

Dr. Maurer:

I think we are going to have to define our area in a limited fashion. We should not try to teach residents to be orthopaedic surgeons in the lab. I think they have to be taught to be orthopaedic surgeons on the patient. However, I think we can teach them to know their tools, know how to use their tools, and how to handle tissues so they have a starting point to be competent surgeons when we have them almost as a preceptorship in their further orthopaedic training. I think we can go too far afield in over-defining and over-organizing and extending the psychomotor skills lab to the point that we are almost trying to teach the entire process of being a surgeon in the laboratory. So my final plea would be to get down to the basics of the mechanical skills we want to teach as a starting point. We should define those skills as best we can and then break them up into smaller components that each group can define and develop and then we can put them together in a complete laboratory.

Dr. Miller:

I suffer from the same fears that we could bite off a mouthful that would be difficult to chew. I don't believe we should set up a skills laboratory on "hip-nailing." The components, yes; putting in a screw, yes; but maybe we should say we are going to create a psychomotor skills Component laboratory because the innovative nature of surgery at the operating table doesn't lend itself to saying this is the way to pin a hip or to do anything else procedural in scope. I am not certain any one of us would even agree upon as the "party line" if we use Components, such as hip nailing, that are procedural.

Dr. Ross:

The radiology residents like what we are giving them in the radiology learning package because this is one program entirely designed to teach them what they did not know heretofore. Everything is done for their convenience and they realize that. I have also found that with the learning package, it helps to explain very carefully what we are trying to do. For example, we pre-test and post-test the residents and explain to them that it is not they who are tested but the method of instruction that is tested. They welcome this.

I have also found that while students and residents are very anxious to be consumers in such a lab, they are not as apt to be producers. They still like to have other people do the work. We have not found a large number of either residents or clinical attendings who are willing to be instructors in such a lab. I have found that all of us like to talk, but there are very few of us who are willing to put the additions into the lab.

Dr. Rostoker:

Most of you came here because you are individually convinced that this is an important thing to try and implement, so the problem of reaching agreement was really fairly easy. But I think we have come to a point where this kind of general discussion might well be counter productive. We are at a point now where we are starting to worry about whether what could be done is not important enough or, the other extreme, that we are going to accomplish too much. I think we are creating some kind of a mental image and every one of us has a different one as to what this is going to look like. We are not going to see how this thing is really going to shape up and what value it really can have until we put it into a formative state.

Dr. Stauffer:

I think we must separate the cognitive element from the psychomotor skills as much as possible. I think the type of psychomotor skill we are talking about, individual, isolated Components, should be taught very much like teaching an individual to play a musical instrument. I take lessons in classical guitar, and it has been brought very clearly home to me that learning to play the instrument is a series of individual movements requiring different hand positions, different finger movements, etc. I think that is

Dr. Stauffer: (Cont'd)

the thing we should strive to teach. We don't set out to learn by playing a complicated piece of music, you set out to learn the very elementary components. I think that is what we must confine ourselves to. I also believe that if we are going to develop any kind of effective teaching technique, we must first identify the Components but we must also attempt to identify and measure the level of attainment. I do not think you can ever teach anything well unless you have an accurate method of measuring. Maybe this will come later, but it seems to me that this is almost equally as important as identifying components.

Dr. Huncke:

Those individuals who are involved in teaching residents will come up against a new problem in the next few years. Our residents, the raw material with which we are working, are going to be less defined as internships are phased out and as we begin to get first-year residents with varying backgrounds. With this in mind, I think one aspect of such a lab should be a pre-residency evaluation. Not only are we going to use this type of material for the instruction of residents, we may be able to use this type of material for evaluating the men who are applying to our residencies. A second aspect is, as I mentioned earlier, to get a standard type of instructional in-put so we can bring the resident to a known level of skill. We can then, perhaps, spend our time on the things that we should be spending our time with, the important judgemental factors. I am convinced there is a minimum standard we should insist upon, where we could weed out the "ten thumb" individual, both in men coming into and during training.

I think it does come down to identifying components. I don't think any of us would fantasize a laboratory situation which would turn out a surgeon. I do think there are certain basic aspects of orthopaedic surgical procedures which should be identified and analyzed carefully for inclusion as basic Components for a learning laboratory.

Miss McGuire:

I am very much taken by Dr. Stauffer's example of learning to play a musical instrument and by Steve's example of flying in fair weather and then handling a storm. I am inamored in two senses: First, I think the kind of laboratory we are talking

Miss McGuire: (Cont'd)

about is one in which you do try to introduce the resident to less than the total complex problem all at once. I think that has been part of the problem in skills instruction. In the operating room with the patient, with all the problems both cognitive and psychomotor that are involved there, the resident is dealing with a very complex situation. It is easier for the novice to develop competence by breaking out the components and letting him practice them under conditions in which he has feed-back and instruction simulating some difficulties, letting him face those and then letting him face the real thing. This leads me to comment on the point that you are making, Dr. Miller. Certainly I am not thinking of the laboratory as a substitute for experience with patients, but rather as a supplement early in the residency experience.

I think some of the general issues we are still wrestling with may be resolved somewhat more easily if we begin to work on concrete Components. The play back and forth between the concrete things and the general may be of assistance. If we try to anticipate all the issues at the general level, we are going to have more trouble than if we get to work with some rather specific things now.

Dr. Fry:

I think, before we go into the small groups, we should decide how detailed we are going to get, or how broad, in defining Components. We can concentrate on the mechanics of drilling the pins or fixation devices. This would be almost purely psychomotor. Next, we could concentrate on one of the problems I have in teaching residents, for example, the matter of interpreting the X-rays. They ought to be able to see the X-ray and recognize that it represents a three dimensional picture. This type of thing is really part of the psychomotor skill. Is this the type of cognitive thing that we are going to include in the components?

Dr. Chapman:

I would like to propose that we stick with the strictly mechanical aspects of skills such as placing a screw or using a tool properly. This, itself, will be a massive task and can be base line from which we can start on development. This is an aspect of surgical procedures which can most easily be taught in a laboratory. The question arises as to how many instrument components will be involved in the laboratory. I believe this could be determined by the priorities we place on different instruments and how much time and the number of developers we have to work on those Components.

Dr. Noble:

We have two component lists which were developed prior to the meeting, one by Richard Stauffer and one by Michael Chapman. If you compare the lists, you will see that they are really quite similar in terms of the components described.

I believe it is evident from the discussion so far that there is concern that the Components to be included in the laboratory may be too general and cumbersome to be effectively developed as a learning experience. From the two lists of components which have already been submitted, I would say they are quite specific and constricted, which should be our initial aim. I believe we should, at this point, break into the small groups and come to grips with the final definition of Components for inclusion in the laboratory. We will collate the reports of the small groups and present them to the Task Force for approval.

Group I will include Mike Chapman, Professor Domagala, Brian Hotchkiss, Gerald Laros and Ed Miller. Group II will be Doctors Cooper, Galante, Maurer, Ross and Stauffer, and Miss McGuire. Group III will be Doctors Fry, Hood, Rostoker, and Huncke. At the termination of the small group meeting we would like you to have discussed and outlined a definite list of Components for the laboratory.

Reports of Small Groups

GROUP I

Student Objectives

The following will be accomplished under each category in the following instrument oriented organization of a skills laboratory:

1. identify instruments
2. knows the purpose of the instruments
3. identifies special features of instruments
4. demonstrates proper instrument use including:
    a. grasp
    b. application to tissues
    c. position of operator
    d. safeguards
5. knows how to care for instruments
6. knows Biomechanical principles of instrument

I. Soft Tissue Instruments

1. scalpel
2. scissors
    a. tissue cutting
    b. suture
3. forceps
4. soft tissue clamps
5. needle holders
6. needles
7. dissectors
8. suckers
9. bovie coagulation
10. ligature
11. retractors
12. tendon passers

II. Bone Instruments

1. elevators
2. clamps
3. retractors
4. chisels
5. osteotomes
6. saws - hand
7. rongeurs
8. cutting forceps
9. curettes
10. scoops
11. gouges

14. mallets and impactors
15. power tools
16. rasps
17. screw drivers
18. depth gauge
19. burrs
20. broach
21. reamers
22. pliers
23. wrenches
24. counter-sink
25. taps
26. plate benders

GROUP I (Cont'd)

III. IMPLANTS

A. internal fixation devices

1. plates
2. screws
3. pins
4. wires
5. rods
6. nails
7. blade-plate combinations
8. staples
9. bolts

B. prostheses

1. Neer

This category borders on the teaching of a procedure and hence is beyond the scope of this present plan.

IV. Miscellaneous

A. Meniscotomes

TEACHER OBJECTIVES

1. Will provide the various instruments with identification tags.

2. Will provide a sound slide program or movie discussing the purpose, special features, use and care of instruments.

3. Will provide a pre-test problem of osteotomy and plate fixation of an animal long bone.

4. Will provide a post-test problem similar to the pre-test program.

5. Will provide a laboratory with the materials and instruments for student practice.

6. Will provide feedback to student during practice sessions and during post-test.

7. Will obtain faculty evaluation of students entering clinical experience.

GROUP I (Cont'd)

PERIOSTEAL ELEVATOR AS A MODEL

A. Use

Sharp elevator

1. Separate periosteum from bone
   - e.g. Sharp incision
     - Use corner of instrument and "wiggle" to start
     - Move in long axis of the bone
     - Move against acute angle of insertion of fibers
     - Grip is demonstrated

2. Separate muscle attachment from bone

Dull elevator

1. Separation of soft tissue planes
2. As a periosteal retractor

B. Non-preferred use

Separation of ligaments or capsule from bone

C. Safeguards

1. Stay on bone
2. Brace hand or use two hands to avoid inadvertant slipping

D. Care of instrument

1. Keep sharp (if sharp)
2. Store away from disimilar metal
3. Don't use as screwdriver
4. Don't use against metallic implant

GROUP II

	Assistant	Retractor	Lights	Scalpel	Hemostat	Scissors	Periost. Elev.	Osteotome	Rongeur	Curette	Needle Holder	Tap	Screw Driver	Chisel	Gouge	Hand Drill	Power Drill	Hand Saw	Power Saw	Hand Reamer	Power Reamer	Mallet	Pliers	Pin Cutters	Drapes	Cautery	Suction	Gigli Saw	Tissue Forceps	Bone Holders	Magnifying Inst.	Sutures	Depth Gauge
Environmental	x	x	x																						x								
Incision of skin			x	x																									x				
Incision of subcutaneous	x	x	x	x																						x	x		x				
Soft tissue dissection	x	x	x	x	x	x																				x	x		x				
Hemostasis - small points	x	x	x		x																					x	x					x	
- large vessels	x	x	x		x	x																					x					x	
Dissecting periosteum, muscle, tendon, capsule	x	x	x	x		x	x																						x				
Dividing bone	x	x	x				x	x						x		x	x	x	x			x						x					
Removing bone	x	x	x				x	x	x	x				x	x	x	x	x	x			x											
Drilling bone	x	x	x													x	x																
Placing screws	x	x	x										x																				
Reaming	x	x	x																	x	x												
Placement of nails, plates rods	x	x	x									x	x			x	x					x								x			x
Remove bone graft	x	x	x				x	x		x				x	x	x	x		x			x											
Place traction pin	x	x	x	x												x								x									
Suture soft tissue	x	x	x								x																		x			x	
Suture nerves	x	x	x								x																		x		x	x	
Suture arteries	x	x	x								x																		x		x	x	
Draping	x																								x								
Tap hole	x	x	x									x																					
Retract (skin, muscle, nerve, etc.)	x	x	x																														

GROUP III

Soft tissue technique

A. Scalpel
   1. identify handles and blade types
   2. adequate edge at all times
   3. use whole edge and not just tip
   4. recognizes that separates by dividing
   5. proper hold
   6. proper passing and asking for it
   7. blade position so you don't bevel
   8. hold varies - with task at hand
   9. change blade - going down
   10. cut through subcut. as few times as possible
   11. learn amount of pressure to apply

B. Finger
   1. as dissector
   2. as spreader

C. Scissors
   1. identify types -
      identify use of each on basis of material to cut
   2. identify quality of scissors
   3. spread tissue
   4. separate tissue planes
   5. identify suture scissors
   6. skiving with scissors
   7. identify those tasks that will injure instrument

D. Forceps
   1. identify types -
      describe most proper common use of each
   2. identify whether it's in proper working order
   3. demonstrate proper hold
   4. identify and demonstrate how to pick up tissue, grab as little as possible, keep off skin
   5. demonstrate as dissector with sponge on end of it
   6. as a retractor
   7. identify those tasks that will injure the instrument

GROUP III (Cont'd)

Soft Tissue Technique (Cont'd)

E. Retractors
   1. names of retractors and principle uses of most common types
   2. know differences between sharp blades and dull blades and dangers of each
   3. conformable body positions for retraction
   4. proper use of self retainers

F. Suturing
   1. identify needle holders and describe characteristics that you make choice on
      a. teeth and type of serration
      b. length
      c. angle
      d. lock or not
   2. identify and demonstrate proper hold of box lock type needle holder
   3. demonstrate to pick up needle and set it in needle holder
   4. transfer of needle back and forth forcep to needle holder
   5. needles
      a. identify types and uses of each
         (cutting vs. round)
         (shaft of needle)
         (hold needle in flat part eyes vs. wedged on)
   6. demonstrate how to make entry of needle into
      a. skin
      b. sub cut
      c. etc.
   7. demonstrate
      a. suture of skin
         (1) interrupt skin
         (2) continuous skin
         (3) subcuticular
         (4) mattress
         (5) pants over vest
         (6) figure '8'
         (7) retention sutures
         (8) suture with steel
      b. suture of subcutaneous tissue
      c. suture blood vessels
      d. suture tendon; Bunnell and pull out wire
      e. suture nerve
      f. soft tissue to bone

GROUP III (Cont'd)
Soft Tissue Technique (Cont'd)
F. Suturing (Cont'd)

8. Name suture materials
   a. describe advantages of each type; gut, nylon, steel
   b. describe weights of suture material
   c. filament types
9. Tie knots
   a. instrument, hands
   b. tension vs. no tension
   c. individually tied, vs. en toto tied
10. Hemostats and clamps (like Rocker)
   a. identify types and advantages of each
   b. how to clamp blood vessels
   c. as dissector
11. Hemostasis
   a. use of cautery - cutting and coagulation
   b. demonstrate clamp of blood vessels
   c. hemostatic agents
      (1) gel foam
      (2) thrombin
      (3) bone wax
      (4) muscle
   d. ligatures
   e. stick ties
   f. packs
   g. getting out of hemorrhage

Bone exposure and cutting techniques

1. Knife on periosteum
2. Elevators
   a. identify types and advantages of each and uses of each
   b. demonstration of elevator in taking muscle off or periosteum off
   c. when elevator isn't good and knife needed.
3. Bone cutting
   a. gigli
      (1) demonstrate use
      (2) name advantages
      (3) precautions when using
   b. amputation saw-types advantages, uses and abuses
   c. osteotomes
      (1) names types, uses
      (2) describe characteristics of osteotomes vs. chisel
      (3) name advantages and disadvantages

GROUP III (Cont'd)

Bone exposure and cutting techniques (Cont'd)

3. Bone cutting
   c. osteotomes (cont'd)
      (4) describe task of cutting
         (a) scoring
         (b) hole drilling
         (c) Holding osteotome
         (d) sound and feel of cutting, splitting, and going through
4. Chisels
   a. identify and describe
   b. uses and abuses
5. Curettes
   a. describe types and uses (hollow vs. solid handle)
   b. hold
   c. method of use
      (1) down and pull back
      (2) levering, fulcrum or not
6. Gouges
   a. types (straight and angled)
   b. use with hammer, without hammer
   c. two hands when thought of doing too deep
   d. use in cancellous bone
   e. not cutting full thickness but trenching
7. Rongeurs
   a. types (name)
      single vs. double action
   b. uses
      (1) nibler
      (2) shaper like fashioning graft
      (3) enlarge defect of hold
   c. demonstrate hold
   d. two hand technique
   e. pituitary
   f. kerasons

Internal fixation

1. Screws
   a. name types and supposed advantages of each
   b. torque application - with torque devices
   c. use of lag screw effect
   d. drilling of screw hole
      (1) keep at right angles
      (2) feel of going through
   e. depth gauge
   f. use of screw drivers
      lock types
   g. tapping screws

GROUP III (Cont'd)

Internal fixation (cont'd)

2. Intermedulary rods
   a. identify types and advantages of each (Kunchner, Rush, Schneider)
   b. closed and open technique
3. Plating
   a. identify types and number of plates
   b. list advantages and disadvantages
   c. demonstrate no scratch technique with clamps
   d. centering tools for holes in plates and bone
   e. identify bone holding instruments and state advantages of each
   f. reduction with clamps
4. K wires, Steinmann pins
   a. define difference between pin and wire reason for use of each
   b. threaded vs. non-threaded - reasons for each
   c. placement of pin in drill
   d. palpation with pins (walking a pin across bone)
5. Hip fixation
   a. closed reduction of hip fracture
   b. identify (most commonly) used types in your inst.
   c. discuss supposed advantages of devices
   d. define acceptable reduction and adequate fixation
   e. demonstrate proper placement of guide pins

Collation of Small Group Results

Dr. Noble:

We have typed and reproduced the results of each group's work this afternoon. There is really quite remarkable agreement on components as defined by each of the small groups.

Dr. Cooper:

Bates, looking at these, it appears we have covered exactly the same things. The only difference is the detail to which we have gone. Some people have gone further and identified the subcomponents of the component and written out the behavioral description of the student when he is doing this. I believe all that is required is some discussion and we can come to complete agreement.

Dr. Noble:

Fine. We will have one member present the report of each group's work. We can then discuss these reports and find common ground.

Dr. Miller:

I would recommend that Mike Chapman present the student objectives which were developed by Group I. We think this is the pattern each Component should follow regardless of the ultimate choice of components.

Dr. Chapman:

There is a remarkable similarity between what we have and the report of Groups II and III, except that we have expressed it in more general terms. We thought five basic things a student ought to be taught about instruments would be:

1) To identify the instrument,

2) To know the purpose of it,

3) To identify any special features of the instrument,

4) To demonstrate its proper use, including grasp, proper application to tissue, and operative safe guards, and

5) To know how to care for each instrument.

Dr. Chapman: (Cont'd)

We organized the instruments into four broad categories: instruments applicable to soft tissues; for bone; implants; and a miscellaneous category to pick up the loose ends. We tried to make the list as comprehensive as we could without getting into details, such as the various kinds of elevators, etc. The only exception to this is in the area of prostheses. The reason we didn't go into any detail there is that we thought that inserting a prostheses is really a procedure and not truly a component. We would be getting beyond the scope of basic skills laboratory with this category. We thought we might include prostheses for identification only. Beyond that, they shouldn't get into the scope of this laboratory. If you apply Items 1 through 5 under each instrument, you end up with the laboratory. We then took one instrument, the elevator, and attempted to work up an example Component for the lab in some detail.

Basically, the teacher objectives represent the structure of the laboratory.

Dr. Cooper:

I believe we should have all the components available and allow people to work on those that they wish. I don't see our function on this go round as narrowing this down and saying this has to be a limited skills laboratory. We should leave it as large as proposed by all three Groups and let those who wish choose the Components they want to develop. When we put the Components together in the final package, you or your Institution can choose which ones you want to use and incorporate them into your own lab. I do not think it has to be a standard unit that we sell to the entire country.

Dr. Chapman:

One thing we were very impressed with in our Group was the fact that we had four people from all over the country and, remarkably, we ended up with a very unified statement; for example, the use of a periosteal elevator. All of us were trained in different programs and are from different parts of the country, but we agreed very well.

Dr. Fry:

We had this experience in our Group as well. There wasn't nearly the problem we had in establishing the "party line" in our

Dr. Fry: (Cont'd)

own residency program in Seattle for procedures. Use of equipment is quite standard.

Dr. Stauffer:

I believe this is a sign that we are keeping this at a very basic level.

Dr. Noble:

This can certainly give us considerable hope that we will be able to develop a nicely integrated laboratory using Components developed in different parts of the country.

Dr. Hotchkiss:

We had one additional portion which is not represented in the actual report from Group I. We are dealing with materials that have mechanical features, both implants and tissue. Somewhere integrated into this laboratory has to be this type of information: how tight do you tighten a screw, how strong is the tissue you are dealing with. This is probably as important as anything we have in the components. I think we might add "bio-mechanical principles" as #6 for Group I's student objective list.

Miss McGuire:

The general thing you are talking about would not necessarily be respect for material, but would be the consideration of the characteristics of the material and that is partly psychomotor and not solely cognitive. It is getting the "feel" of it.

Dr. Chapman:

I believe it would be a mistake to teach a person that you should tap before you put in a certain type of screw but not tell him why. I think by telling him the why, you automatically are going to cover this aspect of materials and the bio-mechanics of internal fixation.

Dr. Fry:

Obviously we have to teach it that way or they won't remember it.

Dr. Cooper:

Group II developed what might be called the "McGuire-Stauffer Grid." I don't think we have done anything different than the other groups except to develop a two dimensional grid by crossing "activities" or tasks with the instrument used in each task. We might be able to see where there is a greater concentration of x's and perhaps get some idea, if we have to set priorities, as to where we should start in terms of defining the rest of the Components. I believe that is the only real difference from the other groups. It is amazing how nearly exactly we reached the same conclusions.

Dr. Maurer:

We took Dick Stauffer's initial list which was compiled in two terms; first, instruments, and secondly, tasks. We decided that by the time you taught the use of all the instruments you would have taught the tasks. To make sure this was truly the case and get some idea of the frequency of use, we simply listed the task on one side and crossed referenced it with the instruments and found that, indeed, that was the case. You can see the distribution of the x's which indicates that on Group II's grid.

Dr. Stauffer:

We would plan then to orient the lab according to the instrument list across the top of the grid.

Dr. Miller:

If we assign the Components according to task, as noted in the left-hand column on the grid, rather than by instrument as noted across the top, I believe we will have considerable amount of duplication of effort since a number of instruments are common to several tasks.

Miss McGuire:

One element came up in our Group which we didn't include in the report, but which I think is particularly important and that is the teaching of three dimensional preception. This is rather a different type of thing and we couldn't fit it in our grid but I would hate for us to lose it.

Dr. Miller:

You can teach some degree of three dimensional conceptualization using a pencil and paper. This is constantly done with engineers and is what used to be called analytical drawing.

Dr. Stauffer:

I believe we should include three dimensional perception in the skills laboratory even though it doesn't actually fit our scheme per se.

Dr. Hood:

What we developed in Group III is really essentially the same as Groups I and II except that for a particular component we tried to draw out those things that immediately came to mind that we wanted to stress as major principles. We had one section concerning hemostasis. We felt it might be important to face the learner with a bleeding situation and then give him the opportunity to extract himself from hemorrhage. Whether this belongs in the skills lab or not, I am not really sure.

Dr. Miller:

There are certain areas of behavior which we are going to have to actually teach in the operating room and, perhaps, this might be one of those.

Component Assignment

Dr. Noble:

We have discussed the reports of the three Groups and have fairly well defined the potential Components for the laboratory. We should now discuss the actual assignment of Components for development.

Dr. Miller:

I believe each Institution represented should take one specific area, try to make up one Component and then get back together and show what we have done.

Looking at the list of instruments we have, the ones of most importance would be scalpel, forceps, scissors, elevator, chisels, osteotomes, scoops and gouges, mallets and impactors, screwdrivers, depth gauge, drills, saws, needle holders, needles, and ligatures. These are the instruments we use the most and can be used as a starting point. I'm not saying the other instruments are not important, but if we were to make a list of priorities, these would seem to be the ones that would be high on the list.

I would like to develop the component dealing with the scalpel and forceps.

Dr. Maurer:

Coming from the home of the double plating, I think the University of California should take Component #6: screwdrivers, screws, depth gauges, hand and power drills.

Dr. Fry:

I would like to work on the osteotome, chisel and mallet Component.

Dr. Hood:

I will develop scoops, gouges, and curettes with the Akron group.

Dr. Stauffer:

We would like to work on the periosteal elevator Component.

Dr. Hotchkiss:

I have already done some preliminary work involving the needle holder, needles, and ligatures Component. I would like to work on that one.

Dr. Chapman:

It is evident we will have some degree of overlap between the components, which is probably good.

Miss McGuire:

We should block out the territory you each expect to cover in the area you have selected. This will minimize the amount of duplicate effort.

Dr. Noble:

In the morning we will have discussion by the component developers to permit them to define their area for the rest of the group. This will give each component developer an idea of what the others plan to do.

PROPOSALS FOR COMPONENT DEVELOPMENT

Dr. Noble:

The Component developers have had a chance to discuss among themselves the organization and, to some extent, the content of their individual Components. This portion of the meeting will be devoted to a report to the Task Force from the developers concerning their ideas and outlines.

Dr. Miller:

I have attempted to put together an outline of the Skills Laboratory for the use of the scalpel and forceps. I would anticipate having a sound movie as an introduction with a general statement about the use of any instrument, proper environment, lighting and positioning, etc., and to note that, while they are not described in this particular Component laboratory, they are not to be neglected by their exclusion. Then I move through the type of outline that we described earlier, that is, identification and demonstration, through the movie, of the various types of scalpels and forceps. There would then be a brief discussion of the purpose of the instruments. The forceps are used in the non-dominant hand to steady tissues manipulated by any other instrument, in this case, the scalpel. The scalpel is used to sharply divide tissues with a minimum of tissue damage as opposed to crushing instruments, such as a scissors. Special features of the various types of handles and blades, and forceps, such as a statement about spring strength on the forcep, would then comprise the remainder of the script which, as I have it here, would probably run fifteen to twenty minutes. There are, for example, four grasps of the scalpel and one for the forcep, so this would not take too long to demonstrate in the course of the movie. We would want to demonstrate several different types of application of the scalpel by making incisions, fine dissection, stripping the periosteum or capsule off bone, shaving cartilage, saucerizing osteochondritic lesions, taking a small split free graft, etc. Under "safeguards" I would point out that you shouldn't push the scalpel into tissue end on. The care of instruments is not too difficult here because of the disposable nature of the blades and proper spring in the forceps has already been emphasized.

Dr. Maurer:

May I make a suggestion as to special precautions in terms of the different types of handles. You should mention dislodgment of blades in places like knee joints.

I would also emphasize the "two-handed" approach to surgery. There is nothing more remarkable than to see a first-year resident operating with one hand and the other just sitting there in the breeze. Two-handed coordinated use of the instruments should be emphasized.

Dr. Rostoker:

Have any of you considered the possibility of synthetic materials for your model in the use of the scalpel or with any of the other components?

Dr. Hotchkiss:

I wonder if you could get a material like the styrofoam material which is put in bouquets of flowers, which is very flimsy and ver fragile, and use it to practice needle passing. You would have to perform the same motion very delicately or it would pull out, which would be an excellent means of feedback for proper technique. Using a very small piece of styrofoam, you could even bring in the use of forceps and emphasize the principle of two-handed surgery.

Dr. Stauffer:

It would be a very good model in that it would be easier to measure performance. The amount of material they cut through could establish a criteria for performance.

Dr. Cooper:

The plastic surgeons have researched skin simulation to some extent and the closest thing to the human skin, as far as they are concerned, is pig feet skin. It is also fairly easy to obtain.

Dr. Rostoker:

I would think the use of the synthetics would also be easier to inventory, which would be better than the use of material such

Dr. Rostoker: (Cont'd)

as pigs' feet. I think there is considerable room for modeling here and there are numerous materials and composites of materials that might serve purposes for the various Components. There are a variety of foam rubbers of different characteristics of stiffness, flexibility, and sponginess, which could be used. There are also numerous silicones and silastic materials which might be considered.

Dr. Cooper:

I am afraid I don't see what is wrong with skin as a substitute for skin. Perhaps for testing you might consider a material which would give way under a certain known tension, but I believe for practice we would find it much easier to use material such as pig skin.

Miss McGuire:

I would have one additional comment concerning the format of the cognitive presentation. I wonder if, in addition to having the movie, it might be a good idea to have a written script with some still pictures. For example, pictures of the various types of instruments and perhaps even the appropriate grips.

Dr. Miller:

I believe that would be a very good idea. Both before and after the movie the learner could review the major points via the stills and the script.

Professor Domagala:

Referring, again, to the procedures we have used in the Engineering Laboratories for teaching, we have found the use of the 8mm cassettes with sound track very useful.for initial material presentation. Another technique that has been used is to take various still photographs from the movie and have them as a separate materials package for review. This could be put out as a separate hand-out and used in conjunction with the movie.

Dr. Chapman:

In terms of actually producing the audio-visual setion, I would like to suggest that we use motion media because this is

Dr. Chapman: (Cont'd)

better for demonstration of the use of an instrument. Secondly, I believe we should initially use video tape since it is so much cheaper than film. There are processes now which can transfer images from video tape to film, so we could make video tapes of the Components and then transfer them to cassette film.

Dr. Miller:

Facilities for using film are certainly more wide-spread around the country than for the use of video tape. I have been disappointed, however, in the films which I have seen made from a video tape transfer.

Mr. Monahan:

Dr. Miller, one point that should probably be brought up here is that in the actual shooting of the video tape or film, the view which the learner has should be the same view as the individual who is actually performing the task from the operator's view, as if it were his hands performing the task.

Dr. Miller:

Yes, the standard technique for making a surgical film is to show the operation from the view of the operator.

Dr. Noble:

May we have the report from the Iowa group concerning the periosteal-elevator component?

Dr. Stauffer:

We have followed the same general outline that was developed in our earlier discussion. Generally, we have the idea that a pre-test would be a good idea. We would then have a hand-out of printed materials, possible use of a sound slide, and a demonstration by an instructor. This would be followed by practice by the student. We thought video tape might be used here to provide feed-back. This would be followed by a post-test evaluation of some type.

Dr. Fry:

One of the problems I would see with the video tape feedback would be the amount of time it would take for an instructor to review these tapes with the student. In my view, we should have the instructor in the lab for very short periods of time for each Component.

Dr. Stauffer:

The student would certainly have a period of time of self-practice and would be able to watch himself on the video tape. He could then compare himself with the model which would have been shown by the instructor or with the movie in advance. We think this monitoring in the development of this skill by the learner would be helpful in preventing the formation of bad habits. I think having the student watch himself would be helpful, otherwise he may not really realize he is carrying out the task improperly. We must have established criteria for what he must accomplish, demonstrated in the initial presentation. He can then check himself against this model.

Miss McGuire:

You might want to develop a check list which could be used to compare the student with the model of the proper approach to the Component skill.

Dr. Cooper:

We thought we might be able to develop such a check list by looking at several video tapes of the pre-test to determine what it is that people frequently do wrong.

Dr. Noble:

This is where we could use industrial engineering techniques. When they do their time and motion studies, they analyze the technique, both of the experienced individual and the novice. They learn from both expert and novice operators.

May we hear from Lou Fry now, concerning the osteotome, chisel, and mallet component?

Dr. Fry:

There are two ways I would like to present this. One is to just list the type of equipment that we could have available. We have a teaching laboratory now that is used as a plaster room and traction area. I can see this lab being built into this area very easily. The student will arrive there whereupon two books will be available to him. One will be a manual which will be an outline of the entire lesson. It will tell him what to do, when to turn on the tapes, when to turn them off, when to look at materials, etc. The other book will be reading material which will have instructional information in it, lists of materials, pictures, copies of drawings from equipment catalogs, and things of this sort.

The instruments he will have available will be of two types: one, he will use for observation to look at and handle. These will be numbered but will not be used in the actual practice segments of the Component. This is so they will remain the same in terms of degree of sharpness, and number of nicks and scratches that are present. They will be numbered so he can identify this particular instrument from a list in the manual. One has a certain wedge, a certain shape, is sharp or dull. The second set of instruments will be the ones he will actually use in the practice sessions. I envision a table with something like a vise on it which will clamp the bone so they can work on it. This vise would also be used, of course, in numerous of the other components, probably, such as the drill. I believe we can use bovine bone, both cancellous and cortical bone with and without periosteum. There would be a projector or a video tape machine available which they can turn on and off as necessary. Specific instruments will be a couple of osteotomes, probably four or five of different widths and shapes and bodies, and ones with long and short handles. There will be chisels of two or three types, and there would be two or three types of mallets. They also would have a drill.

The way this would be set up is that the residents will read a package of instructions about what they are going to do and they will initially turn on the video tape recorder. There will be an introduction to the various instruments. Then we would get into showing them the different sizes, the different parts--the handle, the blade, the corners of the blade, which are used whether it's anterior curved or whether it's flat. Then we would show them a little bit about the equipment, whether it's sharp, whether it's dull, whether it has nicks on it, and then we would stop and have them handle and examine the actual instruments. They then start the film again and go through the exact thing they will need to do in the practice session when they use tools. They will see someone clamp a piece of bone into the vise and will see the actual process of three activities. They will cut cortical bone across and longitudinally and will cut cancellous bone as if they were cutting the neck of a femur and will then cut a window in cortical bone, which involves using a drill in the corners and cutting between the drill holes. The film will then be stopped, they will be allowed to re-play it a couple of times if they feel they need to, and then they will be able to go on toward trying to use the instruments themselves using the guidelines and instructions which will tell them what they need to do with the materials to perform this activity. Once they have finished this, it may take them a short period of time or it may take them a very long period. They may then turn the film on again and see a series of different operators using osteotomes in various situations in the operating room We would then have a final portion on film which would have to do with the care of the instruments; the techniques of sharpening them, putting them in the rack and storing them, how you insure that they will not just be thrown into the equipment bins. We will also have demonstrations of improper use of the instruments and, finally, a summary to bring the whole thing together.

I have post-tests in mind for which they would call the instructor. Their post-test would be criticized and they would then be given instructional prescriptions as necessary.

There will not be an instructor present for any of the laboratory experience. They will go through the entire process on their own and then make an appointment with an instructor to demonstrate the activity to him. It may be possible that they can run through four different packages or components before they would get together with the instructor to demonstrate their capabilities. In this way, the instructor would not be tied down as significantly to the lab. Individuals who would not be able to learn these components very effectively on their own, would probably be identified early on in the Components of the laboratory. With these individuals you would follow a different, perhaps tutorial, approach.

Dr. Miller:

I don't think we should minimize the importance of individualized instruction for the learner who fails to demonstrate an appropriate level of competence at the time of his testing. The proficiency test is to identify the individual who needs the special instruction.

Dr. Noble:

Henry, would you please present the outline for the scoops, gouges, and curettes Component.

Dr. Hood:

My plan is very similar to both Dr. Maurer's and Dr. Fry's presentations. Basically, the format would be similar to what we have been doing in the plaster skills lab. As far as materials go, we need, I think, joints that would simulate bones of the foot or cartilage surfaces for use of curettes. I don't think this will be difficult to obtain. We would want to have cross-cuts of pigs' feet or cows' feet, which would give us surface for practice in the use of the curette. Akron has a Sony unit for video-taping which I think would be the best thing to use there for both feed-back and possible initial packaging.

Dr. Noble:

May we hear the report from the University of California component concerning screw drivers, screws, depth gauges, hand and power drills.

Dr. Maurer:

We broke this down into three sub-components, one which was the drills and the depth gauge. We decided to combine screw drivers and screws, because when you start talking about screw drivers you must talk about screw heads. In discussing, first, the drill, we start with identification of the various types. We want to keep this limited to drills and did not include braces. We feel that the brace on the Trinkle drill or the Hudson brace for reaming belong in a different Component. Initially, we plan to have the instruments available and to have hand-outs with illustrations and names. The hand-outs may also contain some discussion so that they can refer to them. We may

Dr. Maurer: (Cont'd)

even include a discussion of the video tape in the hand-outs. We then went to the purpose of drills. Drills hold K wires, Steinman pins, and bits. We think this can be done in very brief sequence with inserts showing the operating room use of these various instruments. We go then to proper use of the instrument, using the drilling of holes as an example. For the drilling of holes we talk about the selection of the bit. Again, we did not have bits included in the component but we do think it is important for drilling. We then discuss the size of the bit, the material the bit is made of, the sharpness, the length, etc. The proper use of the chuck on the drill and the key, in tightening of the chuck; positioning of the bit within the chuck; the length of the bit protruding, etc.; how to grasp and hold the drill, the selection of the drilling site; for example, if you have a circular bone and you drill off center, you go through the first cortex and the second cortex, and the bit starts to bend, and you snap your bit. There is a proper way of selecting your site, a proper method of starting the drill bit so that it doesn't migrate, (a backward and forward motion until the drill is started), the direction of drilling, the speed with which the drill is run, the force applied and the direction in which you are drilling, to maintain the force, to control the penetration. This would have to do with two things, the feel of the drill as it is going through tissues, knowing when you have gone through one cortex and the next, and then, the length of the drill so that you don't go six inches into soft tissue after you have gone through the opposite cortex. Finally, the extrication of a drill point. You don't just pull it out but simply keep the drill going in the same direction and remove it. We talk about safe-guards. This is primarily protection of surrounding soft tissue so it doesn't get caught around the drill or around the chuck, and also that you don't penetrate too far. We would also talk about proper care of the instrument, such as, proper washing and lubricating. We talk about proper matching of the key for the chuck and having an extra chuck key available. Also, not to force the drill or drill bit; this is when you stop, look to see where it is jammed and the way of getting at it, then getting out without snapping off the drill bit in the tissues. This would all be on video tape. The student would then practice in the lab. We anticipate using a bone specimen, probably calf bone or beef bone, with an instructor available. We have discussed pre-and post-testing but feel we must initially set up a component, and that pre- and post-testing would come once we are able to do a more complex task. In other words, once we have gotten through osteotome, mallets, saws, and so on, we will have them cut a bone and put a plate on. Then we will be able to test the entire complex task.

We will present depth gauges, screw drivers and screws in this same manner.

Miss McGuire:

I like, very much, the suggestion that has been made to combine the testing or some portion of the exercises after several components of instruction have been completed. The resident would be able to integrate the use of several kinds of instruments in a meaningful exercise that would cover all of these instruments and would, therefore, use the instructor more judiciously.

Dr. Maurer:

The reason we decided on this was that we felt the laboratory must be a goal oriented. The resident's goal is operating.

Dr. Stauffer:

There is one idea along this line that might add a certain amount of entertainment value to the laboratory. You could rig a torque screw driver with a small mercury battery so that when maximum torque is reached, a small shock would be given to the hand of the learner. This would give immediate feed-back if you exceeded maximum allowable torque, and this would certainly help them to learn the "feel."

Dr. Chapman:

You can get very sophisticated along this line, I would think. One of the most common errors that the resident makes is over-heating the drill. It would be very useful to put a thermocouple into the bone and have him drill and watch a temperature gauge.

Dr. Noble:

Brian Hotchkiss, will you give the report on the needle holders, needles, and ligatures component.

Dr. Hotchkiss:

I look at this Component as an integrated task, in which it is difficult to separate one portion from another. I believe I will approach it from that standpoint. I will work from the most general use of something to the most specific. For example, a needle holder. The most general use is, as with all these instruments, an extension of the fingers. The needle holder is specifically designed to grasp and hold the needle. The forceps are used to grasp and hold the tissue or to grasp and move or hold the needle. Very rapidly, then, you get into integrated motion between the two to carry out two-handed surgical technique. I feel that the pre-test is applicable to this particular phase of the laboratory. I am assuming that most people I am dealing with have at least seen someone handle the needle holder and suture. Most medical students have at least watched an operation and realize that it is an integrated task. I would pre-test using some form of synthetic materials, such as styrofoam or natural tissue, such as a pig's foot. I would like to compare the two to get an idea of which I like best as well as the resident's response to these two materials. This would be sort of a side experiment in the developmental phase. I would design my pre-test rather specifically and I would give them the incision already made and tell them to place the sutures approximately one-quarter of an inch apart to have them equi-distant from the skin and to approximate the tissue to a degree that did not cause over-approximation and yet to have the ligature snug. I would have them do part of it with a running suture, part of it with hand-tied suture, and part of it with a needle holder tie, interrupted suture.

Using the pre-test as a foundation, I would then try to design a training film, just as we have all been talking about initially using video tape. I want to find a very skilled plastic surgeon or general surgeon whose specialty involves suturing more than ours, and utilize him as a demonstrating model to show the proper grasp of the needle holder and turning the needle through the tissue; use of forceps, how to hold them, how to manipulate them, how to transfer a needle with them. The motor aspects of tying a knot; one=handed, two-handed, and with an instrument, will be demonstrated.

We would then give the resident, or student, opportunity to practice. I think rather than an instructor being there all the time while they are practicing, which would be rather inefficient, I would prefer to have a video tape machine available

Dr. Hotchkiss: (Cont'd)

so that at the end of the practice session they would record the best effort they could make and I would then review it. If I find flaws along the way, I could point this out to them rather than being in the lab throughout the practice sessions. They can practice as many times as they want to and, when they get to the end of the session, they can make a tape so I can see it at my convenience.

Finally, I could give them an integrated post-test, giving them a problem and having them use some integrated cognitive approach to it.

Dr. Fry:

Would the tests be much different than the thing you would have them record on the video tape for your perusal later on?

Dr. Hotchkiss:

If I design a test, I can time it and set up criteria and evaluate these various elements by subtracting errors and certain pluses and use time as a factor. If I am looking at someone on the video tape, I would not have emphasized the time element and I won't be able to look at it as precisely, because I won't have the material directly before me.

Dr. Maurer:

I have a comment concerning the pre- and post-tests for the components. For each component, I believe the pre- and post-tests should be primarily simply feed-back for the learner and should not have major emphasis. I believe the major testing of the laboratory as a whole should be with an integrated task using many, if not all, the Components in that task.

Dr. Chapman:

I would say also that the lab should be as automated as possible to limit the amount of actual time in the lab by the instructor. I think we will find that as we begin to implement this laboratory that there are certain aspects of these components which are not teachable by video tape. For example, one of the things we have a difficult time teaching the novice resident is how to use a needle holder without putting his fingers into the holes. How do you open and close an instrument with the palm of your hand? This is something I suspect we won't be able

Dr. Chapman: (Cont'd)

to get on video tape. So I believe there will have to be a certain amount of teacher input actually in the laboratory.

Miss McGuire:

I think, in setting up the skills lab, there ought to be a place where the residents can go at any time for as long as they want and work in a comfortable setting. This accessability is important for the success of the laboratory.

Dr. Hood:

I would suggest that perhaps we should have Frank Penta and Jim Williams from the Center for Educational Development look into the various types of media which we could use for the initial portion of each component. They could tell us something about the cost and also send us some suggestions concerning possible ways to write the scripts and also the types of video tape or film equipment which would be best for the final product. We should also, I think, consider couching the language in the components, so that it will be compatible among components. We should have, at least, a similar educational terminology and formating so the Components will work together well.

Dr. Noble:

It will be important to have the scripts submitted by the individual developers, both to the Center for review by the educationists, and also for review by the other developers. This, of course, should be done before anything is actually put on tape or film to minimize the possibility of the incompatibility, both in terms of content and equipment usage.

Dr. Hotchkiss:

I believe when we get to the actual production of this, some of our ideas and theories are not going to hold up. It would be a good idea for us to experiment a little bit so we can take as many of the bugs out before we actually start final packaging. We wouldn't really lose anything by putting it on the video tape, for example, because this could always be re-made.

Dr. Noble:

We would expect that after the scripts have been reviewed, the individual developers would carry out a certain amount of experimentation to develop an idea of what will, and will not,

Dr. Noble: (Cont'd)

work. The individual developers can then present this work to the Task Force at the next meeting. At the next Task Force meeting, then, we would anticipate selecting a single format as well as production methods.

Dr. Miller:

How many people have schools of art or design available to them? I am thinking specifically of people interested in art, because I think it would be appropriate to contact these people and see if we could find someone who would be interested in helping with film editing to make this thing not only utilitarian but also acceptable from an artistic point of view. It should be, of course, functional primarily, but something that is functional can also be artistic.

Dr. Fry:

This would have to be something that would be uniform throughout the whole series. I think this is like everyone writing a chapter of a book, if someone doesn't put it into a single format, the book will not be as effective.

Miss McGuire:

As far as the editing and packaging, I think there would be no problem in arranging for that to be done here at the Center so there would be a uniform packaging and style. Perhaps the best thing to do would be to have a selection from among the examples which are produced during the experimental period between now and the next meeting. Those formats which would have the most eye appeal would be selected and developed as a common format in style.

Dr. Noble:

We plan to have that as a major focus of the next meeting. We could have the audio-visual experts, TV and film people from the Center, present at that meeting to make suggestions. The Task Force can reach agreement concerning format and style at that time.

Dr. Cooper:

Are funds available to help us on the material we will be working on between now and the meeting, as far as video tape

Dr. Cooper: (Cont'd)

or 16mm film photography? Do you think that any of the instrument companies would be interested in sponsoring this?

Dr. Huncke:

The VA is sponsoring the sound-slide programs for the Academy. Paul Curtiss worked that out.

Dr. Noble:

Dr. Larman's films were sponsored through the VA, as well.

Dr. Chapman:

I think it would be very worthwhile for the Center of Education Development to contact the various instrument companies because, if this program is going to become an accepted method of education for surgeons, obviously it is much to their advantage to have their instruments in the laboratory components and in the audio-visual materials.

Dr. Fry:

I have contacted a couple of the detail men, already, because I was looking forward to getting together instruments for the Orthopaedic Assistants' lab. They have been glad to assist us in this fashion.

Dr. Cooper:

What about my first question in regard to availability of funds for the development phase?

Dr. Chapman:

My guess is that you could do this development portion for $500. I would expect that we could support this out of our Department.

Dr. Hotchkiss:

We might have some problems in that regard, being a private institution. We might need some seed funds to get us going. The video tape department of our institution charges by the hour. I believe I could get some instruments and suture materials but I would have trouble with the expense of video tapes.

Miss McGuire:

We are talking about several costs, it would seem to me. The one that is clearly outside the study's capability is the cost of setting up and maintaining skills laboratory once you've got all your materials ready to run and you want to set one up in an institution. Those costs would be an individual institution's decision. Looking backward from that, there is the cost of getting from your individual packages into a single edited package and master copy of everything. The Study may look into footing a portion, at least, of that bill. I had the same impression as Mike Chapman that initial development could be done rather economically using the techniques you were suggesting and video tape. I would say that if it is at all possible for the instrument manufacturers to bear some of this cost, that should be done. The major cost is, of course, professional time and you have expressed a willingness to make a major contribution in that form. If there are costs beyond that, you would feel that your institution cannot cover in this developmental stage, I think the only thing I can ask you to do is to write me a letter indicating the budget that you would require. We will simply have to do what we can in that regard.

Dr. Hood:

Very precise planning before you go to the TV department will help you hold down the costs. You should know precisely what you want to do.

Dr. Noble:

At the Center we will explore the possibility of contacting the instrument companies concerning support for the components. With your permission we will be using your names to indicate the depth and breath of support which the concept has. If we go forward with this, we would also ask that you contact the individual detail men from the instrument companies in your territory to underscore these requests. When I was initially working out the format for the traction lab, I contacted Zimmer and received a very excellent response from them. I would hope that we might anticipate this type of response from not only Zimmer, but also other instrument manufacturers when we make this type of request.

Time Table

Dr. Noble:

The next step is the formulation of a time table for initial work on the components and for a second meeting of the Task Force to finalize formats and collate materials.

Dr. Maurer:

We can get a script together relatively rapidly, but for those of us who have had no experience with the video taping, it will be a matter of carving out an hour here and trying something and then another hour there and trying something else. Mike Chapman and I have been talking in the range of about six months.

Miss McGuire:

It sounds to me like there are going to be about four stages in this thing. First, is fleshing out the scripts. The second stage is the initial shooting of the scripts and photographing those things which require visual input; then there is a review of the materials and the semi-final shooting of the video tapes. The fourth element would be combining the individual units into some kind of sequence. I wonder if it wouldn't make sense to set an early date for the detailed scripts and for initial video tapes for those who would be in a position to have shot them.

Dr. Noble:

I believe we should have the scripts come to the Center, have them copied and then sent to all component developers for comment and criticism. The scripts can then be returned to the individual authors. This should be done fairly early on and probably before actual shooting takes place.

Dr. Cooper:

Do you think we could have the scripts finished by the end of July?

Dr. Noble:

We can have a deadline of 1 August for submission of these scripts to the Center for Educational Development. We will make a second deadline for return of scripts to the original authors.

Dr. Chapman:

I think it would be best to have our next meeting of the Task Force after the developers have had a chance to at least do some experimenting with putting their Component on video tape. Then my guess is that we could set a deadline for scripts early, as you suggested, 1 August, but for the actual production of tape, I think the best we could do would be early November.

Miss McGuire:

We could plan to have the video equipment here so we could review each other's work and discuss potential final formats and such things as titles, etc., at that meeting. This would be the point at which we could have the audio-visual experts provide their suggestions.

Dr. Hotchkiss:

I would think the first part of November would be a good time for the meeting. It is before Christmas entanglements and also before the big push to get things ready for the Academy. The flying weather isn't too bad then either.

Dr. Noble:

In polling the group, we have found that the majority would prefer to have the next meeting on a Thursday/Friday date in the early portion of November. We would have the 4th and 5th, 11th and 12th, and 18th and 19th of November. We will propose these three dates as possibilities for the meeting and ask that you check your calendars on return home and let us know as soon as possible which would be the best date for you.

I will summarize our order of business to follow this meeting. Please let Miss McGuire know as soon as possible if you are having problems with initial development costs. We will send a letter to you listing the dates in November and ask that you let us know as soon as possible which dates are best for you so we can plan the next meeting. The deadline for submission of scripts to the Center is the 1st of August. We would, of course, be most happy to have scripts submitted to the Center before that time for dissemination to all component developers. We would like to have those scripts returned to the Center for a second review and returned to the original authors two weeks after you initially receive them.

Dr. Noble: (Cont'd)

We will meet in early November for a "show and tell" session and to develop the final format for the laboratory. We will encourage the Cleveland and Illinois groups to assume the responsibility for development of a component. We will explore the possibility of approaching the instrument manufacturers for potential financial support, both in supplying instruments and in actual production of the laboratory. It would be helpful if you individually talk to your detail men so that the companies have input from those men as well. I want to thank you all, very much, for coming and for your excellent work over the past two days. It has been enjoyable and very gratifying for me.

June, 1971
HBN

PSYCHOMOTOR SKILLS
IN
ORTHOPAEDIC SURGERY

PART II

Edited by

James Monahan, M.S.

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Thursday Morning

Mr. Monahan: Today and tomorrow after viewing the products you have brought with you, we have a number of decisions that have to be made. First of all, a general agreement on the format, length, content, and other aspects of this organization. Second, the organization of each of these components after their completion, i.e,, are they to be sequential or are they discrete units that can be used independent of each other? Perhaps we might find that in certain components there are skills learned which will facilitate the learning of others, and therefore, the components should be arranged in a particular sequence. Production deadlines have to be determined and also the place of production. The media which these components will take also has to be considered: what kinds of media, how much variety, and what should go into each of the kind of media? It seems that perhaps there may be two types of media at least, a stills media and a media which requires or facilitates the teaching of motion. Keeping these points in mind and others that may come up along with the points of criticism, we can begin individually with the components.

The first one is the suturing lesson done by Dr. Hotchkiss here at the University of Illinois.

(Dr. Hotchkiss' unit was presented.)

Dr. Noble: There is one thing I would say about it, that is, breaking it into segments to allow for practice.

Mr. Monahan: The reason we didn't do that, and it can be easily changed, is that in the final product the individual may not have control of stopping and starting it. If this were finally produced on a single concept film loop, then the resident, or anyone else watching it, would be able to stop and start at will.

Dr. Fry: Yes, there are a couple of places you could stop and start again. I thought it was good, but there seem to be a couple of places

was concerned whether that was necessary. Wouldn't it be better to allow them to try it? Then there were a number of things you could put in, that would probably make the lesson too long. Things like left handed technique, different discussions about the needles.

Mr. Monahan: We've got that, Lou. I thought that would go into the manual, and in there, we will set up sections about needles and threads and forceps, etc.

Dr. Fry: Yes, you were probably right in not putting it in.

Dr. Noble: Yes, it doesn't require motion, which is the key here, particularly if we are going to talk about cost.

Dr. Fry: Brian, one thing I noticed is that you started to talk about half hitches before you explained what they were.

Dr. Maurer: There were a couple of points I would make too, and one of them was those half hitches, another was that you obscured in a few places the things you were trying to demonstrate, because of the camera angle. And the final thing is you talked about practicing on skin and you really didn't demonstrate the use of skin.

Dr. Fry: Well you did demonstrate that on the pig's foot behind the title and I kept waiting for you to get back to it.

Dr. Maurer: Yes, I thought you would have perhaps a demonstration at the end of suturing skin.

Dr. Noble: That's a thing we talked about at our last meeting, inserting a section at the end of a lesson showing the actual use in the operating room.

Dr. Hotchkiss: Well my thinking in the preparation of this was only the basic step in a series, and this one was only to show the kinetics of using the instrument. And in the next one we would show laying a seam down.

Dr. Kofman: I'm an internist who doesn't do a lot of suturing and I would like to make a plea to keep in that repetition.

Mr. Monahan: Yes, I, too, feel that this repetition is not necessarily bad, I tried to make a video tape on suturing from just the script before we began the production of Brian's lesson. The repetition in the lesson as we saw it certainly made it much clearer to me than it was when I had tried to practice it before.

Dr. Domogala: Having seen this now—and I am not in any way connected with medicine, I'm an engineer--I don't even sew buttons on. But having seen it, it was beautifully done and I believe that I could now do a type of suture. From an engineering standpoint though, I caught two errors, the needle with the suture on it is called swaged and not swedged.

Dr. Fry: But most surgeons do say swedged.

Dr. Nash: In regard to the teaching of the grasp alone, we all know this thing, and I thought there was no way on God's green earth that anyone was going to get that grasp directly from the demonstration. Perhaps at that point you would have to go to some kind of animation or diagram, and I would like to see a lineup of a number of different needle holders at the beginning.

Mr. Monahan: Well, Lou has done that sort of thing in his piece, he has a manual and an opportunity for the residents to become familiar with the different types of chisels and get experience in grading and rating them.

Dr. Nash: There was also the problem of not having enough instruction right here in forceps. The types of forceps that were used, if a plastic surgeon saw it he would go right to the ceiling, but all that was shown was the forceps which could grasp a piece of tissue and you have to make the point more clearly that suturing is a bi-motor technique.

Dr. Hotchkiss: Well I wrote a section on forceps.

Mr. Monahan: Yes, that's all in there, the whole description, the uses of it, the types of forceps, etc. and the problems of moving and picking up tissue, etc. But those things that are grasped and types of forceps, etc, did not need movement in order to teach them. One thing that is a problem though and may not be teachable apart from the presence of an instructor, at least as far as the technology we are going to be able to employ in these labs, is the problem of pressure on the forceps in order to avoid neurosis.

Dr. Fry: Well perhaps we won't or can't teach this whole thing in these labs. We are still going to have the man in the operating room under the supervision of a surgeon and I don't think that we'll be able to assume that at the end of whatever course we put together here, a man will be able to stand alone in the operating room and procede by himself.

Dr. Olson: That's well worth underscoring here, we must be careful that we don't build into this laboratory more than was intended.

Dr. Cooper: Well a very big point that we ran into (at the very beginning) in trying to do our section is, what is the proper use of the periosteal elevator? What is the most efficient grasp for a needle holder? How many are we going to allow? How do we find that one best way to teach to the novice? There must be a most efficient and most effective way to grasp the needle holder.

Dr. Fry: If that's true, then we have to stop making these and go back to analyze with a couple of engineers, the efficiency and effectiveness of the master surgeon.

Dr. Nash: I think the point to be avoided is the single way to hold an instrument. What we are trying to teach them is the basic mechanics. What we would be talking about are engineering concepts. Now my fingers are longer. I have certain other strengths in my hand, and I will use that as a pro golfer does. Everyone of them has a different grip, and a different type of stroke. But there are certain components of every golf stroke, some men have overlapping, some hold a little lower, etc. and the variations are the result of ones own physiognomy. The plea I'm making is to have a student look at the engineering of the instrument and be aware of what he can do and what he cannot do. What are its mechanical advantages?

Dr. Cooper: But there must be some limits, do we just give him the instruments and let him choose which feels the best and let him go on using what feel the best for him, even if inefficient?

Dr. Kofman: One of my concerns here is that of feedback. You'll see in our models when we look into the physical diagnosis lab, this problem. I was wondering how you will deal with that question of feedback.

Dr. Maurer: But really, all that this is, is a tool to achieve the teaching, but at least from our standpoint we only consider this as a part of the instruction, i.e., something to get them going.

Mr. Monahan: That's another of the points I would like to raise for our decisions; is this going to be a completely self-directed lab? If so then we are going to have to introduce and have other elements in it besides the knowledge components.

Dr. Noble: This is one of the things we hashed over last May, at what point are we going to have an instructor in the lab? Do we plan to have the final run-through with the instructor be a multiple task or a single task? There are things we have to work out in terms of the overall structure and the final format.

Dr. Maurer: Maybe we could talk about these things after we've seen the complete set of materials.

Dr. Albright: I think one of the things that would be good to put into this suturing section is the tension that is put on a suture.

Dr. Hotchkiss: My intent in this section was meerly to introduce the concept of tension by saying that the first knot controls the tension and secured more with the second throw and finally with the third. I purposely avoided in this phase getting into how much tension, leaving that for the second phase when I was demonstrating a running stitch, or a row of interrupted stitches. And as far as feedback for tension goes - there is a type of material called oasis, which is a demanding material. If the tension is too loose, one can see it immediately and if the tension is too hard, it tears very easily. So at least we have a single way of teaching tension.

Mr. Monahan: There is another question I would like to ask. What do you think of the type of content that is in this lesson? Should it be as expanded or lengthy as it is? You'll see the point with the next example. Perhaps we can answer the question after we see it. Ed, do you want to go ahead and introduce this?

Dr. McCarthy: Yes, we are going to see two things, a sound slide and a video tape. I went around to the various staff men at Iowa and tried to find out exactly how they used the periosteal elevator. Well no one used it exactly alike, so I decided to crystalize the points that I had learned and create a sound slide program which would be an introduction to the demonstration of the use of the periosteal elevator in the video tape.

(Dr. McCarthy then went through his sound-slide and video tape.)

Dr. Fry: You are going to have a manual with this lesson?

Dr. McCarthy: Yes, there will be this manual, plus a number of periosteal elevators and the cadaver leg. Now I would like some comment on whether or not you all feel there should be other information in it or things omitted.

Dr. Hotchkiss: I'd like to comment on your media. It seems that if you are going to have a video tape, you could probably have added a couple minutes to it and eliminated the sound slide because of the repetition in the two. If you do use the sound slide, I felt that in the first diagram, where you were talking about the ten degree angle from the bone, is confusing; in fact, I never did figure that out all the way through. The other thing that I noticed, something that we stress when we teach this to residents, is to be sure to stay on the bone with the instrument. I think you implied that, but I think it should be emphasized. A minor point is a technique that you didn't describe which is a wobbly technique. Another question I have is what about this twist? It seems to me the only reason for twisting is to follow the contour of the bone, there is no other necessity for twisting in order to lift the periosteum up.

Dr. Domagala: I'd like to second what Dr. Hotchkiss said, I don't quite see the need for these two media. You didn't say, but maybe its known to the people here, how hard to press on the knife. And the same point on the 45 degree angle and the 10 degree angle, also confused me. I couldn't figure out exactly what you were talking about.

Dr. Fry: I have a couple of comments about the content. You use the corner of the periosteal elevator. There are some people who use periosteal elevators which have no corners. Should you show both techniques? The other point is working in the direction of the muscle fibers so that you come underneath the way the muscle fibers are attached.

Dr. Maurer: There is another point in that you said the periosteum should be raised so that it can be closed evenly back over when the procedure is finished. It never occurs that you will have a nice clean lift off, particularly, say, when you are working in the femur, so that when you close it, it will come back neatly. It's a point perhaps that a person should strive for, but you say it and you demonstrate it, you don't do it.

Dr. Nash: It would probably be good to say that in some areas you can lift it off directly and evenly and in some areas you cannot. This thing brings me back to the point that you have to understand the mechanics of an instrument in order to perform this motor skill. One should discuss the fact that the periosteal elevator has about three or four level systems built into it and you can know the level system, the wobble is a form of the use of the level system. My own feeling is that I would like to see a simple engineering explanation of the tool.

Dr. Fry: This would get around trying to explain the problems of the angle.

Dr. Nash: Yes, I didn't understand that 10 degrees business either. The other thing I thought you ought to demonstrate is getting around the corner; here you are on a flat surface, well, how do you manipulate the instrument to get around the corner of the edge of the tibia?

Dr. McCarthy: One of the things we put into this example is stop time. I'd like to have your comments on those.

Dr. Nash: Can these stop times be actually controlled by the resident? The stop of one minute, three minutes, or even five minutes may not be enough to fit the individual needs of the learner, he may want to take longer to practice.

Mr. Elvey: Yes, on single concept loops and machines of that nature, it can be controlled by the learner.

Dr. Cooper: I would disagree with the point that we shouldn't put in more content.

Dr. Olson: I think we are going to try to hold off on content comments until later and just deal with the media now.

Mr. Monahan: Well, they sort of go together.

Dr. Cooper: I think so, too.

Mr. Monahan: Maybe we have to decide that there will be at least two media, a motion and a printed media, some static media.

Dr. Cooper: I would agree, if you have a manual and some elevators in the lab.

Dr. Noble: Another key thing on this content is going to be a review by everybody of everybody's scripts, that's one point where we had fallen down between the last meeting and this meeting. There isn't any single source that we could go to for this kind of content. And as we go further along in this project, we will have to draw upon industrial engineering techniques to determine what we should be teaching the novice. Right now we need to be in the operating room watching each other to determine just what we'd do with these instruments.

Dr. Cooper: That's important. You know the only reference we can find about the periosteal elevator is in Campbell's made in 1910.

Dr. Olson: May I raise a question here that has to do with the mechanics? Were any of you bothered by the difference in orientation. The first film i.. you recall, was viewed from the standpoint of the operator. In the periosteal elevator film, the viewpoint was reversed.

Dr. Cooper: It probably should be from the operator's standpoint. Actually we learned by doing the watching.

Dr. Noble: That's something for the SOP, we should decide how it should be.

Mr. Monahan: This one point I want to say does not admit to any discussion; it is given in the skills literature. Any kind of skill must be demonstrated from the point of view of the learner who is going to practice it. We have to settle on that being the case.

Dr. Nash: Well we'll have to be careful here from that point of view, in that nothing gets distorted or that nothing gets to block the view. The needle holder for example was distorted.

Mr. Monahan: We'll probably have to treat the instrument from one standpoint, and then in the demonstration of its use, go back to the over the shoulder shots.

Dr. Hotchkiss: I'd like to reinforce what was said earlier. The explanation of the basic principle, why you use the instrument and how it works is vital. The only thing I would like to add is how you protect your instrument from veering off, that is, what that second hand does in the grasp on the periosteal elevator?

Dr. Nash: I would like to raise another point we can think about during the coffee break, the uniformity of presentation. The needle section should be edited the same as the periosteal elevator in terms of format and media, but can we consider having someone talk in terms of the learner. If you are looking at someone talking, you've got three elements: the person's face, the subject material, and one's own materials to work with. It would seem to me that we ought to cut out everything not completely related to the skill that we are trying to teach; that the visual material fit the audio material. At the end of Ed's tape for instance, he was talking about some fairly sophisticated concepts, the planes and anatomy, and I'm looking at his face. I've got to actively block out his face and think about the material. My own vote would be to have one man narrate each of these--who's voice is good, who is a pro. I would also get away from having it be the University of Iowa, Blodgett or anybody else and just have it the Center for Medical Education as the sponsor for all of the labs.

Dr. McCarthy: Our rationale for showing the speaker, and, perhaps, it may not be a valid one, is to provide a teacher image: there is someone there who is teaching as opposed to just a voice out of nowhere.

Dr. Fry: At least in the beginning, the introduction of what this is and what we are trying to do, and from there on, perhaps, not show a narrator but at the end someone to describe what is to go next.

Dr. Nash: Fine, but any time you are talking about the skills, you've got to have the audio and the visual reinforcing each other.

Mr. Monahan: I don't know how pro you want this voice to be, but it has been brought up many times that the better-trained voice in these productions takes away some of the credibility of the content.

Dr. McCarthy: One thing for certain, whoever is going to do the demonstration shouldn't be doing the narration, that's a handicap for the demonstrator.

Dr. Fry: Were all of these done with one run-through?

Dr. Hotchkiss: Well it would be deceptive to assume that it was just one run-through. We spent a lot of time rehearsing the scripts, I did with my tape recorder and we went over it a day in Grand Rapids, and then a rehearsal so that Dick and I could get the timing done, and then the shooting. The shooting was done in one take, but the preparation time leading into it was considerable.

(A small discussion on cost of production was included here. Then Dr. Kofman took the group on a tour of the physical diagnosis laboratory.)

Mr. Monahan: In the specification of what these labs will do, we will have to be very careful in stating exactly what it is we intend to accomplish with them and what cannot be.

Dr. Maurer: We can really overstep the bounds and end up with teaching someone to be an orthopaedic surgeon without ever going into an operating room.

Dr. Nash: We'll probably have to keep as much cognitive material out of it as possible so that we don't give the guy a false sense of the application of the periosteum to the pathology and so that we do not step on the toes of the Chiefs of the particular programs regarding concepts of what they are trying to get across. If we get too much cognative stuff in there, those people are going to argue with it.

Dr. Maurer: But that wouldn't be the case if you are talking about the skills and the design of the instruments.

Dr. Nash: That's right. And as long as you stay in that ground, you're safe.

Miss McGuire: Well as in the first tape on suturing, you said there were alternative ways of doing it, so we do have to avoid the situation of saying we have researched and found the ultimate way of doing this thing. What we will be saying is that here is a systematic way of learning whatever particular use or technique you are trying to learn, and we are not saying that this is a substitute for patient contact, but that this is a more efficient way of getting ready for patient contact.

Dr. Nash: We'll want this as the basis on which we can build the orthopaedic teaching rather than the mechanics teaching. We want to be with the patient in teaching tension, and skin closure, etc., but if you have to begin with the very elementary thing of how to hold a needle holder, etc., then everyone will get discouraged, and it will take an undue amount of time. Under direct observation one could see that a resident has not been in a skills lab and could tell him to get in there and practice.

(Question on practice material arose and whether or not simulated material is going to be effective in this skills instruction.)

Miss McGuire: The answer to the question of material for practice would depend upon the unit.

Mr. Monahan: Some of the decision on the effectiveness of these materials will have to be tested out during pilot runs. But we've got, again, the actual intent of these labs--are they just going to familiarize someone with the use of the instrument while actual techniques in using the instruments are taught in the operating room?

Mr. Bligh: I think you can determine actual characteristics of the instrument such as motion, pressure, etc., all we are concerned about in the lab is hoi you hold it and how you push it in the case of the periosteal elevator, for example. I'm wondering if we can separate certain things, though. Whether we can just be concerned with teaching the motion in the lab, and not be concerned with the pressure to be involved. And if we are not concerned with the teaching of the pressure behind the instrument, then perhaps we can use the grossest materials for the instructional purposes.

Mr. Monahan: But if you are not concerned with all of these things at the moment in that lab, will you be teaching certain things that you must unteach in the operating room.

Dr. Hotchkiss: I don't think so because in the body, all tissues are not the same, that is something everyone will have to learn all alone. You cannot say this is how you close skin, because the skin on the back of the hand, etc., are all different, so if the person learns to work within the tolerance of the material he's given, he's learning something right there. If he can put a suture into oasis, he is learning the tolerance of the material with which he is working, and that is what you want him to learn.

Dr. Nash: This is a problem that we saw in the physical diagnosis laboratory. They turned down models which were close, but not close enough. If you are working with material such as oasis, then the student has no problem realizing he is not working with skin, nor human tissue and that he is just working with the skill.

Dr. Kofman: Yes we did turn down certain materials, but there were things camouflaged in it. They would be learning bad skills if they used those models. We have learned through trial and error that on this very difficult point you have to define exactly what you are going to teach, and you cannot decide now what material you may use, you are going to have to experiment. Then, even after you have picked out a few that seem feasible, you still have to continually re-evaluate because of the possibility of development of new materials. There is no short cut to the determination of the kind of material you want to use.

Dr. Maurer: Why would a model be more necessary here than the actual specimen?

Dr. Nash: Logistics.

Dr. Maurer: Well I was just wondering. Suppose we get to the bone instruments. We are going to be talking about elevators, osteotomes, curettes, depth gauges, screws, etc., it seems to me that all of these things could be used on one specimen of bone. If you have ten different simulated materials for each of these, it would be much harder to get. What we envision for our section regarding screws and screwdrivers is to give the resident a box of jumbled instruments and a cut bone and say, go ahead now, you have ten minutes to plate this osteotomy. After they have done it, you examine it to see what kind of result they have; test it by bending it over your knee or giving it some other kind of stress. And then from that point we would go into our instruction, and they would have some kind of work session integrated into this program and then go into the post-test, in which they are given again ten minutes to plate the bone.

(The next component taken up was that by Dr. Fry on Mallets and Chisels.)

Dr. Fry: Before we begin this, I'll put it into a little perspective. As we started to develop this unit, we raalized a manual should accompany it. In the manual is a brief introduction telling the students what we are going to do and how we are going to approach it, and perhaps if they nee to, they could re-run some of the film. At this point the intent of the instruction is described. "In this portion of the instruction, and principles of the instrument will be considered. At the end of the tape you will be given an opportunity to handle the instruments, identify them and run through a self-test activity. Now start the tape."

(Dr. Fry's unit on the Osteotome and Mallet was then shown.)

Dr. McCarthy: I wonder if perhaps much of your first part could not have been done on a sound-slide format, and then reserve the video tape for the actual manipulation of the instrument?

Dr. Fry: Well the actual cost for the production of this ½ inch tape was $1.00 a minute, that does not include however, our time in producing it, nor the original cost of the equipment which was purchased by the hospital.

Dr. Nash: But with this type of content, I don't quite see the advantage of a sound-slide over a manual.

Mr. Monahan: There is a comment I'd like to make about a piece of the content in there. There was one sentence in particular where you said, never use an osteotome for prying. I would prefer to see the content stated in a positive fashion. It would be better to stress using the osteotome only for cutting bone, rather than to introduce the idea about prying with it.

Dr. Fry: Well if you've stated positively as an "only use", you'd never get it as emphatically as some surgeons would like to make it to forstall its use as a prying instrument.

Miss McGuire: I'd like to say that I like the idea where the video presentation is part of a total package which includes written, photographs, other instructional material which include the exercises and self-testing so that a resident may get immediate feedback on whether he does know about the proper use and identification of the osteotome. There is another point, too, I'd like to make and that is the issue of breaking down these complicated contents into smaller units. It's very difficult to keep in mind all the extensive content that is in this presentation.

Dr. Fry: Yes, there are lots of things I would do differently. Put, for example, all of that introductory material into a manual, and then I would spend the actual video time working on the bone and showing the use of the instrument.

Dr. Nash: What I would like to see come out-(there are other basic components here of any presentation that ought to be covered in an instrument' one is the mechanics that we've talked about, and the other is power and control. Where does the power come from, and where does the control come from You did a miriade of things that you never did talk about when you started to demonstrate on the bone. One of the things is that you tapped on the osteotome and nothing was said about how many times you have to hit it or how hard you hit it, that's power. How much control? The average resident might be pushing with his control hand, so that if it would ever slip, it would go off into the tissue and everyone turns white and the patient turns red. We could cookbook the manual so that everyone talks about power and control, etc. In one case the power might be from grip, and in another, it might be from mallet.

Dr. Hotchkiss: Maybe the first thing you do shouldn't be to demonstrate a transverse cut. Demonstrating a transverse cut with an osteotome is like demonstrating closing a wound with a skin suture. The first thing I think you need to do is show how to hold the osteotome, how to tap it, how it goes through bone, and what happens when it goes through bone. Maybe that's all you really need first. Later on you integrate the concepts and say, "Now we're going to use these tools to do something: we're going to drill holes like you've learned to drill them, we're going to hit the osteotome like you've learned to hit it, and we're going to get the bone to come out." I did like your format about the manual, etc., but maybe this is how we have really been teaching residents to use an osteotome, i.e., getting them right to the finished product before we go to the proper steps of using the instruments.

Dr. Fry: I think we are teaching it that way because that's probably the way we learned it.

Miss McGuire: It might also be necessary to include judgments on when you choose a particular instrument from a number of the same type.

Dr. Hotchkiss: You're getting into a big area there.

Dr. Nash: I think he was right though to say that big bones need big mullets.

Dr. Fry: At times there are distinctions in the way you use these instruments between say an orthopaedist's and even a neurosurgeon's ways of taking out windows, etc., but these choices and these different techniques are things that will be learned in the operating room.

Miss McGuire: Will this answer the question? I wasn't really getting at the cognitive material in choice of different instruments, but rather whether or not there were different things I was suppose to be able to do with one kind over another kind.

Dr. Hotchkiss: Are you going to include the use of chisels?

Dr. Fry: I started to, but I had gotten into the area where I thought that perhaps chisels weren't used that much.

Dr. Nash: But I think it is important that you did express it and bring it out without being negative toward the chisel.

(A general number of comments on the fact that perhaps it might be wise to include comments on the use of the chisel.)

Dr. Olson: I would like to make a suggestion that perhaps after the scripts are done and before the final product is shot, that the initial shooting be done on the ½ inch Sony, which is very cheap, so that the debugging process could be done on that piece of film rather than going after the expensive process of making a 2 inch trial balloon.

Dr, Hotchkiss: If we're going to wind up with this thing on film, why not shoot the final product on film?

Miss McGuire: We did some cost analysis on that and some other pros and cons. In one sense film is easier to edit but there are problems in lighting and studio equipment which we can obviate with video tape and it was just too expensive to do the film.

Mr. Bligh: And then of course you have to shoot so much more on a film. If you make a mistake, you cannot erase it and go back as you can with video tape.

Dr. McCarthy: Maybe all we might need to teach a group of residents is some kind of manual and an instructor in the lab with a beef bone. The instructor could demonstrate it in a one hour session per week. All I am asking is whether or not video tape is necessary to the teaching of psychomotor skills.

Dr. Nash: Well the problem then, is you've got to train the instructors on how to break the skill down and teach it correctly.

Dr. Olson: Also the cost of having one instructor in a lab teaching is also an expensive thing. We're talking about a situation where a man can learn at his own pace and the issue of flexibility, i.e., the resident can work and study with these materials any time that he has free.

Dr. McCarthy: When a resident goes into an operating room to execute the skills he may have learned in a laboratory, an emotional element comes into play. He may have learned how to use a hemostat but when he is confronted with a spurting vessel, certainly that situation may obliterate what he has learned in the lab and the only way to overcome that emotional element is to have practiced and used this thing a thousand times. I am just wondering if there will be enough material and enough opportunity to practice a thousand times in the laboratory.

Dr. Fry: But it is certainly better that he practice at least 10 times in the lab rather than have no practice at all before he goes into the operating room--even if he does it once before he gets into the operating room. He is not going to come into the operating room an accomplished surgeon, but he will certainly be up that learning scale a little further than if he had had no preliminary practice at all.

Miss McGuire: In regard to medium--we will have to be super careful about which one we choose and the media for any particular element of the lab will have to be justified according to its necessity and instructional use. If a thing can be taught effectively through a printed medium, then that should be the medium for it. If it needs motion or the demonstration of combinations of motions, then certainly video tape or film will have to be used.

Mr. Monahan: That's the point I was just about to bring up. It seems we are at a point where we might be able to make a decision on this media: that there be at least two media in this package and that these media be motion and printed as opposed to sound-slides. Is that agreeable?

Dr. Hotchkiss: You mean you're suggesting we do away with the sound-slide.

Mr. Monahan: Yes.

Dr. Fry: Only if there is a way of reproducing illustrations in the printed matter. Perhaps we should consider three media: the written word, the illustrations from the sound-slide and then the motion.

(A discussion ensued regarding the cost of producing the initial tape and then the transfer to film.)

Mr. Monahan: I know that the cost of these things may sound tremendous at first but that is the cost of the initial production. The use of these labs throughout orthopaedic programs and a longevity of their use will certainly cut the cost down tremendously, especially when one considers that the instructor is freed from the routine task of initial instructions and the resident is freed from certain other activities so that he can be used more effectively in other places. Certainly the initial cost becomes pretty minimal. Then, of course, those places which do want to use these materials will have to rent or pay for them, too, and that's where we can reimburse the cost of production.

Dr. Hotchkiss: I can even see the academy holding these materials as a bank and renting them or loaning them out in the same way that they do the sound-slide materials. Perhaps every program will not have to buy a complete set but rotate the materials.

Dr. Albright: But if you were going to have a complete skills lab, you might have to have them all.

Dr. Hotchkiss: But you could schedule the materials per week, or whatever, and rotate them on loan.

Dr. Noble: But we really can't skimp on the production of these labs. This is the first time such a thing is being done in medicine, and we want the product to be initially good to present a good impression.

Dr. Krueger: That's a good point. It is the first time that it is being done and it's going to come under fire anyway so we can't have poor quality or poor technical quality being criticized.

Miss McGuire: The cost analysis that I have now for transfer to film is $54.00 a minute in color to make a negative and a positive print. After that depending upon the number of copies, the cost is between 6 and 7 cents a foot. When you think of between 1200 and 1500 feet for a 30 minute film, the cost runs anywhere between $75.00 and $85.00 for a 30 minute film. In black and white the analagous figures are $11.00 per minute for initial master and one positive print, and the final figure, then is roughly $50.00 for 30 minutes for subsequent prints. If you order between 2 to 7 prints of a color, the cost is then 7 cents; from 10 to 50 copies it's 6 cents a foot. In regard to the transfer from ½ inch tape or 2 inch tape--it was felt by companies doing it, that it wasn't worth the investment to go from a ½ inch to ahe film because of the marginal quality of the ½ inch tape. Although it is really still not clear whether the transfer is not made because of the quality or because it is technically impossible. There is just no price list regarding the transfer from a ½ inch to the film.

Dr. Hotchkiss: Just about everyone has a 16 mm projector so at least in the transfer to the film one would not have to worry about matching up the media with the equipment in any one place.

Dr. Olson: An advantage of the 16 mm projector is that you can go back and look at a particular part without proceeding through the whole film as is necessary with the Fairchild.

Dr. McCarthy: Do I understand then, that we have unlimited time, i.e., until June to get this thing done?

Mr. Monahan: Well, it probably should even be done by February, but that's one thing we have to thrash out. It seems that if there is going to be any kind of determination as to effectiveness of these materials, the production has to be completed well within the time limits of the grant in order to be tested.

Miss MiGuire: Some of the programs would like to use whatever is available even in January and February.

Dr. Hotchkiss: Would it be wise at this time to outline what the ideal format should be? Are we ready for that?

Mr. Monahan: We have two more pieces to look at. So let's do that and then come back to your point.

(Henry Hood's presentation on currettes and gouges was then shown.)

Mr. Monahan: There is a tendency in this presentation for the visual--written visuals-- to compete with the audio. They are not co-ordinated closely enougn, and one would block out the other, i.e. the written words that are projected on the screen do not parallel closely enough, or are not similar enough, to what is said. While the eye takes in what is on the screen, that sensory reception blocks out the audio portion. In s sound-slide presentation, the audio should carry the message.

Dr. Nash: The presentation of the greatest types of equipment some how get to me better if I can look at the picture at my own speed. Using audio visual materials demands that one proceed at a certain pace.

Dr. Hotchkiss: Yes, and it dragged a little.

Dr. Nash: This kind of thing can go into a printed presentation.

Mr. Monahan: Let me ask this one question. Isn't there only one objective in this whole skills lab--the ability to use the instruments instead of a long list including naming the various types, etc.? Is it really valuable to have the information regarding the various types and their characteristics presented?

Dr. Fry: Yes it is. I think every surgeon or every resident--I pretty much require them to name the instruments. Part of the skill is knowing the name of it and knowing how to ask for it in the operating room.

Mr. Monahan: But I wonder if that is really an objective for the skills lab, or a piece of information that is a means to the objective.

Dr. Noble: Yes, this should be part of the format as we discussed it last May. The resident should be able to name, identify the instruments, know what problems he can get into when using it or using it incorrectly.

Dr. Albright: Perhaps this presentation could really be broken into a printed and a visual segment so that one might move quickly through and read and pick up what one needs to know rather than having to go through the whole thing.

Mr. Monahan: Yes, I think there should be some way to break it down into smaller segments because having been given that one objective about being able to name and identi y things, I became very frustrated and nervous as we proceeded so quickly because I could not remember all of those things and knew I would be called upon to identify and name them later. By the way, I hava a solution to the problem of the negative instruction. The issue of negative instruction, in the first place, is not the elimination of the content regarding pitfalls and dangers that might occur; it has only to do with the expression of it in the teaching sequence. Therefore, I would suggest that, instead of including at the end of any piece of instruction, the don'ts and the pitfalls, we might put these at the beginning so that the positive instruction in the skill is not interferred with as we approach the practice session. If positive instruction in the skill is given and the residents are also prepared to practice that skill and then receive instruction regarding the dangers and pitfalls, and don'ts, there is a likelihood that the positive instruction will be inhibited in some way. It might be c unteracted by this new piece of learning that precedes the practice of what the original instruction was intended for. So, put the dos and don'ts, pitfalls and dangers, etc., at the beginning of the instruction.

(Dr. Maurer's section on depth gauges was next presented.)

Dr. Maurer: Before we go into it, I think perhaps a statement of the organization might be in order. We anticipate a pre-test; an evaluation of that pre-test; and the program instruction on video tape; a syllabus which shows the instruments, their names, etc.; a practice period and post-test. The intent in this pre-and post-test is to have a particular task that residents could identify with as a procedure using a number of instruments. We wound up preparing a sound-slide presentation and, in the process, discovered that everything we had in this media could just as easily be put into a manual for the students to look at at any time.

Dr. Hood: I agree with you that this could possibly be in a manual, but the point is that it does not exist any where in a syllabus and the biggest thing about the skills lab that we're offering is a place to practice these things and I am not sure that the arguing back and forth sound-slide, as over video tape is the point. The biggest thing in the skills lab is for the guy to practice.

Dr. Maurer: We could put this on a sound-slide as we do have it here, but we certainly don't want to use video tape for something like this and think that it would be better in a manual and could be referred to much more easily, frequently, say, in the looking up and the remembering of names can be done on a sound-slide.

Dr. Fry: I think after you take apart the activity, the way this has been done, it could be done in the manual, but there should be some place on the video tape the process of putting the plate on, drilling through, measuring with the depth gauge, and putting in the screw, in that sequence.

Dr. Maurer: For example, on the screws, the major portion was taken up in describing the various types of threads, the various types of heads, etc. and the same with the types of screwdrivers and how you put in the screw. All of that could really have been in a syllabus; and the major portion on the video tape showing how it's done and then doing it; and that would have taken only a few minutes. The major thing that we learned is: 1) that we need help in terms of producing a video tape and 2) the sound-slides are fine but probably would be best put in a syllabus.

Dr. McCarthy: It seems to me that it would be easier to have the pictures reproduced with that good color on a slide than it would be printed.

Dr. Fry: And what's the problem with having it doubled in a manual and a sound-slide? Some people learn better by sitting and reading and others by sitting and listening.

Miss McGuire: I was thinking of the same question and I would almost favor producing all the material, the sound-slide and video, as a package and then have a manual in which is incorporated as much as feasible from the sound-slide.

Dr. Hotchkiss: It's easy to skip things in a manual, too, one glance can get you over it if you know it.

Dr. Fry: Are we saying that we are going to have the tape reproduced in the manual along with the slides separate so that if you don't have the tape you can have the manual to read and view the slides, or are there going to be some kind of other line drawings in the manual?

Miss McGuire: I think if you are talking about the ultimate packaging of this, there would be a sound-slide, a manual, and that kind of media which produces motion.

Dr. Fry: And the manual would be self-contained.

Dr. McCarthy: And the manual, too, would provide the whole outline for the whole course.

Dr. Noble: As I personally prefer to have a manual or a script rather than a tape and view the slides and read as quickly as I can.

Mr. Monahan: Your comment, Bates, made me think of the situation when I was in Florida with Dr. Enneking. We discussed the same problem of a script versus the tape and it seems that people would read the manual and then click through the slides just as fast as possible. There is a possibility here of really missing the point and missing specific instruction that might be going along with each slide.

Dr. Noble: A tape still is just an extra thing to be set up in a lab.

Dr. Fry: It seems that what's coming through here is two sets of media, either a manual or a sound-slide, and what's common to all is the motion medium. Now the person who uses the sound-slide will probably need the manual, he'll have to flip through it so that he will know what kind of activities he'll be doing, and then he wouldn't have to really listen to the tape, but would this significantly increase the cost of the lab?

Miss McGuire: I regret to say that everything one does increases the cost. A sound-slide program would certainly be more economical than printing colored plates.

Dr. Fry: I don't think we're talking about colored plates. They're being taken off the slides. These can be done almost as effectively in line drawings and very few black and white plates. I would say that almost all of the things about the depth gauge you can get from a catalog in a line drawing.

Mr. Monahan: Are we now in a position to make a decision? In this discussion about manual and sound-slide? Is this going to hold for every component or are there going to be variations of the media per component?

Miss McGuire: It seems to me that every unit is to consist of a self-contained manual, plus X number of slides, and the cartridge tape which is optional to use with the slides, and a video tape portion that will be put on film for that which involves motion or relationship that need dynamic demonstration.

Dr. Maurer: We have to decide whether the sound-slide can be used in lieu of the manual or in lieu of the film because if you're going to use it in lieu of the manual, then you'll have to include all the various types of descriptions of the tools which will probably be in the manual. If you use it in lieu of the film then you will have to incorporate in the sound-slide various arrows, etc. to show motion or movements.

Dr. Fry: But we decided we needed the video tape to show the motion.

Dr. Maurer: But will we? Supposing that we make a manual and we put in that manual all the things that do not require any illustration other than line drawing and no motion. Now suppose that we say on our sound-slide that because it is in the manual we are not going to put in 10 slides showing different variations of the osteotome; for example, we are just going to show an osteotome and how that osteotome is used and we are going to have arrows and some diagrams, then we decided that we're also going to produce a video tape and that video tape is going to concentrate on those things for which we need motion. When we send out these 3 packets, I would guess that we will find that most of the students are not going to use all three. They will use probably the manual and the sound-slide and if they feel they get enough from that, they won't go to the video tape or they might just use the video tape.

Dr. Fry: Well I had the impression that at least what we have come to is that we will have a manual and a sound-slide which will duplicate much of what is in the manual--the names of the instruments, the shape of them--because some people learn by sitting and reading it and some by listening, and then the actual use of the instruments; putting a plate on, drilling a hole, using the depth gauge, putting a screw in, the things that the students would actually do in their practice sessions. All of these demonstrations would be on the video tape.

Dr. Maurer: Then what is the value of the sound-slide? I don't see any value in putting up 10 instruments and listing their names and then when the sound-slide goes off, you can't remember all those; it's better in a manual. I think if we're going to use them we have to decide now just how they will be used, such as the way Dr. Hood and I used them in showing the actual use of the instruments.

Dr. Hotchkiss: I could put the first half on sound-slide, but I don't feel that I could put it in a manual. I didn't have a lot of descriptive stuff in mine. I just mentioned that there are many kinds of needle holders and left it at that.

Dr. Maurer: But that could be in a manual.

Dr. Hotchkiss: I don't think it could as well. I don't think people would read it. I think I could get in there and by voice, inflection, and emphasis, get across the message about matching needle and needle holder, etc. better than I could in a manual; and then at the point where I said, now let's get to the action, is where we could have cut 10 or 15 minutes off this tape. I really would hate to give up the sound-slide completely.

Dr. Maurer: Then we get into the problem of the guy trying to read his manual and then going to the sound-slide; he's got to go through two media and then transfer over to the video tape. I think it would be difficult to use all three, it would be better to have just two.

Dr. Fry: And I'm saying that the guy who reads the manual may not need to use the sound-slide.

Miss McGuire: He may need to use some of the slides.

Dr. Fry: The controversy between the manual and the sound-slide is that there are some people here who think there are values in each one of them. It is a statement mainly of what they prefer to learn by; that is why we said we would duplicate some of the material in both of them, and my answer to that question of duplicating is because it takes into effect different learning styles.

Dr. Maurer: But Brian has just said that he can't put his stuff in a manual. It has to be on sound-slide or a video tape and that means that the resident will have to use all three, and that means then he's got to go through the whole ball of wax or eliminate one. As Henry and myself showed, we can get some feeling of the motion in the mechanism on sound-slide, perhaps maybe not doing as well as a video tape.

Mr. Monahan: We may have to structure that manual, having at the end of it a post-test in which it is determined, depending upon a degree of passing it, or what not whether or not the resident then goes to the sound-slide and/or the video tape; make this lab more programmed, directing him to various parts of it depending upon his needs.

Dr. Hotchkiss: I can't remember how many textbooks I start to read and never finish because the first three chapters, the anatomy and physiology of something, -- the guy who wrote it thinks it is very vital and important, but by the time you get through it, you think, oh, the heck with it. I wonder if we're biting off more than we should when we try exhaustively to describe an instrument and in addition introduce the use of the instrument. I wonder if we wouldn't be better off in trying to describe the instrument in more general terms, it might be overwhelming for a guy who has never seen one of these instruments before and then all of a sudden to be told that there are 50 of them and the actual thing he wants to do in that lab is to get to use it and by the time he has gotten through this other material, he may have been there an hour and has to go some place else.

Dr. Hood: What about presenting the live stuff first and then when you get done with this, her's a manual and other things you might want to know about the instrument.

Mr. Monahan: Then that could be done at any time.

Dr. Hood: Yes, build up the interest first in the instrument by instruction in its use.

Dr. Noble: Yes, that might certainly grab them. It will be a difference from the old traditional method of insisting that you know everything about a particular instrument before you even get to see it.

Dr. McCarthy: If we eliminate the sound-slide, how effectively are we going to be able to produce pictures in the manual?

Dr. Maurer: I think what we have to do is decide on the sound-slide in three directions, replace the manual in which case we would have an extensive sound-slide and I would be against that, or replace the video tape, and I suspect that if the sound-slide was done very well and if we found that the sound-slide worked, we wouldn't have to go to the video tape, or should we just eliminate the sound-slide and just use manual and video tape?

Dr. Fry: The ultimate thing we want this resident to be able to do is to practice and use the instruments; therefore, it would be much better for him to have the actual moving model of what he is to do, and therefore, the only way to do this is the video tape with the shot over the shoulder. We have gotten to that stage of saying that he even has to look at in the same prospective and, therefore, I think the video tape is mandatory.

Dr. McCarthy: I agree with you and I also agree from the standpoint of the manual. Personally, as a first year resident, I would prefer to be introduced to the basic ideas about the instrument in a sound-slide, which is programmed for me step by step, than having it done in a manual.

Dr. Maurer: May I make a suggestion? Then if that's what we want to do, maybe the manual should simply be an outline plus a catalog and say to the resident that there are multiple curettes, but we are only going to describe one, so refer to your catalog for information about the others.

Dr. Noble: But I think it will necessiate more than just a catalog to describe the various types of instruments, and I think it should be in the manual.

Dr. Hood: Oh, some of it is, but as far as I am concerned, I only use two types of gouges.

Dr. Fry: I think there is another thing we shouldn't slip over. If at the beginning of these things, we can put a shot of someone using the instrument, a real come-on, a grabber, and then go into the details.

Miss McGuire: Well take Brian's tape. It is long, but there is very little that I would want to cut out and put in a sound-slide even when you're describing the instrument there, motion is being introduced. What I am saying here is that break up these tapes into smaller segments so that you don't get away from the initial instruction on the motion when it comes time to practice.

Dr. Hotchkiss: We could set it up so that we have a prototype of the instruments. Teach the man about that instrument and the common elements of it with the others of its type, and then at some later time, if we wanted to expand it, you are now in a more advanced stage and you can learn more about the various aspects of others of these instruments. I, for instance, stopped with the laying of one single suture. We could go on and show him how to lay in a hidden suture, a continuous one, a mattress, etc., all of those kinds of sutures, but initially that would be overwhelming such as I was even overwhelmed with Henry's extensive description of the various curettes.

Dr. Maurer: Well, Dr. Hotchkiss, what would you suggest, how would you divide this up in the package according to manual, sound-slide, and video tape?

Dr. Hotchkiss: Well I think that if you cut down the volumn of material, you could probably put it all on the video tape and not have an extensively long one.

Dr. Maurer: And then you would leave out all the various types of curettes, all the various types of osteotomes, etc., and put those in a manual rather than a sound-slide, which is what I am talking about. You could take Henry's for example, and say, just take all of what he's presented, the description that is, and put it in a manual and we don't know that the video tape is going to make any greater difference.

Miss McGuire: But there were times in Henry's presentation when I was just dying to go into some other media so I could see the motion involved in the use of the curette.

Dr. Hotchkiss: Well I can remember going through a series of still pictures on how to tie a knot made by these experts and I could still not learn how to tie a knot. I really think you have to see someone actually doing it in a media which has movements.

Mr. Monahan: I can testify to that. I tried to learn just from your description on knot tying, but until I saw the thing moving, all mind turned out to be granny knots. I think it's the same with gouges.

Dr. Maurer: We're getting down to them still, do we need the sound-slide?

Dr. Hotchkiss: I don't think we do. If we're going to eliminate something, we could eliminate the sound-slide.

Mr. Monahan: Then we have to go back to what Lou was pointing out a while ago. The purpose of these labs is to instruct and give practice for the use of the instruments; therefore, it is absolutely mandatory that there be a moving model for this instruction. After that, we can look backwards to find out what else is necessary to give a more complete and rounded knowledge about the use of the instruments.

Dr. McCarthy: This brings me back to my original question, how are we going to duplicate those pictures if we are going to cut out the sound-slide and just have the manual?

Dr. Maurer: If we want those nice, pretty kodachromes, we are going to wind up with a glossy book, and we can't have everything; not only just on the basis of money, but also on the basis of so many different types of media. The resident would have to decide how to program himself through this thing. It would be much better if he has a cut and dry program and he can do it at any time: he knows that he reads the manual and then gets into the video tape and then practices. If every module is the same, he will know how to do it, then, all these modules have to be uniform in the media they contain.

Dr. Fry: I would say that the lowest priority is the sound-slide.

Dr. Maurer: There is one other thing that we have not yet discussed and that is that the manual should not be illustrated in itself but illustrated with slides.

Dr. Fry: Then you're saying just do away with the sound from the sound-slide program. This is one of the questions I raised. Do we have a separate entity of sound-slide and a separate entity in a manual so that the resident may select either of these pathways also taking the final pathway, the video tape? Or do we make the sound-slide, manual, and video tape sequential and necessary?

Dr. Maurer: But, Lou, we could make it with just line drawings in the manual, and use slides as an adjunct to the manual. And then in the manual, it says "Slide 1 illustrates the following points".

Dr. Hotchkiss: Then he could say "Well, I don't want to look at 16 different osteotomes right now", and move on to something else.

Mr. Bligh: That would be very efficient for going into and out of the thing rather than having to wind and re-wind tapes.

Dr. Noble: The slides would certainly be in sequence and numbered to correspond with the passage in the manual which describes it. Then the resident could either skim through it fast the first time or come back to the manual at another point, finding the place which describes, say, the various osteotomes and be directed to the correct slide which he could observe as he reads the manual.

Dr. Hotchkiss: The descriptive stuff is a very much lower priority for our lab. The lab could exist without the description of 16 different types of osteotomes, but that is something the resident might want to know, so you might have a place in the lab where he could go to find it if he wanted it. If we put one instrument in each video tape and enough with it so that if the resident decides not to bother with the manual, he will still have learned a sufficient amount in regard to the use of the instrument.

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Dr. Olson: The discussion left off yesterday with whether or not we need all three media: manual, slides, and the video tape.

Dr. Maurer: I think we decided that issue already. We'll have the video tape, a manual which is illustrated with slides, and perhaps line drawings, but there will be no sound-slide element.

Dr. Hotchkiss: As long as I was still on Grand Rapids time, I got up an hour earlier this morning and I did a few things. I summarized in my thinking what we got to yesterday and where we had been the other time, and perhaps for purposes of moving this along, I'll just put these on the board, then we can change them.

Dr. Olson: While Dr. Hotchkiss is putting that on the board, may I ask among you, who would be interested in trying out these labs?

Dr. Fry: My own concern is, what will be ready in February or March! We will be willing to try out whatever is ready.

Dr. Olson: That's another thing we have to come to grips with this morning, is the issue of scheduling.

Dr. Hood: Will all the programs have the equipment, the video tape equipment, to run it?

Dr. Fry: Well it will be on 16 mm film and everyone will have that.

Dr. Olson: Brian, is what you have on the board the consensus of the group?

Dr. Hotchkiss: I don't think it is the consensus; it might be, but this is what I would do based on what I heard yesterday.

I'd have a manual which would be a guide to the instrument. It would list the objectives, it would include a pre-test, it would contain instructions on how to use whatever form the video is in, materials needed, and instructions for the practice needed with the tape. Then there would be a feedback mechanism, either a monitoring by video which would be seen later by an instructor being present, or an idealized model so that learners could compare their work with what it should be. After that, there would be additional written material in the form of a manual which would give all the other details, embellishments of the shape, size, and differences in and among the instruments. This material would be illustrated by slides. It would be similar to Henry's sound-slide, but instead of putting it at the beginning of the lab, I would put it at the end.

Dr. Olson: Are you looking at two different manuals then, Brian?

Dr. Hotchkiss: Well it could be, but it wouldn't have to be.

Dr. Fry: It could be in the back pages of the instruction booklet.

Dr. Hotchkiss: Yes, it wouldn't matter if it was separated physically or not. The point is that it would come after the video tape. Then of course the format for the video tape or film would have the following elements:

1. Discussion of the purpose of the instrument
2. Identification by its basic characteristics
3. Discussion of the biomechanical features which affect the function, as Dr. McCarthy was talking about in his presentation.
4. Demonstration of its use:
   a. the power grasp
   b. the control grasp
   c. a delicate grasp and how to control it from going where you don't want it to go
5. Application to tissue in the connective sense, safe guards in use and the practice part which is mixed all the way through.

Dr. Fry: Is the application to tissue the demonstration of what you want the resident to do?

Dr. Hotchkiss: Yes.

Dr. Maurer: Now, in terms of practice, do you mean to turn off the film in practice?

Dr. Hotchkiss: Well this is the format I pretty much used in my tape. I employed the notes I took when we last met in May, as pretty much all of us did. Now as far as the practice goes- I said in mine, we'd stop 45 seconds at various points for practice. Whether one stops the projector or not is pretty much a moot point. If we want to stop the projector, that is one way of doing it, but we had the thing going on on the video at the same time that the practice was being done, so hopefully if anyone got into trouble he could look up and see what he should have been doing. This is kind of just a theory--I don't know if it really will work--but it seem that anyone practicing for the first time would find it a little easier if the demonstration were going on in front of him at the same time.

Dr. Fry: If it is logistically easy to stop it!

Dr. Maurer: If we are going to do it your way, Brian, then the instrument has to be in the resident's hand.

Dr. Hotchkiss: Yes, that would be in the manual of instructions.

Dr. McCarthy: I thought we had decided yesterday, because of the time cost, that we would cut down the material in the video tape to the bare minimum, and that bare minimum would be the demonstration of use and practice instructions.

Dr. Hotchkiss: We went both ways on that. That was when we still had not decided upon the sound-slide, and when we decided not to do sound-slides, Christine had commented that she would not want to see any of those basic things left out. That material would just take a few seconds, it wouldn't be very long.

Dr. Maurer: But the practice sessions would, if you're going to run the video tape. Maybe we should just turn off the film, just put in a stop.

Dr. McCarthy: Now, we had decided yesterday that the video tape would be the thing he sees first.

Dr. Hotchkiss: Yes, the first thing resident's would do would be to read the manual which gives the objectives and the pre-test. The next thing they would do would be to turn on the tape; then they would have a chance for practice, with feedback, and then, maybe another day or even at home out of the laboratory, they could take their manual and slides and flip through and find out, for example, how many different osteotomes there are.

Dr. Barham: Would you be able to run a video of the actual suturing being done in the way that you would like to see the resident eventually be able to do it?

Dr. Olson: You are talking about a teaser. Ray, would that be possible?

Mr. Elvey: Yes.

Dr. Noble: We had talked about that- to show it as an introduction.

Dr. Fry: It might even be just something from the operating room.

Dr. Hotchkiss: There is one thing bad with that, though. I was watching on the one we saw yesterday that even this plastic surgeon who raally knows his stuff in suturing was not being precise, sometimes the knots were coming down square and sometimes they weren't. So, if you wanted to teach an ideal model, you should probably prepare this model directly for the instruction, because all of us tend to take short cuts once in a while.

Dr. Albright: May I make one request on this point? The person who is actually being filmed should be really expert in the execution of the instrument. Even though that plastic surgeon we saw wasn't perfect in every motion, it was really beautiful to watch. It was an unrehearsed thing; there was very little wasted motion, and there was no distraction. That's the problem: if things aren't done well it distracts from what you are trying to listen to.

Dr. Hotchkiss: I think at some point in here we have to introduce the concept of speed. We have to teach them not only how to do it, but how to do it faster than they were doing it.

Miss McGuire: And I think there are two elements there. One is the security and assurance of the resident in doing the skill and the other is the waste motion element.

Dr. Olson: Would you put that in with the further details and embellishments?

Dr. Hotchkiss: We could do that. We could say "In your practice sessions do it faster and faster".

Dr. McCarthy: It seems to me that the first three things there--Dr. Fry those are the first things you had in your video tape--we decided could adequately go on a slide presentation. It seems to me that to demonstrate properly the basic characteristics of an instrument and to identify the biomechanics of it would take an awful lot of time in a video tape. This information should probably be given in a manual before the student gets to the video tape; as Dr. Nash was pointing out yesterday, regarding the characteristics of periosteal elevator, that is, composed of a number of different wedges.

Miss McGuire: I think that what we are trying to avoid is the strain of going through the various characteristics in detail. What we want is those essential characteristics of the instrument as an instrument done quickly and in a rather tantalizing way.

Dr. Fry: I think you could limit that very easily to between one and two minutes.

Dr. Maurer: Now what time limits, what range, do we have on this video presentation?

Dr. Fry: I think that varies according to the instrument being used.

Dr. Maurer: But we still have to break it up, when we present it, into segments.

Dr. Fry: If I were to throw out a time, I would say no more than 20 minutes.

Dr. Maurer: Well let's say then 15 to 20 minutes.

Miss McGuire: I might even say less. I am thinking of the memory span from the actual instruction to the point of practice. I would not necessarily mean to shorten the whole presentation, but to give a certain part of a short duration and then say practice this and then come back to part II.

Dr. Olson: Are we talking about length of segment or total tape length?

Dr. Maurer: Are we talking about instruments or the length of the lesson?

Dr. Fry: Each instrument is a lesson.

Dr. Maurer: Then there would be 10 minutes per instrument and we are talking about one-half hour.

Miss McGuire: No, I would say 15 to 20 minute range for the instrument. But if it needs the whole 20 minutes, then I would say it should be broken into two segments.

Dr. Maurer: Well what we are dealing with at San Francisco is three different instruments, and I couldn't get that all into 20 minutes.

Dr. Fry: Well I was talking about an osteotome and mallet, two things which are used together. Some people who are talking about the periosteal elevator may need just 6 to 10 minutes.

Dr. Maurer: All right then, the purpose, basic characteristics, and biomechanics will be short, concentrating on the demonstration of the use of the instrument.

Dr. Dimond: You are talking about surgical instruments, what about the plaster lab and the traction lab. Are they going to be different?

Dr. Olson: Yes, we are talking about two different things here, I see it as actually three separate entities, the surgical skills, the plaster and the traction. They may or may not have the same format.

(At this point general agreement was made on Dr. Hotchkiss' format for the video tape)

Dr. Maurer: Well then let's go on to Brian's format on the manual. We have to determine the content of the manual so that we won't get anything from there introduced into the video tape.

Dr. Olson: We have to have an outline of both.

Dr. Noble: Right, because if we don't start formulating the manual, we won't have the proper instructions for the video tape and when to stop it and what the practice sessions are going to be like.

Miss McGuire: You can develop the manual and video tapes simultaneously--at least in outline--and then after the production of the video tape, go on with the development of the manual, preparing it for the printer.

Dr. Maurer: Why don't we, grossly, outline a manual right now? I am talking about the introduction to the manual, the whole series. (See appendix for complete outline, p. 40).

Miss McGuire: We might have in this whole package a brochure which is an introduction to the surgical skills laboratory. The next ones would be on the soft tissue instruments.

Mr. Maurer: Okay, so introduction, objectives of total course.

Dr. Fry: As far as the format for the manual and the individual components go, I have no objection to what Brian has put on the board. Then there would follow depth activities on the care of the instrument, the sharpening of it, etc. I think there also should be an expanded portion on the mechanics of the instruments, besides the short summary on the video tape. These are rounding out activities, the resident would not have to be in the laboratory for them, he could do them at home.

(There was a general discussion about a statement on the acquisition of materials. It was suggested that the manual should contain suggestions as to the kinds of material necessary, the freshness desirable, and the storage until they are used, but that the actual location and places of acquisition of this material should be left up to the local program using the lab, and space should be provided for that program's insertion of such information. In a discussion on objectives, it was decided to state, first, the general objectives of recognition of the instrument, use of it, and the proper grasp of it. The specific objectives would be the actual task to be performed. For example, the laying of a certain number and kind of sutures, the cutting of a transverse section of bone.)

Dr. Hood: One of the biggest advantages of becoming that specific and than defining the criteria you need for pre-test and post-test purposes is that this is the way we can do research on this thing, to see whether it works.

Dr. Hotchkiss: One point I am trying to make clear here is that we are not teaching surgery, and we have to make sure that the student knows that all we are teaching is a skill and that he really isn't able to take this into the emergency room and sew up everything in sight. And if we don't put that in loud and clear, the criticism is going to come cascading down upon us.

Dr. Olson: So right at the objectives you are saying we need the limitations stated of this particular lesson.

Dr. Maurer: That's a problem. The effective part of this is that the residents will be thinking of it in terms of application to their surgery. If we tell them that we are not teaching them to operate, just to open and close a wound, then put a needle through, their interest is going to go down.

Miss McGuire: I think this is where we might take Jim's advice seriously and we make it an upbeat thing, by saying that when you are through you will be able to do this. As you move from this to something else, you will need to do all sorts of new things--you will be ready to do X and then you will have the opportunity to do more in improving it.

Dr. Maurer: Christine, I think that general thing should be in our formal introduction, for the whole series, rather than for each lesson.

Dr. Hood: In regard to the pre-test, it must be emphasized to the resident that this is for his own education, that no one is going to be checking it. It is to help him determine how well he performs at this moment and how well he performs after the instruction in order to check his own improvement.

Dr. Fry: It might even be said also, that if he does well on this pre-test he may not even have to go into the instructional part of the lab, but should then go to his instructor for some other kind of activities.

Dr. Hood: As an evaluation factor we might video tape a man's performance on a pre-test and then also on the post-test.

Dr. Maurer: Actually that would be hard on each individual programs facilities.

Dr. Hood: In regard to the task for practice, those things that you ask him to do on the pre and post-test should be the same things that he is going to get practice on in the lessons. It wouldn't be fair to say I want you to gouge out a bone in such a such a fashion on the pre and post-test and then tell him to gouge it out or do something else.

Dr. Maurer: But you can have him do the same thing as long as it requires the same skill.

Dr. Hood: Yes, I just wanted to emphasise that it wouldn't be fair to ask them to do on a test something they haven't been prepared for.

Miss McGuire: In regard to the feedback raised earlier, during the practice session while he is practicing, do you want to say to him keep on until you achieve X, or after you practice, here's the way to judge your performance. We want to introduce something here that helps him make his own judgment.

Dr. Noble: If the objectives are written well and specifically enough, this should give him the criteria for evaluating that performance in his practice session.

Dr. Hotchkiss: Maybe here's where we should introduce the concept of speed. The goal is to put in 9 sutures in 3 minutes, all of them tied and accurate.

Dr. Fry: Will that vary from lesson to lesson?

Dr. Hotchkiss: Well it might but it certainly pertains to my segment.

Miss McGuire: Well let's put in a sentence here, which says, how to evaluate your performance, and then each of you will have to adapt what you put under that.

Dr. Hotchkiss: Yes, because I don't know how you can put a certain time down for drilling a hole through a certain bone without burning the bone.

Dr. Maurer: The post-test then will have to follow exactly the pre-test with a statement of the criteria of accomplishment.

Mr. Bligh: There will have to be then a comparison of the post and pre-test, and there are two ways of looking at that; that is, how much did you learn, how well did you learn it?

Dr. Maurer: It's going to depend on how these units are going to be used. Let's suppose they are used as an academic session every Tuesday afternoon for two hours for 10 weeks. There the criterion of achievement may be judged by the instructor. On the other hand, if they are going to be doing this totally on their own, then we'll need some set of criteria in which the individual can make his own criticism.

Miss McGuire: I like that point you made before about being able to put stress upon the bone after you've plated it. I think such a criterion for evaluation should be stated even though there is or might be an instructor available.

Mr. Bligh: Yes, that would give the instructor a criterion also for evaluating what comes out of the lab.

Dr. Noble: I think that could be in the objective, you will be able to plate a bone, such that when you apply so much stress to ti over the knwe, or a bench test, it will stand up.

Dr. Maurer: So in essence when we are coming up to criteria of achievement we're going all the way back to here in the objectives of the lesson.

(The format that was initially discussed was then agreed upon in total and the meeting ended with the preparation of a schedule for production.)

/es
February, 1972

TITLE: Plaster Psychomotor Skills Development Laboratory

PURPOSE: Self Teaching Package for Beginning Residents in Orthopaedics, providing basic Plaster Skills.

TARGET POPULATION: First and Second Year Residents in Orthopaedic Surgery

BRIEF DESCRIPTION OF MATERIALS:

An integrated self teaching package consisting of:

1. Resident manual - with detailed descriptions of plaster techniques and self testing exercises
2. Video tape - demonstrating plaster application
3. 6 - sound-slide (audio tape plus 35 mm slides) programs detailing specific areas of plaster technique.

UNIT ARRANGEMENT:

1. Prereading sections of Resident's Manual for overview of specific lessons.
2. Video tape to demonstrate the total motor skill.
3. Sound-slide with step by step application of techniques demonstrated in video tape.
4. Self test exercise.

OTHER:

PSYCHOMOTOR SKILLS PLASTER LABORATORY

RESIDENTS' MANUAL

April, 1972

Orthopaedic Training Study
Center for Educational Development
University of Illinois at the Medical Center

PSYCHOMOTOR SKILLS PLASTER LABORATORY

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PSYCHOMOTOR SKILLS PLASTER LABORATORY

RESIDENTS' MANUAL

Introduction

The objectives of a motor skills laboratory in orthopaedic surgery:

1. To systematically demonstrate (from simple to complex) the motor skills of orthopaedics to all of its residents.

2. To provide a place, apart from the clinical setting, where the resident may initially practice motor skills at his own pace, first, with guidance, and later, alone.

A motor skill is defined as a smoothly integrated series of body movements undertaken for a specific purpose. Through careful analysis, most motor skills can be broken down into a series of movements which can be isolated from one another for teaching purposes. The outstanding popular example of this type of breakdown was the division of the golf swing by Ben Hogan into five components.

The rationale for this laboratory is based on the concept of the learning curve. Educational investigators found that motor skills learning of all types can be represented by a characteristic curve. This curve shows fairly consistent traits:

1. Slow start.
2. Initial rapid rise.
3. Continued improvement interspersed with levelling tendencies.
4. Final level of attainment.

The slow start is due to the difficulties of early learning and the lack of familiarity with the task. The initial rapid rise occurs as the student develops some ability to perform the basic aspects of the task. He starts to get a "feel"or insight for the work and to build past experience into present performance. The next portion of the curve represents a time of continued, gradual improvement interspersed with levelling tendencies. The learning now slows and becomes more difficult because continued refinement entails mastery of detail. Finally, there is a limit beyond which the individual is unable to achieve. This end point is different for each individual.

See Appendix I-A

Thus the rationale for motor skills laboratory takes advantage of this characteristic pattern of motor skills learning. (Developmental insight) Skills learning for residents in a controlled laboratory setting carry through the period of the initial rapid rise of skills performance to a point where the resident, working at his own pace, develops fundamental mastery of the basic orthopaedic skills. The major portion of his residency is then a time of continued imporvement and mastery of detail, as perceptions for the tasks deepen through clinical experience.

When the learner first tries a motor task, his movements are usually awkward. However, with repetition, those attempts become more skillful, (as insight into the motor skill is attained). Slowly, the learner combines his movements into a smooth and finsihed execution. When the individual achieves a degree of dexterity that allows him to focus on technique, he begins to acquire a "feel" for his skill. He begins to understand the sequence and correctness of each movement. When any part feels incorrect, the learner realizes it immediately and instantly tries to remedy the faulty movement. It is as if knowledge of past results is being brought into present performance. This is called feedback. Feedback is an indication of sophisticated skill execution.

The laboratory setting can be used to instruct the student in the basic steps of movements of any skill. The laboratory can provide a place where the student passes from the awkward stages of performance to the point of early mastery of a task. Initially, an instructor can provide feedback to a student as he begins to modify and polish his technique because a motor skill is much more than a mere accumulation of acts, steps and stages. The true mastery of a motor skill entails the development of systematic perception for the task at hand. That is, the individual must perceive the parts of which the skill is composed. He must learn how the parts relate to each other and to produce a formal, intact skill. Furthermore, he must envision the final goal and how this skill will achieve the goal. This perceptual involvement is of vital concern to anyone teaching motor skills because perceptual involvement is necessary for any skill to be stable and remain with the learner over a period of time.

The second element in the stability of a motor skill is the feeling or attitude that the learner develops about the skill. It is extremely important that a student develop an attitude that enables him to see his skill as an art he is trying to perfect.

In medicine, this art is a manifestation of his "feeling" and concern for patients. Furthermore, his skill is frequently the only objective evidence the "lay" public sees of his expertise. If a resident develops a positive attitude about the motor skill, he will make an effort to preserve this skill.

On the other hand, if the learner sees a motor skill as "scut work" which must be done during an apprenticeship, his hostility will be displaced on the skill, itself. He will try to avoid the skill rather than attempt to master it. With this attitude, the resident is not likely to make an effort to keep his skill intact over a period of time.

Proficiency in the motor skills of orthopaedic surgery is an important goal in a residency program. But why teach in a laboratory setting which is artificial? The answer is simple: It is a foundation and starting point to teach skills that will take years to master. In other words, the laboratory has a specific place early in the education of residents. The formal motor skills instruction has three phases: 1) Definition of objectives; 2) Description of the skill; and 3) Demonstration of the skills by qualified individuals and launching the beginner on his way to the practice of these skills by himself. The resident should be allowed to struggle, make mistakes and correct them. The instructor does not aid the resident too quickly, for this struggle is part of the learning process. The instructor should discourage frustration and permanent error, but superfluous instruction at this point may create a feeling of dependency on the part of the student. ("Over-coaching" or "Over-teaching" is to be avoided).

In summary, the concept of motor skills instruction has been presented here. The educational and psychological principles are stressed because they are important to the success of this endeavor.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER I - RESIDENTS' MANUAL

The Plaster Laboratory

Listed in this Chapter are the objectives of the Plaster Laboratory. By clearly stating these objectives in the beginning, residents who use it will have a good idea of what is to be learned and how much they should know when they are finished.

A. Objectives

As a result of working with the written, audio-visual and equipment resources of the Plaster Skills Laboratory, the student should be able to carry out the following activities to the satisfaction of the laboratory instructor:

1. List the basic advantages and disadvantages of the the use of plaster.

2. Enumerate the basic principles of plaster application.

3. Describe the physical properties of the various materials used in the application of a cast.

4. Describe and demonstrate the proper techniques of applications of plaster to the extremities and torso.

5. Demonstrate an ability to handle the equipment commonly used in the application and removal of plaster.

6. List the complications of plaster application and the methods of avoiding or correcting them.

B. Guidelines

The Plaster Skills Laboratory is one in a series of skills laboratories designed to provide the student with an opportunity to learn at his own pace a fundamental knowledge and manual dexterity which he can apply toward the development of effective treatment techniques. In each case the desired skill has been sub-divided into a series of basic steps which can be individually studied and practiced. These are the "building blocks" which can be combined later, as needed, to achieve a particular clinical treatment role. The laboratory does not intend to teach clinical judgment, but rather to provide the basic skills and information which, when used in conjunction with clinical judgment, will help implement an effective treatment program.

Furthermore, the basic skill to be achieved in the laboratory is limited to the mastery of basic components as they are applied to normal subjects and simulated clinical conditions. The translation of these skills to actual clinical situations can only be done in treatment areas under the direct supervision of experienced instructors. However, the constraints of learning a skill from "scratch" in a purely clinical situation will be considerably relieved if the student has the basic tools which he need only learn to adapt.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER II - RESIDENTS' MANUAL

The Organization of the Plaster Room

It should be noted by the resident that the general organization of the Chapters will follow this second chapter. The information contained in the sound slides and video tape will be repeated here with greater emphasis on detail. It is to the resident's advantage to pre-read this manual, (the specific chapter) before he is to view either the video tape or the sound slide. At the end of the chapter there will be a series of exercises which he should perform as time permits. After he has completed the sound slide and the exercises, and feels he has mastered the chapter, he should then have his staff instructor examine his motor skill and check his mastery of the material.

There are two basic goals to this chapter; one, the resident will be able to recognize and name the instruments and materials commonly found in the plaster room; and two, the resident will be able to describe the adequately equipped plaster room and be able to recognize one which is not adequately prepared.

Plaster room equipment has been grouped into four functional categories:

1. Equipment to position or suspend the patient.
2. Padding and cast materials.
3. Plaster removal equipment.
4. Plaster room attire.

1. Equipment to position or suspend the patient.

Every orthopaedic room should have a table. This table is for the patient to sit or recline on while the cast is being applied. There are many types of tables available. All that is necessary is a medium-height table the length of the patient, with some form of soft padding to make the patient comfortable. This table should be set away from the walls so the surgeon and his assistants can work freely without hinderance. Next to this table there should be a small set of stairs or a bench. This is to enable the patient to step up to the table. This will save your back, as you should avoid lifting the patient whenever necessary. A stool is necessary for the operator or for the assistant to sit on to work whenever possible. This helps avoid fatigue, particularly when the assistant holds the extremity for a long period of time. A fracture table is desirable but it is not necessary for every type of cast. There are several types available, they will be demonstrated by your instructor.

1. Other equipment which is necessary - it is necessary to position ~~the child on the sacral rest for the~~ application of spicas. The spica box which has an adjustable sacral seat is useful to apply infant hip spicas. These will be demonstrated by your instructor according to which type is available at your Institution. Suspension systems are necessary. This may be of the permanent type, suspended from the beams in the ceiling or a movable type suspended from an I V pole. The most common type is a chain suspended from the beams of the ceiling with a bar which can be adjusted for the height desired and is attached to the chains by hooks. Other suspension systems commonly in use are the "Chinese hand cuff" finger trap suspension. It should be remembered that the suspension equipment should remain simple for versatility. Finger traps, while desirable, can be made by adhesive tape or gauze suspension. The other materials that should be available are as follows: rope, roller gauze, muslin, cervical collars, and foam and felt padding.

2. Padding and cast materials.

Under this category we will consider padding, plaster of paris, and the tools directly related to the application of cast. Several types of padding are available. Sheet wadding is supplied 2, 3, 4, 5, and 6 inch rolls. It's possible to make a one inch roll by cutting down a 2 inch roll with a scalpel. Felt for piece padding is also available. The felt is supplied in the thicknesses of 3/8 inch but can be split into 3/16 inch pieces when necessary. For certain casts, stockinette is used. It is supplied in 2, 3, 4, 6, and 8 inch sizes.

Plaster of paris for casting is supplied as circular bandage rolls or as flat splints. This material must be kept in a very dry place where the humidity is low and the temperature constant. It is unpackaged only when needed to prevent any loss of chemical reaction. The circular rolls are supplied in sizes of 2 inches through 8 inches. The flat splints are available in sizes 3" x 15", 4" x 15", and 5" x 30". Four to eight thicknesses is best for general cast work when building a splint.

When working with plaster the following equipment is necessary: a work area, preferably a smooth, metal surface so splints can be rubbed out when necessary. This metal surface is particularly handy as it allows dry plaster to be wiped away easily. A bucket for dipping the plaster is necessary; stainless steel is best for its long life and ease of cleaning. A sink with hot and cold running water is necessary; also this sink should have a plaster trap to prevent waste plaster from entering the plumbing system.

Several tools will be needed constantly when working with the padding and the plaster. Two types of scissors should be at hand; bandage scissors for cutting dressings and padding, as well as a pair of plaster scissors for cutting plaster splints. Two types of knives are necessary to trim plaster and padding; an ordinary straight shoe knife with a 1" blade cut off is good for use on plaster, and a scalpel with assortment of blade sizes which can be used for cutting padding and trimming small areas of plaster. An indelible pencil is used to write on casts and it should be handy.

3. Plaster removal equipment.

The third category to consider in our plaster room equipment is plaster removal instruments. The most popular cast cutter is the Stryker electric oscillating saw, the scissor-type is the Stille cast cutter, this should also be available. For small casts, like club foot casts, a pair of plier cutters with beveled tips is useful. For spreading casts, two sizes of spreaders should be available. Furthermore, there are times when a portion of the cast must be bent, and for this the "duck-billed" bender is useful.

4. Plaster room attire.

The fourth functional category of the plaster room equipment is the clothing, or attire. A gown or apron is always used to protect clothing when working in the plaster room. Rubber gloves may be worn to work with plaster; rubber gloves serve two functions; plaster rolls easier, and can be rubbed in better, and secondly, the gloves protect the surgeon's hands from drying out and cracking around the nails.

Shoe covers can be made of stockinette, or plastic shoe covers, or surgical shoes can be worn. They are removed before leaving the plaster room. In this way the halls and other hospital areas will not become tracked with plaster. In consideration of those cleaning the plaster room and in consideration of the patient, the floor should be covered with sheets, and sheets should be used to cover the patient. This eliminates spilled plaster and any unnecessary mess and discomfort. An adequate disposal system for soiled material should be available. Large plastic garbage pails are adequate or the hinged top metal containers may be used.

There are other items in a plaster room which are used in individual situations. These instruments will be introduced as the need for them arises.

Chapter II - Exercises

1. List four categories of equipment necessary for the well-equipped plaster room.

2. List the sizes in which circular plaster is supplied. Also list the sizes in which plaster splints are available.

3. Describe two types of plaster removing instruments.

4. Describe how shoe covers can be made from stockinette.

5. In this section in your plaster room locate --

   a) The roll of plaster
   b) The plaster splints
   c) The cast cutter and trimming instruments, also the cast spreading instruments

6. Take a blank sheet of paper, leave the cast room, draw in sketch fashion where the various categories of equipment can be found: equipment to suspend the patient, the casting and padding materials, the plaster removal equipment, and the plaster room attire.

ANSWERS TO CHAPTER II EXERCISES

1. One - Equipment to position or suspend the patient. (including assistants)

   Two - Casting and padding materials.

   Three - Equipment to remove and modify casts.

   Four - Plaster room attire (and drapes).

2. Circular plaster is supplied in two, three, four, six and eight inch sizes. Plaster splints are available in three by fifteen inches, four by fifteen inches and five by thirty inches.

3. Stryker electric oscillating cast cutter and the Stille mechanical cast cutter.

4. Four inch stockinette can be cut in eighteen inch lengths taped at one end and slipped over the shoes and over the pants cuff and taped.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER III - RESIDENTS' MANUAL

Fixation of the Patient and the Extremity before Cast Application

The objectives of this chapter are as follows:

1. You will be able to brief your assistants in -

   a) How to lay out the materials for padding and cast application.
   b) Holding an extremity motionless with a minimum of effort.

2. You will be able to enumerate and demonstrate the principles of good technique in extremity immobilization.

   a) Holding extremity on the same side on which the plaster is applied.
   b) Your hands supporting the extremity above and below the area of plaster.
   c) Avoiding touching or interfering with the wet plaster or the surgeon.

3. You will be able to list the three criteria of good mechanical suspension.

4. You will be able to enumerate and demonstrate various types of suspension devices, including -

   a) Finger trap suspension.
   b) Gauze suspension.
   c) Tape suspension.
   d) Stockinette suspension.
   e) Counter-traction suspension
   f) The removal of counter-traction suspension after the plaster is applied.

Perhaps the most important step in applying a cast is the organization that precedes the actual work. Several steps should be taken before undertaking the application of any cast. The first step is to brief the assistants. All personnel who are going to help in the application of a plaster must be fully and carefully briefed as to their assignments. They must know what they are to do and when they are to do it. An assistant is of help only when he knows what is expected of him. To apply casts, two assistants are usually necessary, one to wet the plaster and the other to hold the patient's extremity motionless.

The assistant who wets the plaster should know what naterials the surgeon will need and in what order he will use them. It is the responsibility of the surgeon to make sure that his assistant is aware of these duties. The surgeon has to make sure that the assistant has all the equipment to be used for the particular cast laid out and ready. For example, stockinette, if it is used, is cut to the desired length. The appropriate padding material and the specific number of rolls of plaster are laid out. The plaster is unwrapped from the paper only as needed to be dipped in the water. This prevents the roll from getting wet prematurely rendering it useless for future use. Other instruments, such as, the scalpel, or cast knife, pillow, drapes, etc., are also laid out before the cast is applied. To be able to instruct the assistant in these matters intelligently, you, the surgeon, will need to be well versed in procedures and materials.

The other assistant holds the patient's extremity for the surgeon. Some surgeons prefer to hold the extremity and have the plaster technician roll the plaster. This is a mute point, but it will vary according to the program. It is the responsibility of the surgeon to show the assistant exactly and specifically how he is to help in the application of the cast. You must know how to hold the extremity properly, yourself.

The following principles of assistant mobilization are:

1. The goal is to hold the extremity motionless. The holder must be as comfortable as possible to prevent undue fatigue. Your holder will be more comfortable if his back is straight and he does not have to hold the part out at arm's length. For this reason he should stand on the same side of the table as the extremity, and on the side in which you will apply the plaster. He should have his arms close to his body, his back straight and, whenever possible, he should be seated. He should not have to struggle working across the table. If this assistant is not comfortable, he will allow the extremity to move while the cast is setting. This will ruin the cast and may provide the nidus for pressure sores.

2. Your holder must support the extremity without touching the wet plaster or the surgeon's hands. Therefore, he must grasp the limb above and below the site of the plaster application.

When holding the lower extremity the thumb is placed on the dorsum of the foot between the first and second metatarsal heads. The fingers are applied to the sole. The hand is slid in far enough to hold the foot firmly. In this way the holder's grip will not come loose during the application of the cast and he will not have to move. The toes are held down in slight flexion at the m-p joints. If the toes are held up in extension, a claw deformity can develop if the mobilization in the cast is prolonged. When the wrap is started the assistant is wrapped right in and he slides his hand out only when the cast is finished.

When holding the upper extremity the patient's hand alone is grasped by the tip of the patient's thumb and the tip of the small finger. The assistant spreads the thumb so that there is a good space between the first and second digits. If more space is needed, a small block of wood can be applied between the thumb and index finger. If the wrist is to be held in ulnar deviation, such as in Colles fractures, the thumb is grasped in one hand and the ends of all four fingers are taken in the other. In this way the hand can be pulled to ulnar deviation. However, the assistant must make sure that he does not force the wrist into pronation at the same time.

If the holder grasps the foot or the hand in the manner demonstrated in the sound slides, he will have complete control of the limb. Furthermore, he can hold the part in a corrected position for as long as necessary. He will be able to move the part if need be, but as he does so, he will move it as a total single unit without losing a reduction.

3. The holder should stand far enough away from the part to be supported as far as possible with comfort in order to give you a chance to work without being confined. If your assistant is too close, he will be in the way of the plaster, and will be more hinderance than a help.

Once the details of organization have been completed, attention is turned to the patient. You should carefully and tactfully explain what you and your team are about to do. Depending on the patient, you may, or may not, explain the steps of the task and the reasoning behind the procedure. After proper rapport is obtained, the job may begin. Little things, such as, a pillow for the patient's head, adjusting the sheet for the patient's modesty, etc., are very important to enlist the patient's comfort and cooperation and should not be overlooked. If there is more than one patient in a room, drapes or blinds should be provided for patient comfort and modesty.

The part or the parts on which the cast is to be applied must be held motionless for as long as it is necessary to apply the cast and allow it to set. If it appears that you will need more than one assistant to hold the limb you should use a mechanical suspension system to position the limb in such a fashion that it will allow the cast to be applied at a comfortable pace. The holder cannot hold any heavy part in a fixed position for more than three to four minutes before becoming fatigued. Within this time he will start to move about to gain a more relaxed position. He may even put the extremitydown to rest it in the middle of a job. Therefore, if there is any doubt about how to hold an extremity, it should be supported with mechanical aids that will not move.

At this time we will turn our attention to mechanical suspension. Assistants holding the patient's extremity are more flexible in allowing the extremity to be positioned in varied positions. It is also somewhat more comfortable for the patient to have a human holding his extremity rather than a mechanical appliance. However, there are times when assistants are not available or the cast to be applied will take a longer amount of time than an assistant can be expected to hold the extremity. In this case the mechanical suspension is desirable. There are three basic criteria for any mechanical suspension system. Any suspension system must fulfill the following conditions:

1. The suspension of the extremity must be comfortable and safe for the patient.

2. The suspension system must be easy to apply padding and plaster around.

3. The suspension system must be simple enough so that it is easy to rig up and to take down.

There are three basic ways in which the upper extremity can be suspended for the application of upper extremity plasters. First, there are commercially prepared finger traps - they are safe and easy to use. The finger trap may be "Chinese handcuff" or it may have a <u>locking device</u> similar to the small vice which encircles the individual fingers. Whichever finger trap is used, it can be suspended from an overhead bar or beam in the ceiling by rope or chain or it may be attached to an I V pole, which can be adjusted to the desired height. The thumb, index, long and other fingers, as necessary, are placed in the finger traps. The upper extremity is positioned and the reduction is maintained. The patient may be in a supine position on the cast table, sitting on the cast table, or sitting on a chair, or standing, whichever is most convenient.

The <u>second method</u> of suspending the hand is by roll of gauze. Loops of gauze bandages are made for the thumb, index, long fingers and other fingers as necessary. They are placed around the fingers above the proximal interphalangeal joint, they are then gathered together into a single unit which is then attached to the suspension apparatus. The surgeon must be sure to remove the gauze loops once the cast has been completed.

There is a <u>third effective method</u> of suspending the upper extremity. For those surgeons who do not like the use of gauze loops and when finger traps are not available, the thumb and fingers are painted with a tincture of benzoin. Strips of one-half inch adhesive tape are applied to the dorsal and volar surfaces of the fingers. These strips of tape are carried out over the ends of the fingers and then pressed together. Transverse bands of tape around the fingers are applied as necessary to hold the longitudinal strips in place. The pieces of tape are then gathered together into a common suspension system.

When the hand is suspended it is frequently advantageous to create a wide space between the thumb and index finger to work around. This space is created by placing a piece of wood between the suspension systems attached to the thumb and index finger. This is removed when the cast is completed.

Counter-traction for the arm is often necessary. This is rigged in the following fashion. An appropriate length of felt pad is cut and a hole fashioned in either end. The pad is laid over the arm and a spreader bar attached from the two holes. Traction weights can then be hung from the spreader bar. Another method is to use 4 inch stockinette which is placed across the upper arm, both ends which are hanging down are tied together and a weight applied. By means of this suspension apparatus the surgeon can hold the arm for any length of time to gain reduction or apply a cast.

CHAPTER III - Exercises

1. List the principles of good technique in holding the extremity by an assistant.

2. List the three criteria of a good mechanical suspension system.

3. Set up finger trap suspension on a partner, using finger traps available in your cast room.

4. Set up finger trap suspension made from gauze.

5. Set up finger trap suspension using tape suspension and benzoin.

6. Suppose that you have a patient that needs a long-leg cast and no assistants are available. Devise a suspension system using the three criteria of good mechanical suspension in which you can suspend this lower extremity for a long-leg cast to be applied.

7. Suppose that you have an upper extremity fracture of both bones of the forearm. You will need finger trap suspension and counter traction applied from the upper extremity. Use your partner, have him lie supine upon the table, apply the counter-traction and the finger trap suspension. Be sure to use wax paper under the counter-traction so it can be removed after the plaster is applied.

8. Using your partner, suspend his upper extremity as for a Colles fracture and cast application. In this cast use a small block of wood to maintain a web space between the index and thumb. When you are confident that you have mastered the use of suspension, have your instructor check your suspension for upper extremity cast, lower extremity--lower leg cast, upper extremity cast using counter-traction.

ANSWERS TO CHAPTER III EXERCISES

1. (a) The extremity must be held absolutely motionless.

   (b) The assistant should be on the same side of the table as the extremity he is holding, back straight and as far from the limb as possible without interfering with the surgeon, but with undue strain on his back.

   (c) The assistant's hand should not touch the applied plaster, but should support the extremity when possible away from the area where the cast is being applied.

   (d) Sit whenever possible.

2. Good mechanical suspension fulfills the following criteria:

   (a) Motionless, comfortable and safe for the patient.

   (b) Simple to pad and plaster around.

   (c) Simple to apply and remove.

6. Suggestions - Tape suspension or gauze suspension to toes. Stockinette sling with wax paper between sling and padding at thigh level.

Basic suspension of the goot and leg is jurst as easy. For the foot, the commonly prepared finger traps do not work, but the surgeon can easily use gauze loops. The tape method can be used by the surgeon who does not like the gauze loops. Some practitioners even prefer to tape the whole distal portion of the foot in this matter. The foot is never suspended by pulling in the stockinette which has been placed on the leg. Dangerous pressure sores can be created on the heel in this way.

To suspend the leg for a long leg cast (or spica) the surgeon must suspend the thing in the area of the knee. The assistant holds the lower leg in the correct position. The surgeon then puts a piece of felt behind the leg. He then takes a length of three inch gauze and carries it around the leg against the felt. The leg is suspended from the overhead bar. To avoid any source of pressure under the cast the surgeon must remove this gauze after the cast has been set up. For this reason the gauze cannot adhere to the plaster. This can be prevented by wrapping wax paper around the gauze.

These basic methods of suspension will allow a surgeon to arrange a s stem for almost any problem. There are many other methods of suspension, but it is suggested that the resident should learn the basic methods and add to these as necessary. They will serve him well when no assistance is available and a cast must be applied.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER IV - RESIDENTS' MANUAL

Principles of Padding

The following are the objectives of this chapter:

1. You will be able to list the six basic principles for applying cast padding.

2. You will be able to list five dangers of improperly applied padding.

3. You will be able to contrast the major advantage of stockinette over other forms of padding and its two major disadvantages.

4. You will be able to cut stockinette to the proper length for various casts.

5. You will be able to elaborate the purpose of piece padding and list its two chief dangers when improperly applied.

6. You will be able to apply stockinette properly for an upper and lower extremity cast.

7. You will be able to apply sheet wadding for an upper and lower extremity cast.

8. You will be able to demonstrate the use of piece padding, by being able to fill a depression around your partner's supratrochlear area, for a long leg cast.

Now that you have learned how to organize the plaster room and rigged suspension you are know ready to learn the principles of padding. The purpose of all padding is to increase your margin of safety for your patient in plaster. Since no arm or leg must conform to a hard cast the padding wrap must be adaptable to allow clearance and adjustment the limb will make. This will include anticipated swelling after an injury or even just the irregularities of the patient's anatomy.
Sheet wadding and Webril are probably the simplest materials that supply this adaptability and adjustment, however, there are many types of padding, and all have their advantages and disadvantages.

There are several rules of padding to keep in mind:

1. The wrap is to be uniform in thickness.

2. It is applied with only a delicate amount of tension.

3. The sheet wadding or padding must be narrow enough to get good confirmation to the limb. If the choice is too wide it will not conform. If it is too narrow there will not be consistency of thickness.

4. As the padding is wrapped it overlaps the previous turn by 50%. Two to three layers are applied, but no more than this. The more padding that is applied the thicker the cast will be. This makes a heavy cast and is an unnecessary burden on the patient.

5. Joints or irregularities should be bridged with a full width of the wrap. The edges of the wrap should never be allowed to fall into the hollow or over a joint prominence as this is where they will cause constriction.

6. For the acute injury when swelling is anticipated padding which does not have much "recovery power" or "recovery memory" is used. In this situation those padding substances such as webril or waffleweave and stockinette should be avoided. For routine casting these materials, however, are satisfactory, but when excessive swelling is expected sheet wadding is probably the safest padding to use.

Ther are five points concerning improper padding which the surgeon should be well aware:

1. Do not allow a heavy wrap in one area and a light wrap in another area. This encourages pathologic edema distal to the heavy area.

2. Sheet wadding is never forced to conform by pulling or twisting. This can strangulate the limb distal to the area which is twisted. It in effect acts as a tourniquet.

3. Wrinkles, folds, or dents are never left which will pinch or wrinkle the skin. Position the extremity in the proper position before padding is applied

because if you move or try to change the position of the limb wrinkles are bound to occur.

4. Tape is never left under padding. This leads to tape blisters.

5. Too little padding can lead to pressure sores, nerve injury or even gangrene. Too much padding can lead to inadequate immobilization and slipping of the limb within the cast. You may lose your reduction or have the bone fragments heal in the improper position.

Stockinette

Routine use of stockinette is advocated by some and condemned by others. Stockinette makes an excellent padding for the torso where it conforms to general curves. Furthermore, stockinette helps to reduce skin irritation. Perhaps the major outstanding feature of stockinette is its ability to conform to the irregular anatomy of the patient.

The surgeon should know the limitations and dangers of stockinette. First, it is possible to put the stockinette on so tightly that it can be constricting and cause a tourniquet effect. Secondly, stockinette if too loose is prone to produce wrinkles and, hence, cast sores. It is probably better not to use stockinette where there is anticipated swelling and tight plaster is to be applied. If stockinette is used alone without sheet wadding or some form of padding a note to this effect is marked on the cast with an indelible pencil. This serves as a warning to the surgeon who will remove the cast so he does not cut the patient.

When used properly, however, stockinette is quite safe. When using stockinette it is cut three to four inches longer than the proposed length of the cast, since it stretches in width only at the expense of its length. For proper application it is rolled up into a doughnut and then rolled on the limb.

Piece Padding

Piece padding is necessary in some instances to protect areas of irregular bony prominence. Piece padding is controversial in some programs. You should follow the dictates of your individual program. Some chiefs believe that it is necessary to pad around all bony prominences with piece padding; others will believe that adequate padding is obtained with sheet wadding or other forms of rolled wadding. Felt is perhaps the easiest padding to work with, and is applied in thicknesses of 1/4 inch, 3/8 inch and 3/16 inch. The felt should be soft and easily torn into layers. Sponge rubber can be used as piece padding but it has great recovery power if squeezed down. This may cause excessive pressure. Felt must be placed so that it will not move during application or shift under the cast, or extrude some time after casting has been done. For this reason, the piece padding is always placed outermost right under the plaster. This way it is locked in place by the plaster and cannot move.

The principle of piece padding is important. Piece padding is used as a compensatory mechanism to fill in depressions proximal or distal to a bony prominence. Therefore, the padding rests on a soft tissue surface which is adequate to compensate by itself. The thickness of the padding is tailored so that its height just clears the bony prominence it protects. Thus, the padding takes the plaster thrust of the cast. In this way no edema of the protected area occurs. The padding is tailored by splitting, slicing, excising wedges, beveling or whatever is necessary. The padding is held to the stockinette or sheet wadding by pieces of tape or stitched to the stockinette.

Well placed piece padding will relieve pressure quite well, but badly placed piece padding will produce pressure. Piece padding is never placed right over bony prominences. This merely exaggerates the high area of the patient's anatomy.

Do not use doughnut piece padding. This merely cuts off vascular exchange to the area which falls within the hole of the doughnut and will produce "window" edema. Do not circle the extremity with piece padding. This can be constricting, and do not use piece padding for pressure sores on the heel or the knee cap. This merely increases the amount of pressure. For a pressure sore on the heel, you must remove pressure by generalized support of the whole part proximal to the heel.

You have been introduced to the principles of padding, the sound slide and this written text. A large amount of information has been presented, but all of it will become familiar to you as you work and practice in the laboratory. Turn now to the exercises and with the aid of your partner carry them out until you are satisfied that you have mastered the principles of padding then have your instructor check as you apply padding in preparation for a cast.

1. List the six general rules that you should keep in mind when applying any cast padding.

2. List the chief objection to applying heavy padding in one area and a light padding in another area on the extremity.

3. What is the objection in twisting padding to help it conform to the patient's anatomy?

4. Why should all wrinkees be removed from the padding?

5. Why is tape removed and not left under padding?

6. List the pitfalls of too little padding. The pitfalls of too much padding.

7. Once the limb is padded why is it objectionable to change position of the limb?

8. List dangers that you should appreciate in using stockinette.

9. Why is stockinette cut three to four inches longer than the cast?

10. What is the purpose of piece padding? Where should it not be placed initially? How valuable is doughnut padding?

11. How is piece padding prevented from moving?

12. Why is it incorrect to apply piece padding over pressure sores on the knee and heel?

(13-1) Demonstrate on your partner how to properly pad the leg for a long leg cast without using stockinette.

(2) Repeat the same exercise only this time use stockinette alone.

(3) Pad your partner's arm for a long arm cast with stockinette and sheet wadding. Pad around the finger trap suspension; also apply a piece of stockinette and wax paper for counter traction, which can be removed easily.

(4) Apply stockinette to your partner and assume he has a marked depression in the area of his knee. Apply piece padding to build up and protect this area. When you have mastered padding of the extremety have your instructor check you to see that you are properly applying padding before going on to the next chapter.

ANSWERS TO CHAPTER IV EXERCISES

1. (a) Keep the wrap uniform in thickness.

   (b) Apply wrap with only slight tension.

   (c) Use padding narrow enough to get good conformation (but not too narrow as to cause constriction).

   (d) Overlap each previous turn by 50%.

   (e) Bridge joints, bony prominences and piece padding by a full width of padding.

   (f) In an acute injury which you expect to swell use padding which has very little "recovery power" or "recovery memory."

2. This leads to pathologic edema distal to the area of heavy padding.

3. This leads to strangulation or tourniquet effect distal to the area of twisting.

4. Wrinkles lead to pressure sores.

5. Tape, if left for long periods of time, fuses with the skin resulting in blisters or tape allergies.

6. Too little padding leads to pressure sores, nerve injury or even gangrene due to ischemia.

   Too much padding allows the extremity to slip within the cast.

7. Changing position of the limb causes wrinkles and constriction of the padding which may lead to cast sores or circulatory constriction.

8. Stockinette may not conform well to the extremity and produce wrinkles. If it is too tight it may cause ischemia and if used alone makes cast removal hazardous.

   Loose
9. Stockinette stretches at the expense of its length and will be too short if cut the exact lenght desired.

10. (a) Piece padding is a compensatory mechanism to fill in depressions around a bony prominence allowing the surrounding soft tissue to take the thrust of the cast and not the bony prominence.

10. (b) Do not place it over bony prominences such as heel or patella.

    (c) Do-nut piece padding should not be used as it will produce window edema in the area of the hole.

11. By applying it just under the plaster using the plaster to lock it in place.

12. These are bony prominences and it only increases pressure. It is better to pad the soft tissues surrounding the knee cap or heel.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER V - RESIDENTS' MANUAL

Principals of Applied Plaster of Paris Application

The following are the objectives for Chapter V:

1. You will be able to wet circular plaster and splints in the correct fashion.

2. You will be able to correctly hand plaster to another for application.

3. You will correctly apply plaster for the extremity casts specifically you will -

   a) Roll plaster without lifting from the surface of the extremity.
   b) Maintain even thickness by overlapping each previous turn by 50%.
   c) Make tucks to modify the plaster to the tapering limb of the patient.
   d) Span joints and bony prominences with a full turn of the bandage.
   e) Incorporate splints and circular bandage for added strength.
   f) Work plaster to provide a smooth surface and proper amalgamation of the plaster winding
   g) Recognize and be able to compare the surface of plaster still capable of being worked "with plaster that has began setting and should not be worked."
   h) To manage a telescoping roll of plaster by pushing back the center and other techniques.
   i) Be able to tailor the cast to make the patient comfortable by trimming the cast to proper length and padding the plaster edges.
   j) Apply a full appropriate note to the cast.

After you have completed the preceeding section on padding, a discussion of plaster of Paris is in order. This discussion will be limited to the general principles of applying plaster. The details of applying specific casts will be taken up by your instructor and you will be guided into the specific details and techniques that are taught at your institution.

Plaster of Paris is a material well suited for its use as a rigid dressing. It has an unusual compacity to breathe, allowing air to reach the underlying skin. Furthermore, when properly applied it modifies to the patients' anatomy. The plaster dressing will conform and give equal pressure to the limb just the way water conforms to a floating object. On the other hand, improper molding of the plaster can produce isolated pressure, and this isolated pressure if as much as equal to a pressure that will blanche a finger nail bed can cause the skin sluff and underlying tissue damage. A great deal of practice is necessary before plaster technique can be mastered, nevertheless, a knowledge of the fundamental concepts of plaster application will give you a good start. At this point it is assumed that you mastered the section on suspension of the patient and on padding. It is furthermore assumed that all the equipment for subsequent work has been laid out and is ready.

The following principles of plaster application will be of great value to you:

1. The circular bandage is inserted vertically into lukewarm water, while bubbles rise from the roll it is allowed to stand free and undisturbed. When the bandage is removed from the water, the plaster roll is grasped by the ends and lightly squeezed,end to end to remove excess water. The bandage is <u>never</u> wrung out, or squeezed with force, as this only tends to remove the plaster. The principle that you should remember is that the roll should be wet enough so that it is just about to drip. When plaster is wet to this degree it is ideal for molding to the patients' anatomy.

2. The second principle is the proper handling of the roll. When handing the wet plaster to another for application, the tail is unrolled about one inch, the roll is held out in the palm of the hand adjusted to the right or left handedness of the one applying the plaster.

3. The third principle is the proper application of the bandage. The operator takes the bandage in his hand so that it fits in his palm. As he applies it, the bandage rolls from the thumb around to the fingers. Plaster is rolled with the fingers. The plaster must be so wet that it modifies to where it is placed. It is emphasized that the plaster is rolled on, not laid on, it remains on the bias, it is never pulled with tension, as tension will tend to produce ridges in your cast. Each plaster

turn should overlap the preceding turn by 50%, in this way the plaster will be smooth and of even thickness. The roll moves up down the part to obtain the uniform thickness throughout. The roll never stays in one area except at the ends of the cast, here it is permissible to roll one turn over another for a thickness of two turns.

To contour plaster smoothly on a limb, it is necessary to change the direction of the roll, this is done by taking a tuck in the plaster bandage. A tuck is fashioned by pulling at the edge of the plaster with a finger. If the roll is tucked on the edge of plaster which is on the smaller circumference of the limb, it will fall smoothly into place; for example; if the plaster is being applied to the leg and the roll is moving from foot toward the knee, the tuck should be taken on the edge of the plaster closest to the foot. This is the part of the limb that has the smallest circumference. It should also be noted that tucks should be placed on the posterior part of the limb and kept uniform, this way the cast will appear much neater. Tucks should also be placed where they make no significant pressure on the skin, It must be stressed again that the roll is never twisted or reversed or turned to change direction or to make it conform to the patient's anatomy. There is one exception, sometimes it is necessary to twist or turn the plaster roll in the area of the palm in an upper extremity cast. This will be discussed in detail with your instructor.

4. The fourth principle of plaster application is the proper bridging of joints and bony prominences. When plaster covers a joint or prominence or a piece of felt padding, the center of a sheet of plaster must pass over the spot in question. The edge of the plaster should never fall at the joint or this prominence, if the plaster is not centered when the hollow of the joint or prominence is reached the operator should pause and carefully spread the sheet to its full width bridging the joint, in this way constrictions and loss of circulation can be avoided.

5. The fifth principle in plaster technique is the use of plaster splints. Plaster splints incorporated like reinforcing rods or I beams can supply strength to the cast with a minimum of additional weight. Furthermore, the correct use of splints reduces the number of circular rolls needed for any cast and thus reduces the weight with no sacrifice of strength. Splints are

wet as necessary by drawing them through the water. A splint can be, if necessary,"worked" on a smooth flat surface. The palm of the hand can run firmly over the splints so that no wrinkles are left in the splint. The splint is then applied over the circular roll and smoothed into place. Splints are always incorporated or locked by a roll of plaster. When and I beam type splint is to be used, the splint is folded on itself and placed upon the cast molded to make it smooth in contour and then incorporated with a roll of circular plaster. This adds strength where bends or turns of the cast occur, such as at the ankle joint. This is not always necessary but is desirable when undo stress is expected on the cast.

6. The sixth principle of plaster application is the proper working on the plaster. As the operator is rolling the plaster he constantly rubs it in order to provide a smooth amalgamation of all the layers. Furthermore, the operator molds the cast as the plaster is being applied. To mold the plaster over the contour of the patient's anatomy the plaster should be molded only with the palms and thenar eminences of the hands. Molding is never done with the fingertips as this can dent the plaster and this will lead to areas of isolated pressure. Plaster is rubbed and molded until it is firmly set.

It is important to note that the setting point of plaster occurs once the creamy glossy shiny stage is past. At this point the surface starts to take on a dull finish. Further molding and movement are prohibited at this point, because the interlocking of the calcium-sulfate crystals has occurred. As the gypsum has drawn out the water you now have a crystal structure. If you attempt to mold at this time, rubbing will only interfere with the crystalization and the amalgamation of the layers and weaken the cast.

When applying plaster you will frequently have to work around a suspension apparatus. As the roll approaches the elements of the suspension apparatus circular turns are not taken over across the supporting slings. These areas are bypassed when possible, they are filled in later after the suspension apparatus is removed.

Once the plaster is started on the limb the position of the limb is never changed. If the part or extremity is moved padding becomes wrinkled and wedged under the edges of the plaster roll. If the part must be moved in plaster application the whole process of plaster application must be started over again, when a satisfactory motionless position of the limb has been reestablished.

7. The seventh principle is the management of the telescoping roll of plaster. Occasionally, telescoping of the wet roll occurs and the roll may string out. This is especially true when the plaster roll is held perpendicular to the ground. Telescoping can be avoided by the following maneuvers:

a. Picking up the bandage from the water and giving a small circular squeeze around the center of the roll.

b. As it is rolled on, keep the roll down on the part directly on the bias and do not pick it up.

c. Tuck the plaster frequently.

d. If the roll threatens to "telescope", the central core of the plaster can be pushed back or "goosed" back into place with the fingers. This is perhaps the most valuable technique.

e. If the roll does get away as it sometimes will the bandage must then be cut free and a new roll of plaster started. You should not attempt to salvage an unmanageable roll of plaster as this will only lead to a poor cast.

8. The eighth principle for applying plaster is tailoring the cast for the pateint's comfort. After the main part of the cast has been completed the edges must be tailored to make the patient as comfortable as possible. To do this several steps must be taken:

First, make sure the plaster extends only as far as is necessary for the desired fixation. For example, if the wrist is being immobilized the surgeon wants to allow full range of motion to the metacarpol-phalangeal joints, the cast must extend no further than the distal palmar crease. Consequently, if the plaster extends beyond this pointit should be trimmed back to the appropriate level.

By the same token if the surgeon has no reason to immobilize the thumb in his upper extremity cast, the cast should be trimmed up widely around the thenar eminence. This prevents irritation of the skin in this area and makes the patient more comfortable and gives him a useful hand. Also, whenever the cast is trimmed the surgeon should count all toes to make sure they are all visualized and there is no plaster bearing upon any of the digits.

Later in the plaster laboratory when the application of specific casts are presented, this principle will be stressed again. Suffice to say that the surgeon should make a special effort to prevent the cast from extending further than necessary to give proper fixation. While discussing the principle of tailoring a cast for comfort, it should be stressed that the plaster edge should never touch the skin. If plaster rubs on skin a sore area is bound to result. If stockinette has been used it is pulled over the edge of plaster and tacked in place. If sheet wadding or any rolled wadding only has been used it is rolled back and locked down with a strip of plaster.

After the main parts of the plaster are set, the suspension apparatus, if one is used is cut down. The slings are slipped out from underneath the plaster and the gaps are closed with a few circular turns of plaster.

The cast must be kept off any hard surface until it is firm. Pressure sores are caused by resting the cast on a hard surface before the plaster is hard.This is one way dents are created Pressure sores can be produced furthermore by finger or thumb prints in the cast. If an assistant holds the cast he should be instructed not to place his hands directly on the plaster to support the limb as this will also produce pressure points in the cast.

9. <u>The ninth principle</u> of plaster technique is the application of a proper note on the cast. Always place a notation on the cast for future reference. The following information should be written with indelible pencil: <u>the suregon's name or initials; the date of the initial injury; the date of the cast and a small drawing of the fracture or injury.</u> Special notes may also be added such as no padding used, stockinette only; if repeated cast changes are anticipated, the date of the next cast change.

A cast should look neat and tidy. Like a skin incision a cast is the most obvious and visible result of a suregon's work. The lay public uses the cast as the criterion of a surgeon's skill and judgement. They cannot appreciate the surgery or the fine techniques of closed reduction, but they will judge you on the appearance of your cast. The family and others that see your cast will ask who applied the cast. Be proud of your work and always build a cast that you are proud to sign. Let it be your motto: "Build a signer."

EXERCISES

1. Apply a short arm cast to your partner. After applying proper padding, concentrate on proper wetting of the plaster, molding the plaster, taking the tucks and completing the edge of the cast with trimming and padding of the plaster edge.

2. Apply a long leg cast to your partner.

QUESTIONS

1. a. Explain how tucks are taken
   b. Why are they necessary.

2. List the ways plaster can be dented and produce pressure sores.

3. Describe when plaster is ready to set up and not to be worked.

4. List the items to be written on the cast.

At this time you should view the video tape again and when you feel you have mastered applying the basic cast, have your instructor watch you and make comment. Have your instructor show you the way that he wishes you to apply short leg cast, long leg cast with and without walkers, upper extremity cast, short arm, lower extremity cast, the vicular fracture cast. You should practice and gain confidency in applying these basic casts. At a later time you may want to have your instructor demonstrate the body cast, halo cast, spica cast.

ANSWERS TO CHAPTER V EXERCISES

1. (a) Tucks are taken on the side of the plaster turn which will span the smallest circumference. The tuck is taken by catching the plaster turn with the finger of the opposite hand folding the excess plaster down. (Usually on the posterior surface of the cast).

   (b) This allows the slack to be taken up as one edge of the plaster must span a shorter distance.

2. Dents are produced by:

   (a) Finger tips focusing pressure in a small area of wet plaster.

   (b) Resting soft casts on hard surfaces.

3. Plaster is ready to set up when it has lost its shiney, glossy appearance and is dull in appearance.

4. A cast should be labeled as follows:

   (a) Name of person applying it.

   (b) Date of application.

   (c) Date of initial injury.

   (d) Picture of injury.

   (e) Special information such as no padding used.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER VI - RESIDENTS' MANUAL

Care of the Patient in Plaster

The objectives of this chapter are as follows:

1. You will be able to list the five danger signals that warrant a possible plaster complication.

2. You will be able to elaborate a definite order in examining a patient in plaster, noting the six physical signs to look for in logical sequence.

3. You will be able to list the five P's or mnemonic device for remembering the five signs of the ischemia.

4. You will outline the steps of cast removal to check for suspected ischemia and when the cast should be replaced.

5. You will properly demonstrate bivalving a cast and replacing the plaster shell with the proper padding and skin care.

Following immobilization of a fractured extremity it usually becomes progressively painless. Undiminished pain four hours after recovery from anethesia should be regarded with suspicion. If pain continues unabated for six hours a specific active measure for investigation and relief of pain must be immediately instituted. Narcotics are never given until the condition of the extremity in the cast is known to be safe.

Complications of plaster technique can occur quickly. Localized pressure from dents or careless padding can occlude firstly, the local veins and secondly, the arterioles. If the pressure is not released quickly vascular occlusion can lead to skin and nerve necrosis. These areas of skin slough will become painless within a few hours after the local sensory nerve endings have been desrtoyed. The resulting pressure sore develops rapidly, especially in the aged, malnourished or diabetic patient.

Therefore, a single definite area of pain or burning must always be investigated. It is better to cut several casts open and find nothing than to miss one area of localized pressure that will lead to pressure sores. One should remember the old axiom - "Never go to bed with a painful cast in the offering."

Several danger signals hearld the possibility of plaster complication. The physician should make nurses and patients themselves aware of the danger signals listed below --

1. Unabating pain.

2. A sensation of burning, numbness or parathesia.

3. Motor weakness which was not present before the casting.

4. Painful movements of the digits.

5. Painful edema peripheral to the cast.

These are <u>five danger signals</u> that signal plaster complication.

In the immediate post casting period, the nurses should check the injured extremity at least every fifteen minutes for the first four hours; every thirty minutes for the next four hours and then every hour for the next four hours. If any of the danger signals appear the surgeon who applied the cast <u>must</u> be notified. After six to seven hours and no danger signals have appeared it is usually safe to allow the nurses to check the cast every shift.

Physical examination of the patient in plaster should be organized and planned. If a regular routine is used each time a patient in plaster is examined the important findings will not be overlooked. In examining the patient the physician takes note of the following findings in a definite sequence. This sequence is as follows:

1. The <u>color</u> of the extremity.

2. <u>Temperature</u> of extremity.

3. <u>Vascular</u> return.

4. <u>Sensation</u> of the extremity.

5. <u>Swelling</u>.

6. Active <u>motion</u>.

The color of extremity distal to the cast should be the same as the other limb when placed in the same position. Slight cyanosis alone is not immediate indication for action but cause for a close watch, for evidence of venous congestion. If the color deepens and is accompanied by persistent pain or parathesia the pressure must be relieved. On the other hand, palor may be a sign of arterial insufficiency.

In addition to color the surgeon notes the temperature of the injured limb compared to normal side. The cool extremity may be due to the ice pack or may be further evidence of arterial insufficiency.

Next, the surgeon palpates for the peripheral pulses. In addition to the pulses, capillary circulation is checked by pressure on the nail bed. Refill of the nail bed should be prompt and similar to the uninjured limb.

Signs of vascular insufficiency are not "fool proof." On occasions, arterial insufficiency can exist in spite of a palpable pulse or adequate capillary refill in the nail bed. The converse can also exist. As a general rule, however, significant clinical vascular insufficiency will be accompanied by other danger signals such as unabating pain and pain with attempted digital motion. If there is any doubt as to the vascular adequacy of a limb, the cast should be opened and the situation checked.

Once the surgeon has assessed the circulatory dynamics by color, termperature, pulses and capillary refill, he checks the sensation of the extremity. He specifically asks the patient if there are any parasthesias or sensations of numbness. Using a pin or pen knife, a surgeon checks the automonous areas for specific nerve sensations. For example, the terminal sensory branch of the important and vulnerable perineal nerve supplies the web space between the great and 2nd toes dorsally. Loss of sensation in this area means the perineal nerve is in jeopardy and a foot drop may be in the making.

By the same token for an upper extremity cast, the autonomous zones of the ulnar, median and radial nerves are carefully tested. The most constant areas are the volar surface of the index finger, for checking the median nerve, the volar surface of the small finger for checking the ulnar nerve, the dorsal surface of the web space between the thumb and the index finger for the radial nerve. Fractures of the humeral shaft are frequently complicated by radial nerve injuries. Fractures around the elbow can injure any of the three nerves. Compression of the median nerve is a most common complication of fractures of the distal radius. It is important to record any nerve deposits before the cast is applied. If this is done one can differentiate numbness and other sensory changes prior to cast application from signs resulting from cast pressure.

Finally the surgeon notes the amount of edema present in the limb distal to the cast. There is a difference between physiologic and pathologic oedema. Mild edema is to be expected after injury to an extremity. But oedema should not be painful and should not be greater than plus 2. If the swelling seems to be increasing and is accompanied by pain or other dangerous signals such as paraesthesia or numbness, it is certainly a cause for concern. Furthermore, any cast should be split if the surgeon feels that sufficient edema is present or will develop to cause trouble.

Next the surgeon asks the patient to move his fingers or toes himself. Unless the patient has an injury to the foot or hand specifically eliminating motion he should have full active painless range of motion of the digits. Generally speaking, pain on motion means pathologic pressure and swelling that demands attention.

The order and completeness of the assessment of a patient in plaster is assured if the resident remembers the famous 5P's mnemonic,

P - Pain -

P - Pallor

P - Pulselessness

P - Paraesthesias

P - Paralysis

Any of these findings may not be diagnostic in itself, but when the clinical picture is assessed in the light of all 5 P's mistakes can be avoided.

In summary pressure sores, paralysis and the sequelae of eschemia which result from plaster technique are preventable. In the interest of good patient care, these complications should be reported when they occur, and a properly appointed committee should investigate any damage resulting from neglected cast care.

When a cast is to be split to relieve pressure, it must be done in the correct fashion. There are two basic principles to adhere to when splitting a cast:

1) First, the cast is split widely down two sides to the skin.

2) Second, the relief of pain must be immediate. If it is not, the whole plaster is removed and the underlying cause of pain is sought.

These two principles need enlargement. The whole cast is always split down two opposing sides. The sides chosen will depend on the type of motion which should be prevented. Once the plaster is split all padding down to the skin must be cut and the skin must be seen. To do this for a patient who may be in severe pain requires a gentle touch. Cutting the padding is facilitated by a double cut in the plaster removing a small strip of plaster a half an inch to 3/4 of an inch wide. In this way a trench is created through which the scissors can cut the padding easily. All padding down to the skin is cut so that the skin is seen in its entirety. The cast is spread widely to make absolutely sure there are no constricting wraps of sheet wadding or surgical dressing in the concavity of a joint or elsewhere which are causing pressure on vital soft tissues.

As the cast and underlying soft wrappings are cut and spread, the patient should give a great sigh of relief immediately. The severe pain should rapidly disappear.

It must be stressed that if the pain has not rapidly subsided by the time the dressings are loosened the half shell of the cast is removed the the whole limb is inspected. If the cause of the patient's pain is not evident, then immediate measures are instituted to identify the specific underlying problem.

If on the other hand all pressure is apparently relieved and the patient is comfortable, the plaster shell is then replaced. An attempt is made to smooth the underlying padding. The two halves are taped together and the extremity is elevated above the level of the chest. One must be aware that a slow abating pain which disappears slowly is not a sign of safety and this may be nerve death. Pain that is relieved quickly when the cast is split indicates that cause of the pain has been relieved.

The initial care of the injured extremity in plaster is rather simple in principle. Along with the careful observation which has been discussed, an injured extremity which has been placed in plaster should be elevated above the level of the heart for at least 24 hours. It should be suspended from a frame which will allow free circulation of air around the cast. This allows the cast to dry and permits air to get to the skin. A fresh cast should never be covered with bedding which cuts off air and slows drying. Elevation of a fresh cast on pillows, frames or cradles is probably best avoided. They are insecure and produce dents and impede free circulation of air around the cast.

EXERCISES

1. List on a sheet of paper the five danger signals that signal plaster complications.

2. List in definite order the six signs that you look for in proper sequence in examining the patient with a cast.

3. List the five Ps or mnemonic for remembering the five signs of eschemia.

4. Outline the steps to be used for cast removal and the check for eschemia when the cast should be replaced and when the cast should be removed completely.

5. This exercise should be performed after cast removal has been demonstrated to you by an instructor or you have completed the chapter on cast removal. You will place a long leg cast on your partner - have your instructor observe while you demonstrate the techniques of bivalving the cast, cutting the underlying padding to the skin, removing the shell, examining the skin and the extremity gently, replacing the shell after proper padding has been applied and taping it into place.

ANSWERS TO CHAPTER VI EXERCISES

1. The five danger signals heralding plaster complications are:

   (a) Unabating pain.
   (b) Parasthesia or sensation of burning or numbness mentioned by the patient.
   (c) Motor weakness in the digits not present before application of the cast.
   (d) Pain when the digits are passively or actively moved.
   (e) Painful edema distal to the cast.

2. The six signs one should look for in order are:

   (a) Color of the extremity.
   (b) Temperature of the extremity.
   (c) Vascular return (nail bed capillary filling).
   (d) Sensation of the extremity to pin prick.
   (e) Swelling (edema).
   (f) Impediment of active motion.

3. The five P's of ischemia are:

   P - Pain
   P - Pallor
   P - Pulselessness
   P - Paresthesia
   P - Paralysis

4. First bivalve (split the cast widely down both sides) and divide all padding. If the pain immediately subsides, replace the padded shell. If the pain persists or slowly disappears, examine every inch of the extremity in the cast until the source of pain is discovered. Apply a new cast.

   In either case, (replacing the plaster shell or new cast) elevate extremity for 24 hours and maintain close watch with 15 minute examination of the extremity for at least an hour; then at least every 30 minutes for at least two hours. If pain re-occurs, repeat splitting the cast and take other steps to immobilize the extremity such as cotton cast, etc. until pain and swelling subside.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

RESIDENTS' MANUAL

APPENDIX

Specific Cast Applications

The application of specific casts in the sound slide segment of this Psychomotor Skill Laboratory has been intentionally avoided. The reason for this is there is a great deal of variation in the details of application of specific casts. It is felt that confusion will occur if one method of applying specific casts is depicted in the slides or video tape. It is suggested that the individual programs instruct the residents in the specific details desired in the cast. However, in this portion of the manual we will describe for convenience sake one conventional method of applying the basic cast.

The Short Leg Cast

The Position of the Patient: The patient can be supine on the table with the uninvolved leg out to the side. A sling is put under the thigh just above the keee to hold the leg off the table twelve to eighteen inches. The assistant will grasp the foot with his thumb resting on the dorsal area between the first and second metatarsal heads and the fingers are applied to the sole of the foot. He stands on the same side of the table as the leg. He positions himself in a comfortable position so that he will not move and he will make sure he has control of the extremity and that he is out of the surgeon's way. If you do not have an assistant you can suspend the lower portion of the leg by the toes as has been demonstrated before. Another position that can be used is to have the patient sit on the table with his leg hanging over he side. The assistant sits in the chair and holds the foot as described above. His other hand is held up to the knee to control the whole leg. A third position which can be used is to have the patient lie prone on the table with his knee flexed 90 degrees. The assistant then holds the foot with one hand and the thigh with the other hand.

The Application of the Short Leg Cast

1. The stockinette is rolled on, it is cut to the proper length so that it comes well out over the toes and up to the level of the knee joint. This is so that it can be folded back to give a smooth edge to the plaster.

The assistant takes his position and gets comfortable so that he will not move. The stockinette is trimmed in front of the ankle as necessary to remove any wrinkles. The padding is then applied. One layer of 50% overlap of padding is applied well over the toes and up to the tibial tubicle. Pad evenly so that there is an equal amount of padding over the heel as there is over the front of the ankle. Piece padding for around the malleoli is put on if necessary. If the plaster bandage is started usually a six inch roll is used. A toe box may be used if desired. The plaster starts well over the toes and carry the plaster up evenly with a 50% overlap of each turn over the one before it and attempt to get one roll to go all the way up the leg. You should attempt to keep the plaster one half to one inch below the padding so as to allow a margin of padding to be folded over. Next, another roll is applied to go all the way from the toes to the top of the cast. You should constantly rub and mold the plaster with the thenar eminences. Now you may put on a four inch splint, five to eight inches thickness up the back of the leg and rub this in well. Finally, a finishing roll of six inch plaster is applied and is rubbed in well. When initial drying is taking place the top of the foot is cut out with a plaster knife so as to allow freedom to the top of the toes. The stockinette is folded back and locked into place with a splint of a single thickness at the top and bottom edges of the cast. The front of the cast is labeled. There are several important points to this cast. They are as follows:

a) The toes are supported by the cast.

b) The heel is properly padded.

c) The malleoli are properly padded.

d) The perennial nerve at the proximal fibula is properly padded.

e) The ham string tendons should be free in back of the leg so that there is no rubbing from the cast.

f) The ankle should be in the correct position which is usually at right angles to the leg.

g) The cast should be properly molded so that the outline of the foot and ankle is apparent including the transverse metacarpal arch.

In some programs the use of splints will be eliminated. In other programs, the use of the,I beam on the angular surface may be used. In other programs the cast will be cut shorter ending at the metatarsal arch and not extending the full length of the toes. These are individual points which will be taught by your instructor.

The Long Leg Cast

The Position of the Patient: There are basically two positions to apply a long leg cast.

1. It can be applied with a short leg cast allowing it to dry and then apply the long leg portion of the cast with the leg held in desired position, either by an assistant or by a suspension system. This is the way it was demonstrated in the video tape. There are several places where this technique of applying a cast in two parts can be used, such as in surgery after an operation, such as a triple arthrodesis or in the emergency room when no help is available and it is difficult to position the patient. In this fashion the upper part of the cast is applied after the short leg portion is allowed to dry. A long leg cast put on in this fashion has a disadvantage in that it is basically weak at the junction between the two sections. The long leg cast can also be applied easily and safely in one piece by suspending the leg as has been demonstrated earlier. The other leg is suspended behind the calf where necessary. The foot can be held by an assistant or if none is available it can be suspended by various means including traps or gauze around the foot. The lower portion of the long cast is applied in a similar manner as the short leg cast in relationship to the foot and heel. The stockinette has been rolled out and is carried up the thigh, not too high in the groin area, of course. The sheet wadding is then applied in a routine fashion. Piece padding is then placed around the patella as necessary. The plaster is now apllied in a routine manner and care is taken to keep the plaster away from the suspension system so that it can be removed later without difficulty. Splints are locked into place by plaster rolls. Once the plaster has been applied the stockinette is then rolled back over and splinted in place. The cast is allowed to set up well before it is cut loose. Once the cast is cut down and is reinforced in the areas where

it was suspended, again the cast is sized.

The follow up of the important parts of this cast:

1. The foot is molded well including the transverse metatarpal arch.

2. The toes are down in slight flexion.

3. No plaster should touch the skin.

4. The cast is well molded to the contour of the leg. Usually there is a slight bend at the knee.

5.. The patella mechanism is outlined well in the molding.

6. The cast comes up high to catch the bulk of thigh muscles and to encase them.

If a walker is to be applied to the cast, this is applied by folding plaster splints so as to make a thickness of ten to twelve sheets thick. This is applied to the plantar surface of the foot. The rubber foot piece is positioned properly to be in line with the leg for equal weight bearing. A four inch roll of plaster is used to entwine and wrap in the figure of eight fashion around the foot piece. A splint is then taken to close the gaps that arise between the foot plate and the plaster. The important point here is that the foot piece be well seated and imbedded in plaster so as not to move or rock. This foot piece can be applied to other short leg or long leg cast as needed.

<u>The Short Arm Cast Position</u>

The patient is usually placed in a supine position with the arm abducted 90 degrees while the assistant holds the thumb and forefingers maintaining a web space between the index and thumb. Stockinette is then rolled on and it should extend from just distal to the M P joints to just proximal to the flex crease at the elbow. A whole is cut for the thumb.

A one inch roll of sheet wadding or padding is used in the hand and wrist area since the plaster will extend only to the distal palmar crease the sheet wadding should start slightly distal to this line of padding. To get good padding in the space between the index finger and the thumb the padding can be carried around the thumb and is cut out later. Above the level of the wrist a two inch roll of padding is used.

The size of the plaster roll to be used will depend on what the operator is most comfortable with, and will depend on the size of the patient. Generally, a four inch roll of plaster is easiest to control.

The starting edge is applied in the palm. Here it is permissible to crimp or push together the plaster to conform to the palm. The roll is carried up the forearm in the usual fashion and on the volar surface of the forearm the plaster stops about one inch distal to the flex increase of the elbow to allow the full excursion of the biceps tendon on the sides of the elbow medially and laterally. Plaster can be carried more proximal to cut down on the forearm rotation if it's desired.

After the roll of plaster has been applied two - three inch splints, five to eight thicknesses thick can be applied volar ward and dorsally to give the cast strength. These splints are then locked in with an additional four inch plaster roll.

The plaster is carefully molded around the wrist to place the wrist in the desired position, usually in the position of function with the hand in slight extension or any other desired position. The forearm area of the cast is also carefully molded to fit into a flattened oval shape as seen on cross section as is the anatomy of the forearm.

After the plaster has set up the cast is carefully trimmed out around the thumb to give full excursion of this digit. No pressure should be exerted on the thenar eminence. After the trimming has been completed, the sheet wadding or padding and stockinette are folded back and locked in place by single thickness splint.

<u>The Long Arm Cast Position</u>

The patient usually lies supine with the shoulders of the involved side over the edge of the table. If swelling is not anticipated, stockinette is used. Otherwise it may be contra-indicated and sheet wadding alone used.

There are several methods for suspending the hand. There are commercial finger traps available which can be used or as demonstrated before one inch gauze finger traps or tape can be used. We will describe the use of the gauze finger trap.

If stockinette is to be used it is rolled up and threaded on a gauze suspension line that is dropped down from an overhead bar or light or I.V. pole. The gauze finger traps are then tied in to the two inch overhead gauze line. The apparatus should be at such a length as to give 90 degree flexion at the elbow or whatever desired degree of flexion is desired.

For counter traction a piece of felt, three-eighths inch thick - two inch wide and about 12 inches long is fashioned. A small whole is cut through the felt at either end. The felt is then placed over the arm about mid-humerous level. A spreader bar is then put in place and from this appropriate weights can be hung for counter traction.

This apparatus can stand as long as is necessary to gain reduction of the forearm fracture and the bones can be manipulated in this position.

Once the casting is to begin a piece of wood can be placed between the gauze suspension lines to the index finger and thumb to increase the distance of this web space. A change in proination and supination of the forearm can be gained by moving the position of the cast in relation to the suspension or by having an assistant twist the lines.

Once the cast is begun the stockinette which was threaded up the gauze line can be dropped down onto the hand after the thumb is cut loose. It is then rolled up and cut out as necessary, at the flex or crease of the elbow.

One inch sheet wadding is used to pad the hand and the wrist. Two inch sheet wadding is used the rest of the way and overlapped carefully at the elbow. Piece padding is used at the humeral prominences and around the olecranon as necessary. It is also used at "Lister's tubercle" and at the ulnar styloid if desired.

The sheet wadding is carried up the humerus as high as possible. If the counter traction device can be removed, it's done at this time and the padding and casting are done as one separate piece.

If the situation is an unstable fracture it may be advised to put the cast on in two pieces and to remove the counter traction device only after the short arm section of the cast has been applied. As for the plaster application, the hand area can be plastered in a fashion similar to that discussed in the short arm cast. In fractures of both bones f the forearm where some swelling is anticipated, it is usually helpful to apply the intiial cast(with padding) well out to the fingers for the first forty-eight hours. This helps prevent edema of the M P joint area in the fingers in the first twenty-four hours. The cast is then trimmed back to the desired level forty-eight hours post injury.

The plaster is carried up the forearm, the elbow is carefully included, and the bandages rolled so as to center it over the flex or crease of the elbow. The cast is carried up high so that it has a snug grasp on the muscle belly of the biceps muscle, such as in the short leg cast.

PSYCHOMOTOR SKILLS PLASTER LABORATORY

CHAPTER VII - RESIDENTS' MANUAL

Removal of the Cast

The objectives of this chapter are as follows:

1. You will be able to remove the cast using the Stryker saw properly.

2. You will be able to remove a cast using the Stille cast cutter in the proper fashion.

3. You will be able to explain how the Stryker saw functions and is used to cut the cast safely and explain how the patient is prevented from being cut.

4. You will be able to list the major dangers of the Stille cast cutter.

5. You will be able to explain how you would remove a cast from a two year old child who would not allow you to use any instrument.

6. You will be able to explain the proper care for the skin after cast removal.

7. You will be able to list at least two ways to cope with lower extremity oedema after a cast is removed.

There are several methods of removing a cast. The most popular and fastest instrument for cast removal is the Stryker electric oscillating cast cutter. The Stryker cast cutter is safe when used properly. When used improperly, it can cut the skin under the cast leaving permanent scarring. The blade oscillates - it does not turn; thus it decreases the likelihood of skin laceration.

Since the cast saw is noisy and looks rather vicious, the principle of the saw should be explained to the patient before cutting the cast. The patient is told although the saw is noisy, that it will not cut him and in fact does not turn. He is assured that is unlikely he will feel anything. As proof of its safety the saw blade can be rubbed across the surgeon's palm while the saw is on. This shows the patient that under normal circumstances the blade will not cut. The patient is told not to move or try to jerk away as this can cause problems. (Demonstrated to yourself the cast saw may cut. You can do this by placing it against a piece of wood.) The patient is assured he may feel a warm or even a tickling sensation during the procedure. As long as he does not move it will not harm him. If the patient is too aprehensive a tongue depresser can be slipped under the cast so the patient knows for sure he cannot be cut.

The Stryker cast cutter is held with its head grasped firmly between the thumb and index finger. The thumb serves as a guide to prevent the blade from cutting too deeply. When cutting the cast the blade is applied to the cast with very gentle pressure. The saw will do the work. As the saw cuts down to the cast, the thumb rest against the plaster. The initial feeling is firm resistance from the plaster. As the saw cuts down, suddenly the resistance gives way. The saw is then through the under surface of the plaster at this point. It is then lifted out through the track and advanced about one third the diameter of its blade. It is applied to the plaster again. Very slight downward pressure is applied. The feeling of resistance disappears again. The blade is lifted and quickly advanced once more. when the blade is left near the skin too long it creates a feeling of heat or burning.

Thus the cast is cut by series of advancing small cuts. The cast is never split by cutting down on the plaster and pulling the blade through the cast. The patient surely will be cut this way because the underlying surface of the cast has hills and valleys. Moreover, the plaster wall is not necessarily uniform in its thickness throughout. With experience you will become adept in feeling this saw "fall through" the inner wall of the plaster and moving quickly to the next small cut.

Successful use of the cast cutter demands a sharp blade and the blade to be replaced frequently. Therefore, it is very useful to know how to change the blade. The blade is easily replaced in the following manner: First remove the outside hexagonal nut with a wrench which has been provided with the cutter. Next you remove the washer. Then the collar which is indented to fit the projecting key on the shoulder of the shaft is removed. Next, remove the blade and slide on the new blade and note that the notches on the blade fit over the projecting key on the shoulder of the shaft. Then replace the washer putting the recessed side of the washer against the blade so that the recesses set against the projecting key of the shaft. Now apply the washer and finally the nut is replaced and tightened down with the wrench.

In certain specific cases the use of the Stryker cast cutter is not appropriate. Other methods of removal must be employed. The Stille cast cutter can be used. This instrument is grasped by the handles and the jaws are opened. The bottom blade is then carefully slid under the plaster and the handles are closed. A bite of plaster is taken. This bite is removed and the cast cutter is pushed into place again. It is advanced to take another bite. <u>Care must be taken in using this cutter since it is possible to pinch the skin which may be adhered to the stockinette or underlying sheet wadding. This is the major danger of this instrument</u>.

For use on small casts, such as club foot casts an alternative to the Stille cast cutter is the pair of plier cutters. The points of these pliers are bevelled so that they can easily slide under the cast. Bites are taken in a manner similar to the Stille cutter.

A third method of removing plaster is to soak the cast in water to soften the plaster. It then can be removed with a knife or unwound winding by winding "in toto". With many small children this is probably the easiest way, with less fuss to remove a cast.

While discussing the removal of casts, a word about bivalving a cast is in order. If a limb is not to be removed from the posterior shell of a cast which has been split, the padding should be cut down the front and not the sides. This padding can be pulled back and pinned into place as a lining for the half shell. The edges of the posterior shell should be bevelled or bent back so that there are no sharp points digging into the patient's skin. Lambs wool, moleskin or stockinette can be placed in this posterior shell to give it an extra layer of padding.

When removing any cast it is important that the patient be made comfortable and that the part is supported. Sudden loss of support of an injured extremity which is just coming out of the cast is painful and quite frightening for the patient. Consequently, as the cast is being cut it should be well supported on a table so that no sudden movements are possible. Your patients will appreciate this and you will gain greater respect from them.

Once the cast has been split the arm or leg is never suddenly lifted out of the plaster by grasping the fingers or toes. Furthermore, when the extremity first comes out of the plaster, it must be handled <u>very gently</u>. An extremity which has been immobilized for any period of time will be painful if sudden changes in the position of the limb are attempted. When lifting the extremity out of the half shell of plaster the limb should be supported on both sides of the immobilized joint. It should be carefully lifted out and examined.

Care of the patient and his extremity after removal of the cast is very important. You will note the skin on the involved extremity is usually caked with exudate of sebaceous material and dead epithelial cells. There are two "schools of thought" concerning the management of the skin. One "school" suggests that this material be scrubbed off with phisohex or betadine. The other "school" believes that this material and dead skin has the function of a protective mechanism. They suggest removing it by general soaking over a few days time. The use of phisohex or betadine scrubs is probably safe as long as it not painful to the paitent.

With the cast off, the skin is best lubricated with or without its covering of sebaceous material. This lubrication can be done with a lanolin solution, cocoa butter or A & D ointment or some other emollient. The limb should be supported either with Ace wrap or appropriate soft cotton wrap for the first few days. Warm soaks in water can then be ordered as necessary.

The patient should be warned that immobilized joints will be stiff for a period of time. Parents of small children should be specifically warned not to force a child to move his extremity too vigorously. Children seldom ever need formalized physical therapy and usually are capable of working out their joint problems quite well by themselves.

Swelling of the involved extremity is common after the removal of a cast. This is especially true in injuries of the lower extremity. Elevation of the limb higher than heart level at night and at intervals during the day is usually the only measure required for this.

The leg which is recently been removed from plaster should be dependent only when walking. The patient should be warned to keep it elevated if possible at other times. Encourage the patient to walk since intermittent weight bearing is a good venous pump. The patient should be told that tendency to swell will lessen as time goes on.

The use of "Ace" elastic bandages after the immobilization of the extremity is a debatable point in some programs. If they are used they should be used only during the day time and should be removed at night. Ace bandages should be taken off and rewrapped several times a day. This prevents them from becoming constrictive, because if they are not rewrapped they will slide down, bunch and act as a tourniquet. You should instruct your patients in the proper way to figure of eight wrap the Ace bandage.

The use of support stockings for a long term is probably a better means of preventing edema. However, the patient should be measured for these and they are a greater cost for the patient.

EXERCISES

1. List two ways to cope with lower extremity edema after cast removal.

2. Explain how you will care for the skin after the cast is removed. What will your instructions be to the patient.

3. You have a two year old child in the clinic. As you attempt to remove the case he screams and puts up a fuss. You substitute the Stille cast cutter and he continues to fuss. You substitute the plier cutters and he continues to scream. How will you remove the cast from this two year old child - explain.

4. What is the chief danger of the Stille cast cutter.

5. Explain how the Stryker saw is used to cut the cast safely. What prevents the patient from being cut.

6. You will need a partner for this. Place a lower and upper extremity cast on your partner. With instructor, have him observe you. Demonstrate how to remove one cast with a Stille cast cutter, the other cast with the Stryker cast cutter.

ANSWERS TO CHAPTER VII EXERCISES

1. One - Support hose or elastic wraps during the day and elevation at night.

   Two - Gentle walking to encourage muscle milking action to remove edema fluid back to general circulation.

2. Depending on your philosophy, either scrub the sebaceous exudate away with soap, or gentle warm water soaks for a few days. Apply lanolin oils.

3. Have child soak cast in warm water for one to two hours under nurse's or assistant's direction. Then when you see the patient unwind the plaster.

4. Pinching or cutting the patient's skin if it has adhered to the stockinette or padding.

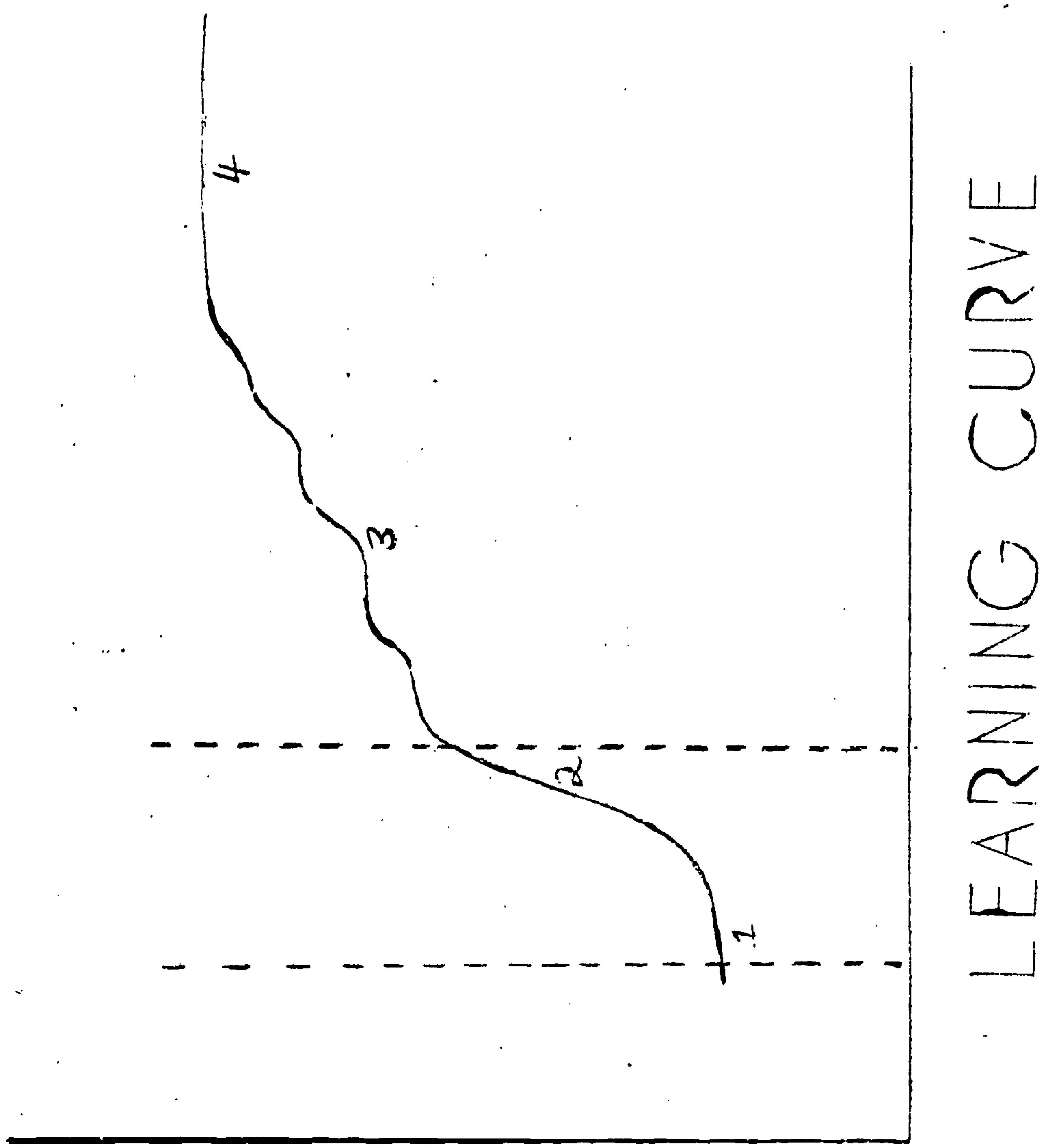
5. Advancing small cuts, one third the diameter of the blade, using your thumb to prevent the blade from going to deeply when it "falls through".

   The patient is prevented from being cut by:

   (a) Warning him not to jump.

   (() Cutting the cast in small vertical cuts, never pulling the blade horizontally through the plaster.

Appendix I - A



ORTHOPAEDIC TRACTION SKILLS LABORATORY

MANUAL

ORTHOPAEDIC TRACTION SKILLS LABORATORY

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ORTHOPAEDIC TRACTION SKILLS LABORATORY

Instructor's Manual

INTRODUCTION

Part I

The Orthopaedic Traction Skills Laboratory has been produced to aid the orthopaedic resident and other interested personnel in developing the psychomotor skills involved in applying traction to a patient. A motor skill is a series of integrated motions designed to reach a previously defined objective. Athletics and industrial engineers have studied the components of various motor skills in order to analyze and perfect their development. The professional football player and the golfer have analyzed the components of effective blocking and golf swings and then have put this information to use in improving their games.

We propose to use this concept to assist the orthopaedic resident in developing his orthopaedic traction skills and to help him understand the basic components of those skills. Educational psychologists have identified a "learning curve" on which the beginner, after his first ineffective efforts, improves very rapidly in his skill for a period of time before starting to level off in rate of improvement. By providing the traction student who has some basic concepts, and then asking him to perform exercises which require skills which closely imitate those required for effective actual performance, he can best utilize the early rapid learning phase of this learning curve. In a laboratory situation away from the pressure of an actual patient lying in pain on a stretcher, he can learn the basic concepts and components of traction and he can develop these into the skill necessary to actually apply the traction. The skills laboratory provides a setting for this initial learning and practice. He can then continue to perfect that skill in applying traction through the remainder of his residency and practice as an orthopaedist.

The skills laboratory has a performance rather than subject matter orientation. The subject matter included in the Resident's Manual, Section I, is provided to influence the traction student's subsequent performance in the laboratory. The laboratory has been constructed so that the resident can learn as much as possible without the actual presence of an instructor. He can work at his own convenience and set his own pace of learning. Having done some initial work on his own, he should be able to make maximum use of the instructor's time when the instructor is in the laboratory.

Part II

The format of the orthopaedic traction skills laboratory is listed below:

1. The Resident's Manual also starts with an Introduction to the traction skills laboratory. The goals of the course are listed. Sections dealing with the objectives and limitations of traction, the principles of traction and counter traction then follow. The traction equipment is described and the sequence of setting up the traction is suggested. Following this the various traction devices are described, the clinical use of each is listed as are the advantages and disadvantages. Sites for insertion of skeletal traction devices are listed. Steps in application of the various encircling skin and skeletal traction devices are also discussed. Then follows a section dealing with the care of the patient in traction.

2. A laboratory should be available in which the traction student can become familiar with the traction equipment and practice applying the various types of traction.

3. When the resident feels prepared to demonstrate his traction technique, this should be assessed by the instructor. To complete the traction skills laboratory, the resident should be able to demonstrate that he has accomplished each of the goals listed in Section II of the Student's Manual. A pre- and post-test are desirable but not mandatory because it is the development of the skill that is more important. Should a written pre- and post-test be given, suggestions for questions to ask the student can be found in Goals for Improving Traction Skills in Part II of the Resident's Manual.

4. Self-assessment by the student is extremely important. He should be encouraged to frequently review the goals for improving his traction skills. He should also be encouraged to refer to the traction books and articles listed in the Bibliography.

Part III

General comments to the instructor:

1. It is desirable for the instructor to be present when the residents are introduced to the laboratory. Your general comments at this time, as to the location of materials and equipment, are helpful. You should encourage the residents to strive to attain the goals listed in Part II of the Resident's Manual.

2. If you are in the laboratory with the residents, you should be a silent observer most of the time. This is the resident's learning experience, not your teaching experience. The resident will eventually be more aggressive and confident of his skills if he does not have to rely on you to answer all of his questions regarding traction.

3. A post-test may be given, but is optional. The performance, rather than the subject matter, should be stressed. The resident's performance can be assessed by having him adjust or modify incorrectly applied traction, or by describing adjustments and modifications of photographic slides of incorrectly applied traction.

4. I strongly advise you, the instructor, to read both the Resident's Manual and the Laboratory Manual. Your residents will soon understand the concepts of traction. Review your own traction skills.

ORTHOPAEDIC TRACTION SKILLS LABORATORY

Resident's Manual

I. INTRODUCTION
TO THE ORTHOPAEDIC TRACTION SKILLS LABORATORY

The Orthopaedic Traction Skills Laboratory has been produced to aid you in developing the psychomotor skills involved in applying traction to a patient. A psychomotor skill is a series of integrated motions designed to accomplish a previously defined objective. Athletes and industrial engineers have studied the components of various psychomotor skills, in order to analyze and perfect their development. The football player analyses the components of effective blocking, and the golfer analyses the components of his golf swing, and each combines these components to improve his skill. You will develop your orthopaedic traction skills in a similar way.

The Orthopaedic Traction Skills Laboratory has a performance rather than a subject matter orientation. The subject matter included in this manual is placed here to influence your performance in the traction skills laboratory. In a laboratory situation, away from the pressure of an actual patient, who is lying in pain on a stretcher, you can more easily learn and develop the basic traction concepts and skill, which you can then perfect in clinical situations through the remainder of your residency and practice as an orthopaedist. The laboratory is designed so that you can learn as much as possible without the presence of an instructor. You can work at your own convenience, and set your own pace of learning.

The format of the Orthopaedic Traction Skills Laboratory is listed below:

1. The Resident's Manual is designed to introduce you to traction concepts, and to traction skills. The goals you should strive to attain are listed in Part II, and you should refer to that part of the student manual frequently as you complete other parts of the manual. The next parts of the manual deal with the objectives and limitations of traction, and the principles of traction and counter-traction. The traction equipment is then described, and a sequence for setting up traction is suggested. Then the various types of encircling, skin, and skeletal traction devices are described. The clinical use of each is listed, as are the advantages and disadvantages of the use of each. The application of each type of encircling, skin, and

skeletal traction devide is described, and tips and precautions are listed. The care of the patient in traction is then discussed.

2. In the laboratory, you can become familiar with the traction equipment, and you can practice applying the various types of traction. A number of color slides are at your disposal to use as you read the manual, and you should refer to these at the appropriately marked places in the manual. You should also refer to the traction books and articles listed in the Bibliography, and the anatomy book, when necessary.

3. Your self-assessment is extremely important. Be critical of your limited knowledge of traction, and poor traction skills. Re-reading of pertinent parts of the manual, and practice applying the various types of traction, will eventually improve your traction skills, and your confidence in your traction skills.

II. GOALS FOR IMPROVING TRACTION SKILLS

Upon completion of the traction skills laboratory, you will be able to demonstrate your skills in the following ways:

1. You will be able to identify the three principles of traction involved in managing fractures.

2. You will be able to identify the objectives of traction.

3. You will be able to identify the advantages and disadvantages of traction.

4. You will be able to identify by name and function all the commonly used traction devices.

5. You will be able to identify the clinical situations in which skin traction is applicable and you will be able to:

   a. Select and identify the materials and traction devices necessary for application of skin traction.
   b. Prepare the skin for application of skin traction.
   c. Apply skin traction in the proper manner.
   d. Recognize the potential complications of skin traction and formulate approaches to their prevention and management.
   e. Recognize the clinical situations in which skin traction has relative contra-indications.

6. You will be able to recognize the clinical situations in which skeletal traction is applicable and you will be able to:

   a. Identify by name and use the components of the complete traction pin tray, and of a local anesthetic tray, and be able to recognize if essential components of these trays are missing before starting a procedure.

   b. Select and identify materials and tractiondevices necessary for application of skeletal traction.

   c. Prepare the skin for insertion of a skeletal traction device.

GOALS - Continued

6. d. Select the proper location for, and then insert appropriate skeletal traction devices at the following sites:

   (1) Proximal ulna.
   (2) Distal radius and ulna.
   (3) Metacarpals.
   (4) Proximal femur.
   (5) Distal femur.
   (6) Proximal tibia.
   (7) Distal tibia and fibula.
   (8) Calcaneous.
   (9) Skull.

   e. Describe the potential complications of improper site selection at each of the above locations.

   f. Demonstrate the essential components of proper skeletal traction device care including the proper removal of the devices.

   g. Recognize the potential general complications which may be associated with skeletal traction devices and outline the proper management of these complications.

   h. Recognize the clinical situations in which skeletal traction has relative contra-indications.

7. You will be able to identify, recognize the usual indications for, and apply the following types of traction devices:

   a. <u>Encircling traction devices</u>.

   (1) Traction splint and anklet.
   (2) Pelvic traction belt.
   (3) Pelvic sling.
   (4) Head halter.

   b. <u>Skin traction devices</u>.

   (1) <u>Buck's</u> traction.
   (2) <u>Russell's</u> traction.
   (3) "Split" <u>Russell's</u> traction.
   (4) <u>Bryant's</u> traction.
   (5) Dunlop's traction.

7. c. Skeletal traction devices.

(1) Proximal ulnar pin traction.
(2) Lateral proximal femoral pin traction.
(3) "90-90" traction.
(4) Balanced suspension
(5) Crutchfield Tong skull traction
(6) "Halo" skull traction.

8. You will be able to recognize physical factors, such as, muscle action, ligamentous laxity, fracture type and soft tissue injury which require traction adjustment or modification.

9. You will be able to formulate instructions which are to be given to the following personnel to help with care of the patient in traction.

a. Nurses and aides.
b. Physical therapists.
c. X-ray technicians.

10. You will be able to formulate instructions for the patient in traction.

11. You will develop a rehabilitation program for the patient to follow while he is in traction.

III. THE OBJECTIVES AND LIMITATIONS OF TRACTION

The first crude traction device was used to treat a femoral shaft fracture in the 14th Century. Since that time traction has been used to treat fractures not only of the femur, but of other long bones of the extremities and other fractures of the axial skeleton. Most fractures of the extremities were first treated by manipulation of the fracture and then splinting plus traction, holding the extremity in complete extension. In the 19th Century major advances were made in the treatment of fractures. Hamilton's fracture tables, first published in the 1850's, stimulated that generation of orthopedic surgeons to find better ways of applying traction. About this time, there was a change from treating extremity fractures in complete extension, to one of placing the extremity in the position in which the muscles were most relaxed. Skin traction was first used by [illegible] in 1850, however, Buck popularized the use of skin traction in the 1860's and his name is usually mentioned regarding the use of skin traction in the lower extremity. [illegible] traction was developed and first described in the 1870's. Russell described further modifications with the use of extra pulleys and an upper calf sling in 1921. Wilhelm Conrad Roentgen's article "On A New Kind of Ray," published in 1895, stimulated another generation of young orthopaedic surgeons to find better ways of applying traction for treatment of fractures. Shortly after the use of the x-ray had been popularized, it was found that 100% of 115 fractures of the femoral shaft treated with manipulation and straight Buck's extension traction gave unsatisfactory results. In a search for more effective methods of traction, skeletal traction was popularized. A form of skeletal traction was first used in 1847 by a Malgaigne, who used compression hooks for treatment of patella fractures. Fritz Steinmann in 1907 described the use of skeletal pin fixation. In 1909 Martin Kirschner introduced the use of Kirschner wire skeletal traction. A satisfactory tension bow was developed for the wire in 1927. Fractures are presently treated by one of the five following methods:

1. By the use of a sling, or sling and swath, for treatment of undisplaced fractures or certain fractures especially about the shoulder.

2. Closed reduction and cast immobilization.

3. Closed reduction with the use of external pin fixation to maintain that reduction with or without the use of a cast also.

OBJECTIVES - Continued

4. Closed manipulative reduction plus continuous balance traction.

5. Open reduction of the fracture with or without internal fixation.

Continuous balanced traction is used to treat other conditions besides fractures also. These include degenerative disc disease, both of cervical and lumbar spine; contractures, such as, in rheumatoid arthritis, scoliosis, and congenital hip dislocation. The objectives of traction can thus be listed:

1. In fracture treatment, traction forces may be applied to extremities or to the axial skeleton to bring the fracture fragments into alignment and to maintain that alignment until there is union of the fracture.

2. Traction may be used to distract or immobilize diseased or injured joints of the axial skeleton.

3. Traction may be used to immobilize or limit motion of a joint or extremity after surgery.

4. Traction may be used to allow greater joint motion and more use of surrounding muscles than would be possible with plaster cast immobilization.

The advantages of the use of traction for treatment of fractures are:

1. The avoidance of potential surgical infection.

2. The avoidance of potential surgical devascularization of the bone.

3. The greater potential for maintenance of joint motion and for muscle exercising than is afforded by a plaster cast.

The prime disadvantages and limitations of traction are:

1. Prolonged recumbency is necessary.

   a. Extra hospitalization cost.

OBJECTIVES - Continued

1. b. Increased frequency of skin pressure sores, especially sacral, and possible increased frequency of thrombophlebitis.

2. The condition of the skin and the tolerance of the skin to skin traction.

3. A shorter period of time and smaller amount of traction force can be used with skin traction than with skeletal traction.

4. The potential for development of infection at the traction pin site or of migration of the pin.

5. The limitation by development of pain or [illegible] abnormal symptoms and signs when traction [illegible] stretch contracted joints and to length[illegible] the treatment of scoliosis.

IV. PRINCIPLES OF TRAC[illegible]
IN [illegible]

In many fractures, traction is used to align the fracture fragments and to maintain the alignment of these fracture fragments until union occurs. There are three primary principles which must be observed.

1. Traction is used to [illegible] the fracture [illegible] into alignment. [illegible] fracture. [illegible]

2. [illegible]

3. [illegible] force is required [illegible]. These forces should remain constant in terms of the amount of force and the direction of force applied. It is best to apply the maximum amount of traction force when the traction is initially applied. This force may ordinarily be reduced as soon as the fragments come into a proper alignment. If the traction forces do not remain constant, both in amount and in direction, the fracture may lose its reduction and heal in a position of mal-alignment or may go on to delayed union or non-union.

Traction forces pull against three major forces: body weight, friction of the body surface against the bed, and intrinsic muscle contraction. The traction forces can be made more efficient if the traction pulls in a straight line with the axis of the fractured extremity. This can be more easily achieved by providing a firm surface on which the patient lies. Bed boards are commonly used to eliminate the sag in the mattress, thus making the traction more efficient. When light weights are used for the traction force, the patient's body weight plus the friction of the body surface against the bed is usually adequate in providing counter-traction. Larger traction forces, however, often pull the patient towards the fracture force and, therefore, it is often necessary to elevate the foot or side of the bed to increase the counter-traction. Migration of the patient toward the traction force can also be

V. THE TRACTION EQUIPMENT

A. The bed. The hospital bed should be one that is well-built and should be adjustable to positions of comfort for the patient. The bed legs should have casters so that the patient can be wheeled on the bed to an elevator to go to x-ray or to the operating room. The mattress that is chosen should be of the best construction, inner spring mattresses are preferable in that they are firmer and more comfortable than are rubber, cotton, horsehair or other type mattresses. Split or divided mattresses have a definite use especially if the patient is extremely obese or has multiple injuries that make movement in bed very difficult. Frequently getting the patient on or off the bed pan becomes a real problem. This is especially true in patients who have fractures of the pelvis. By sliding that one segment of the mattress from beneath the patient, the bed pan can be handled with minimal effort by the nurses and orderlies, and there is minimal discomfort to the patient. A few mattresses of this type could be kept in reserve in hospitals for use with obese or multiply-injured patients.

B. Equipment attached to or placed on the bed. A variety of traction equipment is available to attach to or place on the bed.

1. The Bradford frame. The Bradford frame is similar to a cot in construction. Single or multiple segments of canvass are connected between the two long metal poles. The frame is elevated several inches above the mattress of the bed and the patient lies on this frame. It can be used in place of the split-mattresses mentioned above with obese or the multiply-injured patient and it is frequently used for the treatment of children's fractures. It is easy to attach a posey, or vest-type, belt about the child and about the frame to help maintain traction alignment.

2. Bed boards. Bed boards are very important in maintaining efficient traction. They are used to eliminate the sag in the mattress. They are not large and cumbersome pieces of plywood or fiber board, but are slats of wood, 3/4 inch thick by 10 inches wide by as long as the width of the mattress. They are arranged parallel and close together between the mattress and springs and should not interfere with the cranking up of the back rest or knee rest.

Traction Equipment (Cont'd)

3. Shock blocks. Shock blocks are wood or metal blocks approximately 6 to 10 inches in height. They are frequently placed under the fasteners of the foot or the side of the bed to improve counter traction.

4. The overhead frame. The overhead frame should be of tubular metal construction, the octagonal tubular aluminum construction being recommended over the round tubular construction. Frames are of varying construction some fitting into the four corners of the bed, others attaching to the head and foot of the bed and others being designed for specific types of traction application, such as, for side arm traction, or for Buck's traction to the lower extremity. Pictures of the various frames can be found in instrument company traction equipment handbooks or in the books listed in the bibliography. You may refer to these references at this time.

5. Traction components attaching to the bed or to the frame. These include, bars, bars with clamps, clamps, IV bars, pulley bars, pulleys with clamps and the trapeze. For further information reference can be made at this time to the instrument company traction handbooks or to one of the books listed in the bibliography.

6. The Bohler-Braun Frame. An overhead frame is not required when the Bohler-Braun Frame is used to apply longitudinal traction to the leg or the knee bent. This may be used with skin traction but usually it's used with skeletal traction.

C. Equipment attached to or around the patient. Equipment attached to or around the patient include:

1. Skin traction (This will be described in another section)
2. Skeletal traction (This will be described in another section)
3. Slings, traction belts and head halters (refer to Section VII, Encircling Traction Devices.
4. Traction Splints. The most commonly used are the Thomas Splint, which has a proximal full ring and the Kellar-Blake type, which is a reversible half ring traction splint. These splints may be combined with skin traction, skeletal traction, or an encircling device such as an anklet. (Refer to Section VII Encircling Traction Devices)
5. Attachments to the traction splint. These include:
   a. The Pearson Attachment. The Pearson attachment is used to control the amount of flexion in any joint in treatment of fractures of the femur or fractures about the knee.

It can be adjusted in a fixed position or applied and attached to ropes that will allow the knee to be exercised.

b. Hand towels. Hand towels are attached to the counter splint or Kirschner attachment or other type splint to allow the leg and thigh to lie on a smooth even surface. Large safety pins or large towel clips may be used to fix the towels to the splint or attachment.

D. The Slip Knot. The application of orthopaedic traction requires the knowledge of how to tie a knot. The knot most commonly used is the slip knot. It is a very elementary form of knot, is efficient and will not loosen regardless of how much weight is applied to the traction. If you do not know how to tie a slip knot, see the description on the inside of the back cover of the Zimmer Traction Handbook or on page 5 of the book entitled, "A Clinical Manual of Orthopaedic Traction Techniques" by Schmeisser. The essential steps in tying the slip knot are: 1) up and over, 2) down and over, 3) up and through. After the knot is tied a small piece of adhesive tape may be used to hold the short end of the rope parallel to the long axis of the main strand of the rope in order to eliminate a lot of dangling rope ends. A piece of tape one inch in width and 1½ to 2" in length in perferred, ¼ to ½ inch is folded over so that there is a smooth surface of adhesive on both sides and then the remainder adhesive is wrapped around the ropes. To remove the adhesive is very simple to grasp, the folded back portion and then unwind the tape easily. Adjustments can be made through the traction in this manner and the tape can then be reapplied.

VI. ENCIRCLING TRACTION DEVICES

A. Clinical Use. An encircling device is frequently used instead of skin or skeletal traction to obtain traction on a part of the body. Examples of such encircling devices are the traction splint and anklet, the pelvic traction belt, the pelvic sling and the head halter. They are used to apply light or imminent traction.

B. Advantages. There are several advantages of using an encircling traction device.
   1. They are usually easier and quicker to apply than is skin or skeletal traction.
   2. The patient may learn to apply the traction device himself.
   3. Since they are often used imminently, nursing care of the patient is made easier.
   4. The traction program can be changed to either skin or skeletal traction at any time.

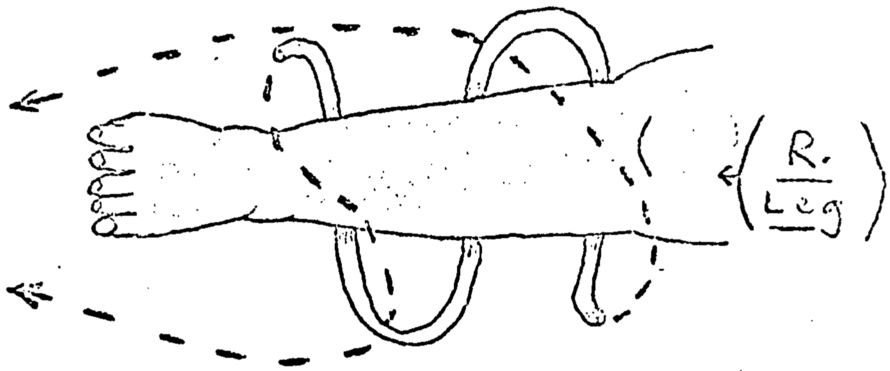
C. Disadvantages. The main disadvantage of the use of an encircling device is that skin does not tolerate pressure of ten or more pounds of traction for more than 24 hours. After this length of time there is frequently pressure necrosis. The skin can tolerate higher traction forces for a few hours, provided all pressure is removed after that time. Therefore, this form of traction device can not safely be used to treat fractures requiring large traction forces necessary to maintain reduction and alignment of the fracture.

D. Application of individual types of encircling devices.
   1. Traction splint and anklet.
      a. Clinical use. The Thomas traction splint are modifications of the traction splint have for many years proved efficient and even life saving in the initial immobilization of femoral shaft fractures. Further laceration of muscle by the bone ends with subsequent hemmorrhage is prevented. The patient can be easily transported in this encircling device. However, this traction device is only temporary and eventually within a few hours a more elaborate traction arrangement usually of the skeletal type should be assembled.
      b. Materials and equipment needed.
         1. Thomas splint or reversible half ring traction leg splint
         2. Heal rest
         3. Hand towel or a two foot length of medium width stockinette

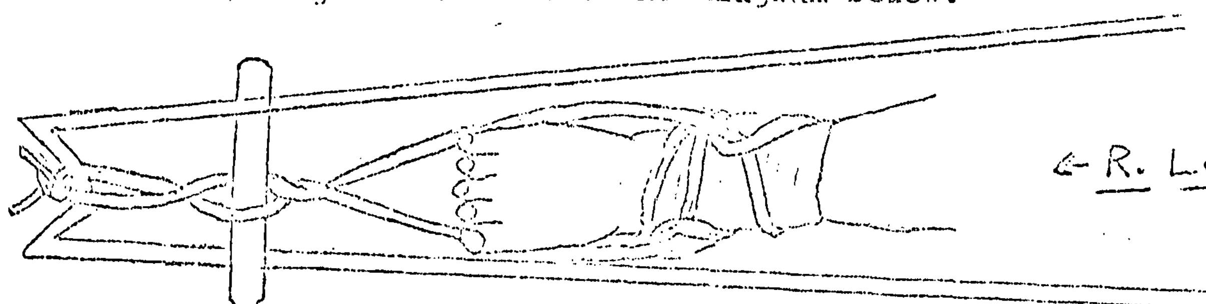
VI. Encircling Traction Devices (Cont'd)

4. Eight spring clips or 8 large safety pins
5. One traction anklet with 3" sp • er bar or a one yard length of muslin
6. Two yards of traction rope

c. Application of the traction splint and anklet. First of all a Thomas splint or reversible half ring traction splint of adequate circumference to be placed around the upper thigh is selected. Then the hand towel or stockinette should be applied to the bars of the splint to form a hammock in which the thigh will rest. Four safety pins are used to attach each side of the towel to this splint. The extremity should then be placed in the splint while maintaining support behind the upper calf and steady longitudinal traction on the foot. If a half ring splint is used the half ring should be oriented posteriorly and should lie in the gluteal fold. When longitudinal traction is applied, the splint will press against the ischial tuberosity in such a fashion as to maintain effective countertraction. Then a commercially prepared traction anklet is applied and this is hooked to the 3" spreader bar. The traction rope is then tied, under tension to the end of the splint thereby fixing the traction, i.e., fixed traction. This is the only example of fixed traction that will be described in this manual. The remaining types of traction whether they be encircling, skin or skeletal are all continuous balanced traction. If a commercial traction anklet is not available, a substitute can be improvised from a length of stockinette or muslin tied about the ankle as illustrated below:



Padding about the ankle, heel and malleoli should be used before the stockinette or muslin is applied. The stockinette or muslin strips are then tied under tension around the end of the traction splint. Increased traction may be obtained by twisting the strips with a tongue blade. See the diagram below.



The distal end of the splint may be supported at any height necessary to minimize anterior angulation at the femoral fracture site. If a commercial heel rest attachment for the splint is not available, a box of plaster may be used to support the end of the splint above the bed, or cart.

d. Tips and precautions. This is a form of fixed traction and should be used only temporarily until either skin or skeletal traction or surgery is arranged. This form of traction should not be used for more than a few hours as skin pressure necrosis may occur about the ankle malleoli, heel or buttock or groin.

2. Pelvic traction belt.
   a. Clinical use. The pelvic traction belt is frequently used for the relief of low back pain not associated with fractures. Example of clinical situations in which the pelvic traction belt may be used are for treatment of sciatica associated with herniated disc or with symptomatic degenerative joint disease of the lumbar spine. Sufficient traction forces cannot be applied to affect the lumbar vertebra articulations nor the para-vertebral muscles directly. This type of traction is frequently helpful and probably works by discouraging the patient from frequently climbing out of his bed and perhaps by fatiguing muscle in spasm.
   b. Material and equipment needed.

      1. One pelvic traction belt with large spreader.
      2. One yard of traction rope.
      3. One weight carrier and 20 lbs of weights.
      4. One overhead frame.
      5. One trapeze.
      6. One 9-inch
      7. One pulley with clamp assembly.
      8. Two large pillows.
      9. Two 6 or 10-inch shock blocks.

VI. Encircling Traction Devices (Cont'd)

c. Application of Pelvic traction with a pelvic belt. First of all, the bed should be equipped with an overhead frame, and a trapeze should be attached to the overhead longitudinal bar. Then the 9-inch bar, with end clamp, is attached to the upright post at the foot of the bed. It should be placed three to four feet from the floor. Then a pulley is attached to this 9-inch bar, and is then pulled through the pulley and is tied to the weight carrier. Then the patient's girth is measured at the crest of the illium, and the traction belt is adjusted and fitted to the patient. Next the spreader is attached to the traction belt straps, and the 20 lbs. of weight are placed on the weight carrier. Countertraction is maintained either by "gatching" the bed at the knees, by placing pillows under the knees, or by placing the shock blocks under the distal legs of the bed.

d. Tips and precautions.

1. The pelvic traction belt should be applied so that the lower portion of the belt is at, or slightly distal to, the greater trochanters of the femur. The belt is not to be applied like an abdominal binder.

2. The belt should be applied directly to the skin. If it is placed over clothing, this clothing frequently wrinkles, causing increased problems with irritation of the skin.

3. If countertraction is obtained by "gatching" the bed at the knees, then the traction bar and pulley must be placed higher from the floor to prevent blocking of the transmission of traction forces to the pelvis.

4. It is recommended that the traction belt be used intermittently, with several periods out of the belt each day being scheduled. This will decrease the possibility of skin irritation from the pelvic belt.

3. The Pelvic Sling.

a. Clinical use. The Pelvic sling has in the past been used to treat a variety of fractures of the pelvis, including fractures of the pubic rami, fractures of the wing of the illium, and separation of the symphysis pubis.

VI. Encircling Traction Devices (Cont'd

It should theoretically be useful if the pelvic bones are displaced laterally, like the pages of an open book. However, if the sling is correctly applied, it is very difficult to use the bed pan. When the bed pan is used, the sling is usually released and slid down, thereby losing the effect of pelvic compression. Many physicians now feel that the pelvic sling should not be used, but the patient should be treated on a fracture bed with a split mattress or Bradford frame. They feel that when displacement is great enough to require reduction, either closed reduction, followed by the application of a spica cast; or rarely, open reduction and internal fixation, is necessary.

b. Material and equipment needed.

1. One overhead frame.
2. One trapeze.
3. One 9-inch traction bar with end clamp.
4. Two pulleys.
5. One weight holder.
6. 20 pounds of weights.
7. Three yards of traction rope.
8. One canvas pelvic sling.
9. Two metallic rods, for support of the sling.
10. One spreader bar.
11. One spring with hook.

c. Application of Pelvic Sling Traction.

1. Attach the overhead frame to the bed.
2. Attach the trapeze to the overhead bar.
3. Attach the 9-inch traction bar with end clamp to the upright post at the foot of the bed.
4. Attach to pulley to the horizontal bar above the pelvis, and another pulley to the 9-inch traction bar at the foot of the bed.
5. Set the spreader bar on the edge of the bed, attach the hook of the spring to the spreader bar and attach rope to the spring. Then thread the rope through the two pulleys, and tie the weight carrier to the other end of the rope.
6. Position the sling under the pelvis, and then insert the metallic crossbar into the ends of the sling.
7. Hook the metallic crossbars into the notches of the spreader bar. The sling support bars are usually hooked on the notches of the spreader bar,

VI. Encircling Traction Devices (Cont'd

vertical to the bed. However, for extra compression they can be crossed, from right to left and left to right.

8. The weights are then applied to the weight holder. Usually 15-20 pounds of weight is all that is needed for traction.

d. Tips and Precautions.
1. If more than 15-20 pounds of weight is used, the pressure points over the iliac crest must be watched closely for signs of skin irritation.
2. Foot drop should be prevented by placing a footboard or blanket roll at the end of the bed.

4. Head Halter Traction

A. Clinical Use - Head halter traction is commonly used to obtain relief of neck pain, associated with cervical degenerative joint disease, with or without nerve root compression; or for the initial treatment of cervical fractures or dislocations, until skeletal traction can be applied.

B. Material and Equipment Needed.
1. Adjustable buck's extension bracket, or overhead basic frame, with 9-inch single bar with end clamp attached to the upright bar at the end of the bed, with pulley attached to this 9-inch bar.
2. One head halter.
3. One spreader bar.
4. One yard of traction rope.
5. One weight carrier, and 5 pounds of weights.
6. Two 6-inch shock blocks.

C. Application of Head Halter Traction.
1. The buck's extension bracket is attached to the head of the bed. This can only be used if the head of the bed is slatted. It cannot be used if the head of the bed is solid. In the latter case an overhead frame is attached to the bed, and then the 9-inch traction bar with end clamp is attached either to the head or foot upright bar at the desired height. The pulley is then attached to the 9-inch bar.
2. The rope is then tied to the spreader bar,

VI. Encircling Traction Devices (Cont'd

threaded through the pulley, and tied to the weight carrier.

3. The head halter is then applied to the patient and the proper angle of flexion or extension of the neck is adjusted. Increased flexion can be obtained by raising the 9-inch bar. Increased extension can be obtained by placing a small roll of towel behind the neck of the patient. The head halter should be applied in such a manner that the ears are not caught, the rope does not rest against the side of the head, and the chinpiece does not constrict the throat.
4. The spreader bar is then attached to the head halter straps.
5. The 5 pound weight is attached to the weight carrier.

D. Tips and Precautions.

1. The patient may be positioned with his head at the foot of the bed, for greater ease of using the buck's extension bracket on certain beds.
2. The head halter straps should be attached to the spreader bar in such a manner that the rope or straps do not touch the side of the head nor pinch the patient's ears.
3. Skin irritation may be prevented by rubbing corn starch into the skin of the neck and head where there is contact with the head halter.
4. The skin generally does not tolerate more than 5 pounds of traction for prolonged periods of time.
5. If the standard head halter is not available, one can be improvised from a 3 foot strip of stockinette. This is spilt longitudinally for 2 feet, and then is placed over the patient's head and under his chin.
6. When head halter traction is used for temporary immobilization of the neck, for suspected fractures or dislocations, confirmatory x-rays should be taken. Skeletal skull traction may then be applied.
7. It is best to keep the bed flat. Counter traction is best obtained by using shock blocks under the end of the bed nearest the patient's head. The bed should not be cranked up, especially if a fracture or dislocation is suspected, as this will change the angle of traction force and may cause serious neurological complications.

VII. SKIN TRACTION

A. Clinical Use - The use of skin traction involves the application of adhesive strips or rubber or foam coated strips to large skin surfaces of an extremity. Skin traction is used when the traction is needed for a short period of time. In adults it is safe to use 5-8 pounds of skin traction up to 1 week. If more traction force is needed for a longer period of time skeletal traction is preferable. In children, however, when the skin traction is properly applied, the skin can withstand approximately 10 pounds of traction force over a period of 4 weeks. These limitations of traction force in time are,however, variable and depend on the condition of the patient's skin and the proper application of the skin traction. Skin traction may be used:

1. For fractures requiring light traction forces for short periods of time.
2. After an injury or after surgery to overcome muscle spasm.
3. To attempt to stretch out joint contractures .
4. To immobilize an extremity for a short period of time.
5. In combination with skeletal traction to immobilize or elevate the distal part of an extremity.

B. Advantages of Skin Traction - The advantages of skin traction include the following:

1. The potential complication of surgical infection or periosteo stripping of bone with delayed or nonunion is avoided.
2. Skin traction will allow a greater use of muscles and allow more joint motion than does plaster cast immobilization.
3. Skin traction is especially suitable for children. They usually heal rapidly and require light traction forces for the maintenance of the reduction of their fractures.
4. Skin traction has an advantage over skeletal traction in the treatment of fractures in children, because the potential hazards of skeletal pin tract infection or epitheseal migration of the skeletal wire or pin are avoided.
5. Skin traction may also be applied over a potential site for surgical incision when the clinical situation requires traction before surgery.

C. Disadvantages of Skin Traction. - There are several disadvantages with the use of skin traction:

1. It is difficult to control or apply rotational forces in the axis of the traction system.
2. The skin cannot withstand large traction forces over long periods of time.
3. Skin traction cannot be used over injured skin.
4. Skin traction should be used for a very short period of time or not at all if surgical correction of the fracture is anticipated.
5. The patient, especially a child or a disoriented adult, may easily remove the skin traction from the extremity.

D. Application of Skin Traction. The following materials are necessary for the application of skin traction:

1. Adhesive tape, mole skin, or a commercially available traction tape.
2. An elastic bandage. This may vary in size from a 3 inch bandage in children to a 4 or 6 inch bandage in adults.
3. A spreader bar with attached hand or footpiece.
4. Phiso-hex soap.
5. Alcohol.
6. Four-by-fours or a clean towel.

Optional materials include:

1. A shaving device of the blade razor or electric shaver type.
2. Tincture of benzoin.

It is important that the skin be properly prepared prior to the application of skin traction. Many surgeons advocate shaving extremity prior to application of the traction tapes, however, others believe this is unnecessary. Some commercial traction tapes should be used with the unshaven extremity. If the extremity is not shaved prior to application of skin traction, especially when adhesive tape is used, traction bond is improved but removal of the traction is quite uncomfortable. If the surgeon prefers to shave the extremity, it is preferable to use an electric shaver. Scratches and deep shaving are more easily avoided as is subsequent folliculitis. The unshaven or shaven extremity is cleansed carefully with Phiso-hex soap and is then rinsed with alcohol and dried. Some surgeons then apply tincture of benzoin to the skin following this cleansing but it is questionable whether the tincture of benzoin actually improves the bond of the skin traction materials, and whether it actually protects the skin. Wide 2 or 3 inch adhesive tape strips or strips of mole skin may be used for the skin traction, but the commercially available traction tapes are most frequently used. The adhesive material on the traction tapes is frequently covered with a paper backing which is removed at the time of application. Other traction tapes of the foam rubber sponge type rely on a bond between the foam rubber padding and the unshaven extremity. Any material applied to the skin for skin traction will be irritating to some extent. It should not be used where an incision or traction pins might subsequently be necessary. The skin traction, in some cases, should not extend above the fracture site because this will permit transmission of the force of traction through the soft tissue to the proximal fragment rather than to the distal fragment and, therefore, would decrease the efficiency of the traction system. No overlap of the traction tapes, either in front or in back of the extremity, should be allowed. A small strip of skin should be left uncovered both anteriorly and posteriorly to allow swelling and to prevent constriction should the traction tape slip down the extremity. The traction tape should, however, cover as much of the skin as possible to minimize the traction force on each square inch of skin surface.

After the traction tape is applied to the extremity, an elastic wrap is applied over the traction tape. It should be first wrapped around the hand or foot for several turns and then applied over the traction tape. The wrap is applied tightly enough to improve the bond of the traction tape, but not so tight as to produce distal edema or vascular compromise. Care should be taken to insure that no wrinkles are present as the elastic wrap is applied. Pressure points, especially the Achilles tendon and the ankle malleoli should be padded to prevent pressure before the wrap is applied. The spreader bar and hand or foot piece is then placed in the distal loop of the traction tape and the traction force is then applied to the extremity.

E. Care of the Patient in Skin Traction. Frequent inspections of the skin traction system should be carried out to avoid complications. Please refer to Part VI, Care of the Patient in Traction, at this time. It is essential to daily remove the elastic wrap to inspect the skin traction tape. Areas of skin blebs, abrasions or folliculitis or pressure points may be discovered and treated early. Slipping of the traction tape is a common complication and this may be corrected at the time of the daily traction tape check. If there is evidence of skin damage on the daily check and there is a need for continued traction force, consideration should be given at this time to insertion of a skeletal pin or wire. If the skin is in good order at the time of the daily check, the elastic wrap is reapplied. When the skin traction is first applied, frequent checks of the neurovascular status of the distal portion of the extremity should be made. If edema is noted or there is a question of the status of the circulation, the wrap should be immediately removed. When the circulation returns to normal the elastic wrap may be reapplied, but less tightly than before. If circulatory impairment is not discovered and treated early, the eventual result may be a Volkmann's contracture or gangrene of the distal extremity. Care should be taken that pressure is not applied to bony prominences. In the lower extremity if skin traction is applied too far proximally over the lateral aspects of the leg, the head of the fibula and the adjacent common paraneural nerve may be subjected to pressure with a resultant paraneural nerve palsy. Frequent checks should be made on patient's Buck's traction to insure that paraneural palsy is not occurring. If weakness of dorsiflexion of the foot or loss of sensation between the great and second toe on the dorsum of the foot is noted, the skin traction should be removed immediately and reapplied in the proper fashion. Pressure to the heel may be avoided by placing a pillow under the distal thigh and calf thereby raising the heel from the bed or by applying a doughnut to the heel.

F. Individual Types of Skin Traction

1. Buck's traction

a) Clinical Uses. Buck's skin traction may be used on one or both lower extremities for treatment of any condition of the knee, femur or hip joint in which partial immobilization with light traction force is desired. When greater traction force is necessary as possible with skin traction, skeletal traction should be used. Buck's traction may be used for:

1. Temporary immobilization of a fractured hip prior to surgery
2. Immobilization of a hip following reduction of a dislocated hip
3. Immobilization of a hip following reconstructive surgery to the hip.
4. Immobilization of a painful hip or knee regardless of the cause for the pain.
5. For treatment of sciatica when pelvic belt traction is poorly tolerated. When Buck's traction is used for this clinical condition, it is frequently applied bilaterally and is combined with pillows beneath the thighs and knees.

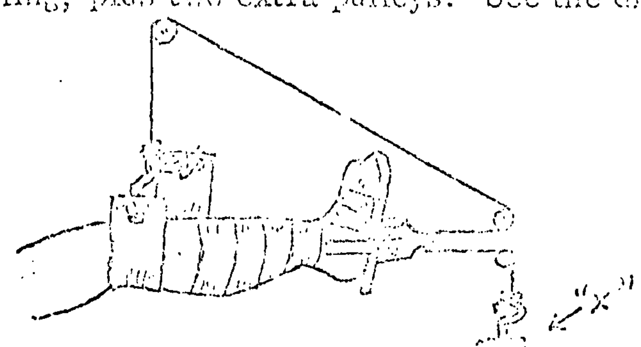
b) Materials and Equipment Needed.

1. Materials for preparing the skin, including soap, alcohol etc. Please refer to Part D above "Application of Skin Traction".
2. Either one strip of commercial sponge traction tape or two strips of moleskin or 2 strips of two inch adhesive tape.
3. One four inch elastic wrap.
4. One spreader bar with attached footplate.
5. One adjustable Buck's extension hook to attach to the foot of the bed or one 18 inch single traction bar with end clamp which should attach to the central end pole of the overhead frame. Note: if bilateral leg Buck's traction is used a 9 inch single traction bar may be attached to the central upright pole at the end of the bed and then a 36 inch bar may be attached to the end of this bar, this 9 inch bar.
6. One or two pulleys depending on if Buck's traction is to be applied to one or both lower extremities.
7. One yard of traction cord for each extremity.
8. One weight carrier and 10 pounds of weights for each extremity.
9. One trapeze to attach to the overhead bar.
10. One large pillow to place under each lower extremity to prevent pressure on the heel.
11. Two 6 or 10 inch shock blocks to place under the distal legs of the bed to provide countertraction.

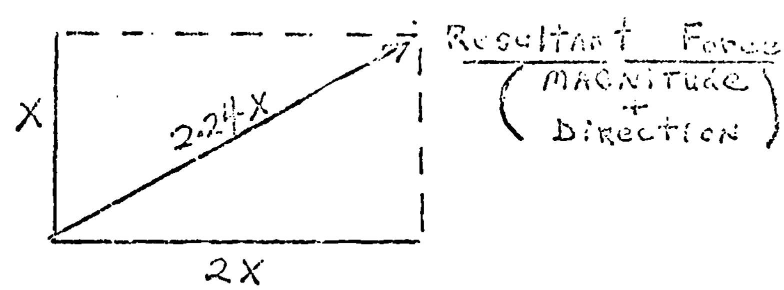
c) Application of Buck's Traction. First of all the basic overhead frame and trapeze are attached to the bed. Then the crossbar and pulley are attached to the upright pole distally. An alternative method is to place an adjustable Buck's extension hook over the end of the bed. Then the Buck's skin traction is applied to the lower extremity as described in Part D, "Application of Skin Traction". After the elastic bandage has been applied the rope is tied to the spreader bar and it is threaded through the pulley and is then tied to the weight carrier. Next the shock blocks are placed under the foot of the bed. The footplate is correctly ajusted and then the pole is placed beneath the calf and lower thigh. Finally, the weights are added to the weight holder.

d) Tips and Precautions.
   1. Pressure on the heel should be avoided as described above.
   2. The kneerest of the bed should not be elevated as this tends to block transmission of the force about the knee.
   3. The crossbar and pulley may need to be adjusted so that the line of traction force is pulling in the proper direction.
   4. The patient should be encouraged to use a trapeze and the leg not in traction to pull himself back up in bed should he migrate toward the traction and the weight come to rest on the floor. A footboard for the other foot will help prevent this migration.

2. Russell's Traction
   a) Clinical Use. Russell traction is a form of skin traction that employs the principle of double pulleys to double the longitudinal traction on the extremity. It is in essence Buck's traction plus an appropriately placed sling, plus two extra pulleys. See the diagram below.



As shown below, the direction of the resultant traction force is not in the axis of the leg nor in the line of pull of the sling. See drawings below.



Russell's traction may be used for the same conditions as Buck's traction and may be used for treatment of tibial plateau fractures in adults also. It is useful in treating fractures of the femoral shaft in children. As with Buck's traction Russell's traction is useful only when fairly light traction forces are needed, and if heavy forces are needed for long periods of time, skeletal traction should be used.

b) Material and Equipment Needed.
1. One overhead traction frame.
2. One trapeze.
3. One 9 inch crossbar with end clamp.
4. Two 18 inch crossbars with end clamp.
5. Three pulleys.
6. One footpiece an additional pulley.
7. One kneesling.
8. One spreader bar.
9. One weight carrier.
10. Five pounds in weights.
11. Four yards of traction rope.
12. One large pillow.
13. Two 6 or 10 inch shock blocks.
14. One strip of commercial traction tape, or 2 wide strips of mole skin, or 6 long strips of 2 inch adhesive tape. Materials to prep and clean the leg.

c) Application of Russell's Traction. First of all attach the overhead frame to the bed. Then attach the trapeze to the overhead frame. Following this attach one 9 inch crossbar with end clamp to the overhead bar and two 18 inch crossbars with end clamps to the distal upright pole. These latter two bars should be placed 3-4 inches apart. Next attach pulleys to each of the 3 crossbars so that an imaginary line connecting the 3 extends in the same line as the injured leg. Then prep the leg and apply the skin traction. See Part D, "Application of Skin Traction". The skin traction is applied the same way as is Buck's traction. Then attach the traction tapes to the footpiece. Next apply the kneesling beneath the upper calf. Then tie one end of the rope to the spreader bar and attach the spreader bar to the knee sling. Then thread the rope through the overhead pulley and then through the upper pulley attached to the 18 inch crossbar, then through the pulley on the footpiece, then through the pulley on the lower 18 inch crossbar and then tie this end of the rope to the weight carrier. Finally, apply the 5 pounds of weight to the weight carrier. A pillow should then be placed under the lower thigh and calf to lift the heel from the bed. Countertraction is obtained by placing 6 inch or 10 inch shock blocks under the distal legs of the bed. A final check of the direction of traction and countertraction should now be made. Maintenance of the proper position of the sling usually requires a vertical or slightly cephalad orientation of the overhead pulley. The distal pulleys should apply traction force in line with the leg.

d) Tips and Precautions.
   1. Avoid pressure over the fibular head and paraneural nerve.
   2. Prevent pressure sores on the heel by elevating it from the bed with a pillow placed under the calf and distal thigh.
   3. Avoid sling compression of the popliteal area.
   4. Check the skin under the traction tapes frequently for signs of irritation, of pressure to the ankle malleoli.

3. "Split" Russell's Traction.
   a) Clinical Use. - Split Russell's differs from Russell's traction in that separate traction is applied to the sling and to the footpiece. There is no double pulley arrangement at the foot of the bed so that the resultant longitudinal traction force is not doubled. Clinical uses are the same as with Russell's traction. See Russell's traction.
   b) Material and Equipment Needed. Material and equipment needed to apply split Russell's traction is very similar to that needed in applying Russell's traction. Six yards of traction rope is needed as is an additional 8 pounds of weight.
   c) Application of Split Russell's Traction. The overhead frame and trapeze are attached to the bed. A 9 inch crossbar with end clamp is attached to the overhead bar directly above the injured knee. Then the two 18 inch crossbars with end clamps are attached to the distal upright bar of the overhead frame. The upper of the two is attached near the top of the crossbar. Then pulleys are attached to the 3 crossbars so that an imaginary line connecting the 3 lies in the same line as the injured extremity. The skin is then prepped and the traction tapes and elastic bandage applied as described in Part D, "Application of Skin Traction". Pressure over the fibular head and paraneural nerve should be avoided. Then the footpiece with pulley is attached to the traction tape and the sling is placed under the upper calf. The rope is cut into 4 and 2 yard segments. The spreader bar is attached to the sling and one end of the 4 yard segment of rope is attached to the spreader bar and is then threaded through the pulley above the knee and then through the pulley on the upper 18 inch crossbar. One end of the 2 yard segment of rope is attached the bottom of the footpiece and is then threaded through the lower of the 2 distal pulleys. Weight carriers are tied to the free ends of the 2 ropes and 8 pounds of weight is added to the carrier attached to the rope tied to the footpiece and 5 pounds of weight is added to the carrier attached to the rope tied to the sling. The distal shock blocks and the pillow under the calf of the leg are then added for countertraction. A final check should be made to be sure that the traction and countertraction is balanced.

d) Tips and Precautions.

1. Read Tips and Precautions listed under the description of Russell's traction.
2. Two separate traction systems are used to maintain this traction so that the longitudinal traction is not doubled. This is the reason 8 additional pounds of weight are necessary.

4. Bryant's Traction.

a) Clinical Use. Bryant's traction is used to treat fractured femurs in children who are 1-3 years in age and who weigh less than 40 pounds. The opposite well leg is usually treated in traction also. If only the injured leg is suspended in traction the active child may twist and squirm about in bed and produce ang[illegible]tion at the fracture site. For this reason many surgeons place both legs in traction. Bryant's traction is preferable over Buck's traction for treatment of these femur fractures in light children because the overall body weight of the light child is usually not sufficient enough to permit longitudinal traction with Buck's traction. It should not be used in the older and heavier child because the weights needed for traction are greater than the skin can tolerate, and the position required by the patient is precluded by the tightening of the hand string, secondary to assuming an upright posture.

b) Material and Equipment Needed.

1. One 5 1/2 foot upright pole with clamps to attach to the bed.
2. One 36 inch traction bar.
3. Two 36 inch traction bars with center clamps.
4. Four pulleys.
5. Six yards of traction rope.
6. Two weight carriers.
7. Ten to fourteen pounds of weight.
8. Two 2 inch spreader bars.
9. Two 3 inch elastic wraps.
10. Two strips of commercial traction tape or 4 wide strips of mole skin or 12 long strips of 2 inch adhesive tape.
11. Material to prep the skin. See Part D, "Application of Skin Traction".
12. One vest type restraint (optional).

c. Application of Bryant's traction. The five and a half foot upright traction pole is then clamped to the upper or lower end of the bed. The thirty-six inch plain traction bar is clamped to the upper end of this pole. Then a thirty-six inch crossbar with center clamp is attached to each end of this plain bar, one end of the plain bar aligned vertically above the patient's pelvis and the other end of the bar aligned vertically above a point distal to the foot of the bed or proximal to the head of the bed. At this point look at the picture on page 18 in the traction book by Schmeisser or the picture on page 25 of the Zimmer Traction Handbook. Next attach two pulleys to the proximal crossbar and two pulleys to the distal crossbar positioning them directly above the patient's hips. Next tie the rope to the spreader blocks and thread the ropes through the pulleys and then attach the weight carriers. Then prep the legs and apply the skin traction as is described under Part D (Application of Skin Traction). Care should be taken to avoid pressure over the head of the fibula and peroneal nerve. After the elastic bandages are applied and the spreader blocks placed in the loops distally, the weights are added to the weight holders. The amount of weight needed will vary depending on the weight of the child. However, five to seven pounds on each weight carrier is usually sufficient. The patient should now have both legs suspended vertically above the bed with the buttocks lifted barely off the mattress. A vest-type restraint is used by many surgeons to restrain the child so that he cannot twist about. This restraint is attached to the bed or to a Bradford frame lying on the bed.

d. Tips and precautions.

1. Avoid pressure over the fibular head and peroneal nerve.
2. Frequently check both feet and legs for adequate circulation and sensation.
3. Do not hang weights over the patient and keep the weights out of his reach.
4. This form of traction rarely needs to be used longer than three weeks. By three weeks there is usually enough healing at the fracture site that the patient can be taken out of the traction and treated in a hip spica.

5. Dunlop's Traction

a. Clinical use. Dunlop's traction is used to treat transcondylar and supracondylar fractures of the humerus in children, in which closed reduction cannot be easily performed, or in which elbow flection to 90° will compromise circulation to the hand.

b. Material and equipment needed.

1. One base clamp to be attached to the under surface of the bed or under the mattress.

2. One thirty-six inch traction bar with end clamp.
3. One twenty-seven inch traction bar with end clamp.
4. Two pulleys.
5. One yard of traction rope.
6. One weight holder.
7. Ten pounds of weights.
8. One spreader bar with attached hand-grip.
9. Materials to prep the skin.
10. One strip of commercial traction tape or one long strip of mole skin or four long strips of two inch adhesive tape.
11. One three inch elastic bandage.
12. One three inch sling.
13. Two six inch shock blocks.
14. One vest-type body restraint. (Optional).

c. Application of Dunlop's traction. First of all the bed is prepared. The base clamp is assembled and attached to the under surface of the bed, or under the mattress, at a level opposite the upper chest. The thirty-six inch traction bar is attached vertically to the end of the base clamp. The twenty-seven inch traction bar is attached horizontally at the top of the thirty-six inch traction bar. The pulley is then attached near the end of this twenty-seven inch traction bar. The skin is then prepped. Then the traction tape or mole skin strips or strips of adhesive tape are applied to the volar and dorsal aspects of the forearm, covering as much skin as possible between elbow and wrist. Radial and ulnar strips of skin should not be covered with tape. (See Part D, Application of Skin Traction.) The tape should extend proximally to the antecubital fossa. It should not cross it, nor should it cover the olecranon. If the skin traction proves to be inadequate, skeletal traction through the olecranon may later be applied. The traction tapes or adhesive tape strips are then attached to the spreader bar with attached hand grip, leaving enough room for the patient to nearly fully extend his fingers. Then the elastic wrap is applied, leaving a small space between wrappings on the lower aspect of the wrist for palpation of the radial pulse. The side rail on the injured side is raised and taped in that position. The injured extremity is then brought through the slats of the side rail, the patient shifted to the side of the bed until the axilla is close to the side rail. Towel padding to the side rails about the shoulder is now applied. Traction rope is then tied to the spreader bar and threaded through the pulley and then tied to the weight holder. The extremity should be maintained with the elbow at a 135° angle. A sling is then placed about the distal arm above the popliteal fossa and the second weight holder is attached to this sling. Four pounds of weights are placed on the weight holder attached to the slind and six pounds of weights are attached to the other weight holder. To maintain this traction the patient must be kept at the edge of the bed. This is facilitated by the use of the shock blocks. A vest-type restraint may be used, but is optional.

d. Tips and precautions.

1. The forearm and hand are usually maintained in a supinated or neutral position. However, this will depend on x-ray evidence of reduction of the fracture.
2. Avoid pressure on the olecranon, bony prominences of the wrist and antecubital fossa.
3. Check the neurovascular status of the forearm and hand frequently.
4. When there is clinical evidence of union of the fracture the pulley position may be changed so that flection is gradually brought to 90°. When 90° of traction has been obtained without loss of fracture alignment, the extremity may be taken out of traction and then treated in a sling and swath.

6. Combinations of Skin Traction. Combinations of skin traction for treatment of humeral, clavicular, femoral, and other types of fractures are described in various fracture textbooks and in the Zimmer Traction Handbook. These combinations are less than ideal and usually are best substituted with skeletal traction. Examples of these combinations of skin traction are found on pages 22 and 24 in the traction textbook by Schmeisser and on pages 28 and 29 and 38 and 39 in the traction handbook distributed by the Zimmer Manufacturing Company.

VIII. SKELETAL TRACTION

A. Clinical Use. Skeletal traction is used when large traction forces are necessary to maintain reduction and alignment of a fracture or for distraction of a diseased joint or joints, and for distraction and treatment of scoliosis of the spine. The traction force is applied through a metal device directly to bone, thereby, avoiding transmission of the force to the skin and tissues over the bone. These traction devices include pins, wires, screws, tongs and other metallic devices and each will be described in reference to its clinical use in Part G (Individual Types of Skeletal Traction).

B. Advantages of Skeletal Traction. There are many advantages when skeletal traction is used.

1. The traction force is more efficient because it is applied directly to the bone. Skin traction is less efficient because the force must be transmitted through the skin and soft tissues to bone.

2. More traction force can be applied when traction is applied to or through bone. Skin traction has lower limits of traction force and time of application.

3. If properly applied, skeletal traction is more comfortable than is skin traction.

4. Skeletal traction involves only a small area of skin surface than does skin traction.

5. It may be used where there is a fracture associated with extensive soft tissue and skin damage. It is possible to dress and observe compound fractures and extensive soft tissue injury and keep traction force intact. Skin traction could not be used in this situation.

6. Skeletal traction frequently permits earlier joint motion then is possible when plaster cast immobilization is used.

7. Skeletal traction will allow the application of rotational forces directly to bone in the correction of some rotational fracture deformities.

8. Skeletal traction is often more effective in maintaining extracting forces to the spine or to a joint contracture,

SKELETAL TRACTION (Cont'd)

etc. than is plaster cast demobilization.

C. Disadvantages of Skeletal Traction. Skeletal traction has several inherent disadvantages.

1. The protective barrier of skin and soft tissue over bone is violated, and the medullary canal of the bone is entered. This allows potential infection along the skeletal device with possible skin or soft tissue infection and possible osteomyelitis. Infection is inevitable after approximately three to four months of use. Infection may become a problem before that time if the device is inserted without careful aseptic technique, or if the subsequent care of the skin at the entrance and exit sites of the skeletal device is not hyg[illegible].

2. The second major disadvantage is that it is possible to introduce the traction device through a joint capsule and into the joint. Should this occur the joint might be infected.

3. If the traction device is accidentally introduced into the fracture hematoma or throught the fracture site, infection of the fracture hematoma or delay in union of the fracture might occur.

4. If the fraction device is introduced too rapidly, excess heating of the adjacent bone may result in a ring of dead bone which may become infected.

5. If a small wire is used in children it may migrate through an epiphysis and into a joint with resulting epiphyseal injury or joint infection.

6. When a pin or wire is inserted through a long weight bearing bone, stress rises at each of the holes and may lead to a stress fracture when weight bearing is begun.

7. If the skeletal traction device is not applied perpendicular to the center of axis of the fractured extremity, the fracture fragments may be pulled into non-alignment when the traction force is applied.

8. Skeletal traction necessitates a long period of recumbence and decubitous ulcers, phlebitis and pneumonia occur more

frequently, especially if the nursing care is poor.

D. Application of Skeletal Traction. There are several general principles which should be observed when skeletal traction is applied.

1. The anatomy at the site of the insertion should be understood. An inadequate understanding of this anatomy frequently leads to complications involving injury to nerves and vessels, tendons, viscera, or even the brain.

2. This skeletal traction device should usually be as small in diameter as is consistent with the amount of force necessary. A smaller skin wound is needed and there is often less discomfort to the patient.

3. When possible, it is wise to insert the skeletal traction device in the first metaphysis distal to the fracture site.

4. When possible, the diaphysis of the bone should not be crossed with a traction device. This will cause a local concentration of forces at the sire or pin holes and may lead to a stress fracture at this site when the patient is again ambulatory.

5. It is best to pass skeletal traction devices through a minimum of sliding soft tissue. The more sliding soft tissue that is traversed, the more likely it is that the patient will experience discomfort while in traction or develop stiffness in surrounding joints after the traction is removed.

6. In children skeletal traction wires should not be used where they might migrate into or through a growing epiphysis. (Example, the distal femoral metaphysis).

7. The skeletal traction device should not be introduced through the fracture hematoma or into a joint. Refer to disadvantages of skeletal traction above.

Before we discuss the technique of insertion of a skeletal pin or wire, it is important that you are familiar with the components of the (1) traction pin tray, and (2) the local anesthetic tray. If you are familiar with these trays you will save yourself a great deal of time when you insert the pin or wire, and will also avoid the embarrassment of finding yourself in the middle of a pin insertion lacking an important component of the trays.

SKELETAL TRACTION (Cont'd)

1. The traction pin tray.

Contents:

Six - 4 x 4's
Six - Towels
One scapel handle
Two No. 11 blades
Three towel clamps
One suture scissors
One hemostat forceps
One needle-nose pliers
One regular pliers
One hand drill with chuck key
One multiple action pin cutter
Three threaded pins of each of the following diameters: 3/16's, 5/32nd's, 9/64th's, 1/8, 3/32nd's, 5/64th's and .062 inches.
Three plain pins, each of the following diameters: 5/16th's, 5/32nd's, 9/64th's, 1/8, 7/64th's, 3/64th's, .035, and .062 inches.

There is disagreement among surgeons concerning the use of threaded versus smooth wires or pins. The threaded devices tap threads and bone as they are inserted, and this tapping turns to fix them firmly, and allows no back and forth movement of the device in bone. However, threads in a pin or wire make it weaker in a smooth device of the same diameter. Some surgeons also believe that threads tend to wrap soft tissue about the wire, causing more soft tissue damage during insertion. Most surgeons, however, believe that stability of the threaded pin or wire is paramount, and they use a larger size to compensate for the inherent weakness due to their threads.

2. Local anesthetic tray.

Contents:

One 5 cc. syringe
One 10 cc. syringe
Two - No. 22 gauge, 1/2" sterile needles
Two - No. 18 gauge, 1/2" sterile needles
Two - No. 18 gauge, 1-1/2" sterile needles
Two sterile 4 x 4's

A bottle of local anesthetic solution, such as 1% plain Zylocaine, should also be available.

SKELETAL TRACTION (Cont'd)

The general technique for insertion of a skeletal traction pin or wire will now be described. First of all, the appropriate anatomic site is selected for insertion of the pin or wire. The skin at this site is then usually shaved, either by the surgeon or an assistant. The surgeon then puts on sterile gloves and preps the site. A phisohex and water or an iodine and alcohol prep is suggested. The traction pin tray is opened for the surgeon and the site for insertion of the skeletal pin is carefully draped. (It is best to perform this procedure in the operating room.) If local anesthetic is to be used, the local anesthetic tray is, at this time, opened for the surgeon. The local anesthetic is injected into the skin and periosteum on both sides of the bone or bones to be transfixed with the traction device. The area of the anesthetic injection over the exit site should be larger than for the entrance site. Then the scalpel blade should be used to make a small incision in through the skin prior to insertion of the traction device. However, some surgeons prefer to push the sharp point of the device directly through the skin, believing this method creates an opening in the skin which is only large enough to allow admittance of the device, itself. The traction pin or wire is then inserted into the hand drill. Only a few inches of the device should protrude from the chuck of the drill. If more than a few inches stick out, the device may bend and be difficult to control. The pin or wire is then advanced through the soft tissues to bone, and the surgeon should carefully insert the device in a line perpendicular to the anticipated line of traction force. The line of traction force is usually in the long axis of the fractured extremity. When the point is placed at the correct location on the bone, the inner wire is lengthened from the drill chuck. In starting the point into the bone, it is helpful to work the handle of the drill back and forth in order to "start" the point, to prevent its slipping off the bone. The pin or wire is then drilled through the bone and through the soft tissue on the opposite side of the bone, until the skin is "tented up" over the end of the device. When the skin is "tented up" additional local anesthetic is injected in the skin, if necessary, and then a second small incision is made over the point of the device. The pin or wire is then drilled through this second skin incision until approximately equal lengths are present on each side of the extremity. The pin is then removed from the drill and a pin cutter is used to remove the sharp point of the pin. A dry dressing, in the form of several 4 x 4's, is then applied over the ends of the pin. The application of tincture of benzoin, or ointment, to the pin sites is optional. Then a bow or a wire tractor is applied to the pin or wire. The bow is used with a stem and pin and a wire tractor is used a Kirschner wire. There are now available disposable tractors which can be used either on a wire or on a pin. When a wire tractor is used, it is important to tighten the tractor tightly to minimize bowing of the wire when traction force is applied. The ends of the pin or wire are then bent and tape or corks are placed over the ends to prevent the ends from injuring the patient or from tearing the bed clothes. The traction force is then applied to the bow or tractor. See Part G, Individual Types of Skeletal Traction.

E. Sites of insertion of skeletal traction.

1. Upper extremity.

a. Proximal ulna. Two types of skeletal traction may be applied through the proximal ulna.

(1) One is the screw. An eyelet screw is commonly used and provides an excellent means of applying traction force. To insert the screw, a small incision is made in the skin over the upper, posterior ulna, 1 to 1-1/2 inches distal to the tip of the olecranon process. This is the point about opposite the coronoid process, where the greatest depth of bone is available for inserting this screw. A wood screw may be used without fear of metallic reaction because it will only be used for several weeks and then will be removed. A drill bit one size smaller than the diameter of the threads of the screw is used to drill a small starting hole in the cortex of the ulna. The screw is then twisted into this hole until the threaded portion is buried beneath the cortex. After applying a sterile dressing to the insertion site, traction force is applied to the eyelet portion of the screw.

(2) A pin or wire. The second method of applying skeletal traction to the proximal ulna is with a pin or wire placed transversely through the ulna. The preliminary steps of prepping the skin, injecting local anesthetic into the skin periosteum, and making a small incision medially at the point 1 to 1-1/2 inches distally and approximately 1/2 to 3/4 inch lowerly, are first done. The wire is then inserted from medial to lateral, taking care that the ulna nerve is not injured, and that bone is actually entered. Care must be taken not to slide off the bone and place the wire in a subperiosteal position. Much of the bulk palpable about the olecranon is actually tenderness insertion of the triceps muscle, and if the wire is inserted too far

SKELETAL TRACTION (Cont'd)

Section B., 1., a., (2) Cont'd)

proximally, it may actually be passing through tendon and not bone. When the pin or wire is inserted at this site, the joint capsule of the elbow is also avoided. After application of sterile dressings to the entry and exit sites, a traction bow or tractor is applied and then the traction force is added.

b. Distal radius and ulna. Traction pins are not commonly introduced in this site. When they are, they are most frequently inserted along with an upper ulna pin for double skeletal traction for treatment of fractures of the humerus and forearm. The approach is made from ulnar aspect of the wrist just proximal to the ulnar styloid process. The pin or wire should be inserted perpendicular to the axis of the forearm and fractured [illegible] pass through the metaphysis of both ulna and radius. Care must be taken in placement to avoid the dorsal and volar tendons and neurovascular structures and to avoid the radial artery and the branches of the radial nerve. The tendons of the short firm extensor and the long firm abductor may be traumatized when a pin is inserted at this site.

c. Metacarpals. Skeletal traction with a wire or pin is occasionally used to treat a severe a comminuted Colles fracture of the wrist, or to treat forearm fractures, especially if they are compound injuries. Sites for insertion through the metacarpals are: the distal metaphysis of the first metacarpal; the proximal metaphysis of the second and third metacarpals; or the distal metaphysis of the second, third and fourth metacarpals. When skeletal traction is applied in any of these locations, the primary concern is to avoid impaling or injuring tendons or neurovascular bundles. When the first metacarpal is approached, the wire or pin should start from the ulnar aspect of the forearm and be introduced radially. The fourth metacarpal is quite mobile, so when a wire or pin is placed through the distal metaphysis of the second, third and fourth metacarpals, it should be started in the ulnar aspect of the fourth metacarpal and then should be introduced radially. Because of the natural palmar arch, no more than three metacarpals can be transfixed with one pin or wire. Whenever skeletal traction is applied through metacarpals, some joint stiffness can be expected due to inflamation of tendons and other sliding soft tissues.

SKELETAL TRACTION (Cont'd)

E. (Cont'd)

2. The lower extremity.

a. Proximal femur. Proximal femoral traction is occasionally used to treat central acetabular fractures. There are two methods of applying traction to the proximal femur.

(1) A large eyelet-type wood screw may be inserted just below the greater trochanter of the femur up into the neck of the femur in a fashion similar to inserting a nail for treatment of an inter-trochanteric or femoral neck fracture. (A lateral hip incision is made longitudinally from the tip of the greater trochanter distally for approximately four to five inches.) The approach is developed until there is good exposure of the base of the greater trochanter. A drill bit one size smaller than the diameter of the threads of the screw is used to drill a small starting hole into the cortex of the lateral femur. The screw is then twisted into the hole until the threaded portion is buried in the cortex. The wound is then closed in layers around the screw and a sterile dressing is applied to the incision. Traction force is then applied to the eyelet of the screw.

(2) A second method of applying skeletal traction to the upper femur is by drilling a wire or pin through the greater trochanter in an anterior-posterior direction. A tractor or bow is then attached to the ends of the wire or pin and the traction force is applied to this bow or tractor. A disadvantage of the second method is that it passes through a large amount of sliding soft tissue, and there frequently is significant soft tissue irritation and scarring. Both of these methods of proximal femoral skeletal traction have the disadvantage of interferring with subsequent surgical approaches to the hip, should traction fail to produce the desired result.

b. Distal femur. Skeletal traction may be applied through the distal metaphysis of the femur to treat inter trochanteric fractures of the hip, sub-trochanteric fracture, and fractures of the mid-shaft of the femur. It may also be used to treat some varieties of pelvic fractures, especially if there is sacro-iliac joint fracture and/or dislocation with proximal shift of the hemi-pelvis and may be used for treatment of acetabular fractures. In

SKELETAL TRACTION (Cont'd)

E., 2., b. (Cont'd)

the adult the traction pin or wires should be inserted approximately 1/2 inch proximal and anterior to the adductor tubercle. The pin or wire is drilled from medial to lateral and is usually introduced perpendicular to the long axis of the femoral shaft. Care should be taken to introduce the pin or wire proximal to the adductor tubercle to avoid impaling the medial collateral ligament of the knee. The supra patellar pouch anteriorily and the neurovascular bundle posteriorily should also be avoided. The skeletal pin or wire should be inserted with the knee held in a partially flexed position, because this is the position the knee will be in when the extremity is placed in skeletal traction. When the knee is flexed during pin insertion, the sliding soft tissue structures are not placed on a stretch over the pin or wire when the knee is placed in traction. There are several advantages of placing skeletal traction through the distal femur instead of through the proximal tibia. The first advantage is that the traction force to the femur is not transmitted through the ligaments and tendons about the knee. The second advantage is that rotational force can be applied to the femur much easier through the distal femoral pin, when rotational fractured deformities must be corrected. If skeletal traction is considered at this site in the child, care should be taken that the pin is inserted proximal to the distal femoral epiphysial plate. A skeletal pin should be used instead of the wire as the latter may easily migrate into the epiphysis and into the knee joint. Most surgeons prefer to use a proximal tibial pin instead of a distal femoral pin in the treatment of femur fractures in children.

c. Approximal tibia. Approximal tibial skeletal traction is most commonly used to treat supracondylar fractures of the distal femur. It may also be used to treat other thermo shaft and hip fractures, acetabular fractures, and pelvic fractures. A traction pin or wire is used, and is introduced from the lateral aspect of the upper leg. The point of entry of the pin or wire should be situated approximately one inch distal to the tibial tubercle and 1/2 to 1 inch posterior to the tibial crest. The main anatomic structure to avoid is the

SKELETAL TRACTION (Cont'd)

E., 2., c. (Cont'd)

peroneal nerve or its branches. The peroneal nerve courses laterally and then anteriorily around the head and neck of the fibula. The traction pin or wire should be inserted posterior to the cortical bone of the crest of the tibia. A disadvantage of using this site is that the pin holes concentrate stress and may result in a fracture to the holes when weight bearing is resumed. In it is important to avoid transfixing the proximal tibial epiphysial plate, cephalad to the device, and the epiphysial plate of the tibial tubercle, anteriorily. It is important to remember that the traction force to the femur is transmitted not only through the upper tibia but also through the tendons and ligaments about the knee. This is a disadvantage, especially if there is an internal derangement of the knee joint.

d. Distal tibia and fibula. Skeletal traction may be applied through the distal tibia and fibula in the treatment of certain fractures of the leg, especially if the fracture is compound. It may also be combined with a skeletal traction pin through the distal femur or proximal tibia for treatment of fractures of both the femur or pelvis, and fractures of the leg. The traction pin or wire should be introduced, at a site approximately 2-1/2 inches proximal to the tip of the lateral ankle malleolus. The pin or wire is introduced starting laterally and should be directed antero-medially, through the fibula and tibia. The pin or wire should pass through the center of the lateral surface of the fibula, avoiding the peroneal tendon sheaf, and should exit through the center of the medial surface of the tibia, avoiding the extensor tendons and saphenous vein anteriorily, and the tarsal tunnel tendons and neurovascular bundle posteriorily. If the pin or wire is introduced perpendicular to the long axis of the leg, it will exit approximately 2 inches proximal to the tip or the medial malleolus. It is important to introduce the pin or wire this far proximally to avoid entering the ankle joint. The tractor or bow that is applied should be large enough to fit entirely around the sole of the foot without touching the sole. A good piece should also be applied to avoid "foot drop" when the extremity is in traction.

e. Calcaneus. This site for skeletal traction is rarely used because of the great risk of pin tract infection, which, should it occur, is extremely difficult to eradicate. It

E., 2., c. (Cont'd)

is, however, used by some surgeons in the treatment of the resistant club foot, after soft tissue releases posteriorily; it is also occasionally used to attempt to correct position of a severely comminuted fracture of the calcaneus prior to triple arthrodesis. When skeletal traction is used at this site, the traction pin or wire should be inserted as far posterior in the calcaneus as possible. The recommended site or insertion is 1 inch distal and 1 inch posterior to the lateral malleolus, (in the average adult). Retainer wires should be introduced from the lateral aspect of the heel, and should exit medially at a site approximately 1-1/2 inches distal and 1-1/2 inches posterior to the tip of the medial malleolus. Because the calcaneus is composed largely of soft, spongy, cancellous bone, a large diameter pin or wire is used to avoid migration, (i.e., "cutting out"), through the calcaneus. The tendons and neurovascular bundle which passes behind the medial malleolus, and the tendons which pass behind the lateral malleolus should be avoided, as should the talo-calcaneal joint. Care should be taken to avoid insertion of the pin or wire in soft tissue between the calcaneus and the Achilles tendon. A pin placed in this site can lead to soft slough and infection. The tractor or bow which is attached to the wire or pin should be large enough not to exert pressure on the sole of the foot. A foot plate should also be applied when the specific type of traction is set up.

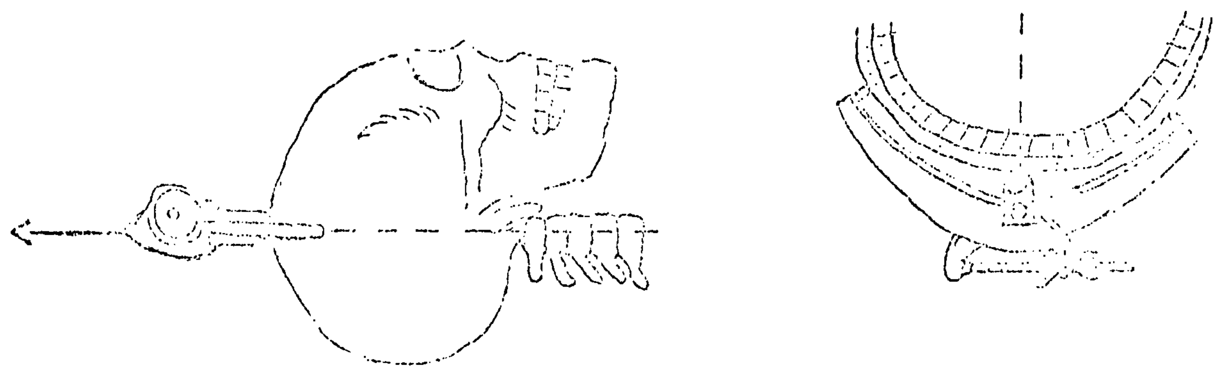
3. Skull. Skull skeletal traction is used by the orthopaedist for treatment of various fractures and fractures-dislocations of the cervical spine. Feasibly, it has also been combined with skeletal traction of the distal femur or pelvis, in conjunction with the operative correction of scoliosis. Presently, skeletal traction is obtained by one of two methods. These are: with the crutchfield tongs; and with the "halo".

   a. Crutchfield tongs. The insertion of crutchfield tongs is often a painful procedure. It is best to insert the tongs in the operating room and the patient should have heavy sedation if local anesthesia is to be used, or should be given general anesthesia. The crutchfield tongs, the drill bits, the traction pin tray, and the local anesthetic tray must be sterilized as for any major operative procedure. The head is then shaved in the two sites where the tongs will be inserted. The skin is then prepped with phisohex and water, with

SKELETAL TRACTION (Cont'd)

E., 3., a. (cont'd)

iodine and alcohol, or with another prepping agent. The gloved surgeon then determines the exact points for inserting the tongs by the following method. The metal loop for attachment of the traction rope is rotated 180 degrees and the span of the tongs is adjusted until the two points touch the scalp in line with the axis of the cervical spine, and at the same time the metal loop touches the scalp in the mid-saggital plane. (See the diagrams below).



The diagrams above illustrate that the mastoid process and the external auditory meatus lie in the axis of the cervical spine. The tongs are usually applied to lie in the axis of the cervical spine, however, if the surgeon desires to apply traction with the neck flexed or extended, a slightly posterior or anterior site of insertion of the tongs should be chosen. The tongs are then gently pushed against the scalp so that a small dent is made where the tongs are to be inserted. Then local anesthetic, if used, is injected into the skin and periosteum of the skull at each site. A small incision is made at each site and is carried down to the galea of the skull. A hole is then drilled through the outer table of the skull with a special drill tip that has a guard that prevents penetration of the inner table. The crutchfield tong points are then inserted into these holes and the metal loop for traction is rotated back to the traction position. The crutchfield tongs are then firmly imbedded into the skull by turning the thumb screw on the tongs. Finger tip tightness should be obtained to firmly lock the position of the crutchfield tong points. Traction can then be applied to the metal loop. See Part G, Individual Types of Skeletal Traction, for further information regarding the clinical use and application of crutchfield tongs.

SKELETAL TRACTION (Cont'd)

E. 3. b. "Halo" skull traction. Halo skull traction is used by many surgeons for treatment of various fractures and fracture-dislocations of the cervical spine. Recently it has been combined with distal femoral traction for maintenance of continued balanced traction in the treatment of scoliosis. It is also used in combination with a plaster body cast, for treatment of cervical fractures with or without cervical fusion. It is also used in combination with pelvic skeletal pins to maintain a constant fixed traction in the care of scoliosis. More information about this use in the treatment of scoliosis is found in Part G, Individual Types of Skeletal Traction.

It is best to apply this traction device in the operating room. The halo device is basically the same described by Perry and Nickel, and used by O'Brien, Yau, De Wald, and Ray. See the Bibliography. The halo head rings are made in four sizes, and the ring about 1/2 inch larger than the circumference of the patient's head should be used. The halo is easier to apply if the patient is in a sitting position but it can be applied with the patient supine. If the patient lies supine, the head is supported at the occiput by a thin, metal or wood strip, placed between the patient's back and the operating table. The patient's head is then shaved at each of the four pin sites and the four areas are prepped with phisohex and water, iodine and alcohol, or with another prepping solution. After the halo, pins, and screw drivers are autoclaved, the gloved surgeon then centers the halo so that the anterior attachment for the vertical traction rod is directly aligned with the nose. Horizontally, the margin of the halo ring should be placed just above the ears and about 1/4 of an inch above the eyebrows. This positioning usually places the anterior pins in the shallow groove on the forehead between the supraorbital ridges & frontal protuberances. The optimum sites for the halo insertion are the sites where the most medial holes in the two frontal attachments, and the two central holes in the posterior attachments are located. An assistant holds the ring in its proper position, and the surgeon inserts the four pins into the four holes in the halo that have been selected. The four pins are then screwed in firmly by using the finger tips. No scalp incisions are needed since the pins easily penetrate the skin and soft tissues. It is important to tighten diagonally opposite pins together to avoid side-to-side drifting. After the four pins are screwed in to maximum fingertip tightness, the diagonally

E., 3., b. (cont'd)

opposite pins are simultaneously tightened with a screw driver to fingertip tightness. If a torque screw driver is used, the pin should be tightened to 5-1/2# of torque. The allen-headed bushing is fastened onto each pin, and then a lock nut is applied to the outside of the pin to prevent increased skull penetration if the pin or bushing should loosen. The three vertical traction rods are then attached to the halo head ring and the specific type of traction is then applied. See Part C, Individual Types of Skeletal Traction.

F. Care of the Patient in Skeletal Traction.

At this time read Part IX, Care of the Patient in Traction. The general care of the patient in skeletal traction is the same. The sites of insertion of the skeletal traction device must be inspected daily. The edge of the sterile dressing should be lifted, and the entrance and exit wounds should be inspected for evidence of drainage or infection. Under discomfort may be an indication of infection, or that the device has not been inserted into bone, with the consequence that the traction force is pulling on soft tissue instead of bone. It may also indicate that traction force is not pulling in the correct direction, or that the traction device was inserted in the wrong axis.

If there is evidence of infection, if the source of discomfort to the patient cannot be corrected, or if it is time to remove the skeletal traction device, the device should be removed using the following technique. First of all the skin at both the entrance and exit sites is cleansed thoroughly. If a traction pin or wire is to be removed, the end that will pass through soft tissue and bone during extraction is prepped with iodine, rinsed with alcohol, and then dried with a sterile 4 x 4. The wire or pin may also be shortened to decrease discomfort to the patient during extraction. If it is shortened, it is best to shorten it and then prep it, making sure that small pieces of metal do not remain attached to the cut end. The traction device is then extracted, and the skin wounds are covered with a sterile dressing.

SKELETAL TRACTION (Cont'd)

G. Individual Types of Skeletal Traction.

1. Upper Extremity.

a. Proximal Ulna Pin Traction.

(1) Clinical Use. Skeletal traction in the proximal ulna can be used to treat fractures of the humerus, supracondylar fractures of the distal humerus that can't be adequately treated by manipulation and casting, and severely comminuted intra-articular fractures of the elbow joint.

(2) Material and Equipment Needed. The above-mentioned fractures may be treated in a lateral, or over-head position. The material and equipment needed for application of over-head upper ulnar skeletal traction is listed on Page 51 in the Traction book by Schmeisser. The material and equipment needed for application of lateral upper ulnar skeletal traction is listed below.

1 Base clamp assembly which can be fastened to the underside of the bed.
1 - 36" traction bar with end clamp.
1 - 27" traction bar.
1 - 9" traction bar with end clamp.
3 pulleys.
2 weight carriers.
15 lbs. of weights.
3 yds. of traction rope.
1 spreader bar with hand grip.
1 traction pin tray.
1 sterile eyelet-type traction screw (optional).
1 local anesthetic tray.
1 shaving device plus skin prepping solution (phisohex and water, iodine and alcohol, or other prepping solution).
1 sterile ring forceps, and 8 sterile 4 x 4's, for prepping the skin.
1 strip of commercial traction tape, or 1 long strip of moleskin, or 4 long strips of 2" adhesive tape.
1 - 3" elastic wrap.
2 - 6" or 10" shock blocks.

(3) Application of Skeletal Traction to the Upper Ulna. The bed is, first of all, prepared. See Figure 43, on Page 49 of the Traction book by Schmeisser. The base

SKELETAL TRACTION (Cont'd)

G., 1., a., (3) (Cont'd)

clamp is, first of all, attached to the undersurface of the bed, and should be positioned to lie at a level beneath the patient's chest. The 36" traction bar is then attached vertically at the end of the base clamp. The 27" traction bar is centrally positioned in the end at the top of this 36" traction bar. The 9" traction bar is clamped to the vertical bar so that it lies in longitudinal axis of the bed, and at the level of the elbow. The three pulleys are then attached: one pulley is attached to the end of the 27" traction bar directly above the elbow; the second pulley is attached near the opposite end of the same crossbar; the third pulley is attached to the 9" traction bar directly opposite the injured elbow. The upper ulnar skeletal traction pin, wire or screw is then inserted. It is best to insert the device in the operating room. See Section E, Sites of insertion of skeletal traction, for a description of the technique of insertion of the pin, wire or screw. The patient is then placed in bed in a supining position. Skin traction is applied to the forearm and is attached to the spreader bar and hand grip. See Part VII, D., Application of skin traction. The 3" elastic wrap is then applied. The traction rope is cut into 1 Yd. and 2 Yd. strips. The 2-yard tope is tied to the spreader bar and hand grip, and is then threaded through the two over-head pulleys, and is attached to a wright carrier. The one-yard strip of rope is attached to the upper ulnar screw, or to the traction bow or K-wire tractor, and is then threaded through the auto-pulley and is attached to a weight carrier. Approximately 10 Lbs. of weight is added to the traction on the upper ulnar skeletal traction device, and 3 to 5 Lbs. of weight is added to the other weight carrier. The amount of weight necessary will vary with the size of the patient and the type of fracture. Counter-traction is maintained by placing shock blocks beneath the legs of the bed on the side of the injured upper extremity. It is easier on everyone, if the shock blocks are positioned before the patient is placed on the bed.

The traction may also be arranged in over-head manner. This position may be needed for correct alignment of a humerus facture, when the proximal fragment of the humerus is adducted and flexed. If the over-head position is used, no shock blocks are needed for counter-traction. An

SKELETAL TRACTION (Cont'd)

G., 1., a., (3) (Cont'd)

additional pulley, and a forearm sling is needed in addition to a longer over-head traction bar. Refer to Figure 45, on Page 51 of the Traction book by Schmeisser.

(4) Tips and precautions.

(a) When the lateral position is used, both skin traction and skeletal traction are used and each should be closely observed for possible complications. See Part IX, Care of the Patient in Traction, and Parts B. and C. of Part VII and VIII, Advantages and Disadvantages of the use of Skin Traction and Skeletal Traction.

(b) When this traction is used the patient must cooperate by remaining flat on his back, and must be as quite as possible. No sitting up can be tolerated, unless the traction can be altered so that the base clamp assembly is attached to the bed spring rather than to the main framework of of the bed. If this modification is made, the backrest can be cranked up to about a 45 degree angle, provided there is no alteration in the orientation of the patient's arm to his trunk.

(c) Follow-up x-rays should be ordered frequently the first few days the patient is in this traction. When there is evidence of distraction at the fracture site, the traction force to the upper ulnar skeletal traction should be decreased.

(d) If this form of skeletal traction proves unsatisfactory, surgical correction can be used, but is not advisable because the traction pin tract is quite close to the operative field.

b. Combinations of Skeletal Traction in the Upper Extremity.

(1) Clinical Use. Combinations of continuous, balanced skeletal traction may be used to treat fractures of the forearm associated with a fracture or fractures of the humerus. Combination skeletal traction is indicated if surgery is contra-indicated because of associated skin lacerations or abrasions, or compounding of the fractures, especially when the patient arrives at the hospital long past the optimal time for surgery.

SKELETAL TRACTION (Cont'd)

G. 1. b. (2) Material and Equipment Needed. The material and equipment needed is essentially the same as that listed under Part G, Sec. a., Skeletal Traction in the Proximal Ulna. (Please refer to that list at this time). An additional pin bow or K-wire tractor is needed.

(3) Application of Combinations of Skeletal Traction in the Upper Extremity. The bed and frame, pulley, etc., are set up exactly as described in Part G., Sec. a., Skeletal Traction in the Proximal Ulna, above. After a pin, K-wire or screw is inserted in the proximal ulna, and a K-wire or pin is inserted in the distal radius and ulna, or in one or more metacarpals, the patient is placed supine on the bed and the traction forces are applied to each of the skeletal traction devices. (Refer to Part VIII, E., Sites of Insertion of Skeletal Traction, and see Pages 52 and 53 in the Traction book by Schmeisser).

(4) Tips and Precautions.

(a) See the Tips and Precautions listed as Part G, Sec. a., Skeletal Traction in the Proximal Ulna.

(b) Approximately ten pounds of traction force should initially be applied to the proximal ulnar traction device. Approximately five pounds of traction force should be applied to the distal radius and ulna, or metacarpal, traction device. Serial x-rays should be obtained and traction forces decreased or increased as necessary. See and read Part IX, Care of the Patient in Traction, at this time.

2. Lower Extremity.

a. Lateral proximal femoral skeletal traction.

(1) Clinical Use. Lateral proximal femoral skeletal traction may be used to treat central fracture dislocation of the hip.

(2) Material and equipment needed.

1 - Base clamp assembly to be attached to the underside of the bed.
1 - 18" Traction bar with end clamp.
1 - 9" Traction bar with end clamp.
1 - Pulley.
2 Yds. of traction rope.

SKELETAL TRACTION (Cont'd)

G. 2. a. (2) Material and equipment needed (Cont'd)

1 - Weight carrier.
15 Lbs. of weights.
1 - Long eyelet-type traction screw, or 1 - 1/8" Steinmann pin.
(A traction pin tray, and prepping solution, and a local anesthetic tray should be available when the pin or screw is inserted).
2 - 6" Shock blocks.

(3) Application of lateral proximal femoral skeletal traction. The eyelet screw or large pin should be inserted in the operating room. (See Part VIII, D., Sites of insertion of skeletal traction, for a description of the technique of insertion of the pin or screw). The bed should be prepared before the patient is placed on it. Since the patient will have considerable pain with movement and should be discouraged from moving, a Bradford frame placed on the bed will help the patient use the bed pan more easily. If the Bradford frame is not used, a firm mattress with bed boards should be used. The base clamp assembly is attached to the undersurface of the bed and the 18" traction bar is attached vertically to the end of the base clamp. These pieces of equipment are positioned near the foot of the bed. Then the 9" traction bar is attached horizontally at the top of the 18" traction bar. Shock blocks are then placed under the legs of the bed on the side of the acetabular fracture. The patient is then positioned on the bed and one end of the traction rope is attached to the eyelet screw or to the pin bow. The traction rope is inserted through the pulley and then is attached to the weight holder. The traction bars are positioned so that the line of traction force pulls in line with the neck of the femur. The weights are then added to the weight holder. No vest-type or posey-type restraint is necessary as counter-traction is maintained with the shock blocks.

(4) Tips and precautions.
(a) This technique is especially advantageous if the superior portion of the acetabulum is crushed.
(b) A disadvantage of this form of traction is that skeletal traction is placed in an area that would interfere with any operative procedure, if the traction fails.

SKELETAL TRACTION (Cont'd)

G. 2. a. (4) Tips and precautions (cont'd)

(c) If for any reason it is anticipated that open reduction of the fractured acetabulum might be necessary, one of the alternate types of traction should be used. (Alternate methods are with "90-90" traction or with balanced suspension traction using a skeletal pin through the distal femur or proximal tibia).

(d) The bed should be tilted to provide adequate counter-traction.

(e) The side rail should be raised on the bed.

(f) Read Part IX, Care of the Patient in Traction.

b. "90-90" Skeletal traction.

(1) Clinical Use. "90-90" Skeletal traction may be used to treat sub-trochanteric fractures; it is also used to treat central fracture dislocation of the hip, especially if the injury is primarily a posterior fracture dislocation.

(2) Material and equipment needed.

One overhead traction frame.
One trapeze.
Four 18" traction bars with end clamps.
Six pulleys.
Three weight carriers.
Thirty pounds of weights.
Twelve yards of traction rope.
One 18" x 12" sling with holes for 2 spreader bars.
Two spreader bars.
One traction pin tray.
One local anesthetic tray.
Prepping solution.
One traction bow or K-wire tractor.

(3) Application of "90-90" Skeletal traction. First the traction pin or wire should be inserted. (Read Part VIII, E., Sites of Insertion of Skeletal Traction). It is best to insert the traction pin or wire in the operating room. Because a heavy traction force is needed to overcome muscle pull, and to lift the leg and thigh from the bed, a 1/8" traction pin or a large 0.62" Kirschner wire should be used. If a smaller wire or pin is used, it may migrate distally, or it might bend. The distal femoral metaphysis

G. 2. b. (3) Application of "90-90", etc., (cont'd)
must be used as the site of insertion of the traction pin. (The proximal tibial metaphysis cannot be used, because the large traction forces needed cause transmission of force to the knee, which is painful). After the traction pin is inserted and sterile dressings are placed over the entrance and exit sites, a traction bow is applied.

The bed is then prepared. Bed boards are placed under the mattress. The overhead frame is attached to the bed as is the trapeze. The four 18" traction bars are then clamped to the overhead 8' frame bar, three bars being clamped distally over the injured pelvis and thigh, and the fourth bar being attached horizontally near the head of the bed. Three pulleys are attached to the proximal 18" traction bar and one pulley each to the distal three 18" traction bars. Six yards of traction rope are doubled to form a three-yard doubled rope and one end is attached to the traction bow. The doubled rope is threaded through the pulley located above the patient's hip and is then threaded through one of the pulleys attached to the proximal 18" traction bar. A weight holder is then applied and about 20 lbs. of weight attached to the weight holder. The hip is thus flexed 90 degrees. A sling is then placed beneath the patient's calf and the two spreader bars are inserted. Ropes are attached to each of the spreader bars, and they are threaded through distal and proximal pulleys and attached to weight carriers. Five pounds of weights are then attached to each of the weight carriers and the knee is held flexed at 90 degrees. (A short leg cast applied before the sling is placed about the calf will prevent foot drop and will provide constant pressure about the calf and leg. This is optional, but is to be recommended). See pages 44-46 in the Traction book by Schmeisser.

(4) Tips and precautions.
(a) Read Part IX, Care of the Patient in Traction, and Part VIII, F., Care of the Patient in Skeletal Traction.
(b) Frequent x-rays should be taken at first so that distraction of a sub-trochanteric fracture can be avoided. The traction force can usually be reduced within several days.
(c) When there is clinical evidence of union, general hip and knee exercises can be initiated. As more

G. 2. b. (4) Tips and precautions - (cont'd)

(c)

union occurs, the traction force should be reduced and the overhead pulleys and traction bars should be moved toward the foot of the bed. This reduces the degree of hip and knee flexion. When the thigh and knee have been brought into a position of about 45 degrees of hip flexion and 45 degrees of knee flexion, the skeletal traction is removed and a spica cast is applied. The patient then is sent home for the remainder of the period of immobilization.

c. Balanced suspension skeletal traction.

(1) Clinical Use. Balanced suspension skeletal traction is used most frequently to treat fractures of the distal two-thirds of the shaft of the femur in older children and in adults. It can also be used to treat fractures of the proximal shaft of the femur and hip.

This arrangement consists of two separate systems, a traction system and a suspension system. The traction system consists of the skeletal pin or wire, the traction bow and its attached traction line, a traction crossbar and pulley at the foot of the bed, and a heavy weight. Counter-traction is maintained by elevation of the foot of the bed with shock blocks. The other system, known as "balanced suspension", is used to suspend the injured lower extremity in such a way as to prevent angulation of the fracture site, especially when the patient is moving in bed or is getting on or off the bed pan. This system consists of a traction splint (Thomas splint, Ilfeld's splint, or Keller-Blake splint), Pearson attachment, supporting towels or slings for the thigh and calf, four suspending traction ropes, two overhead crossbars with pulleys, and four small counter-balancing weights.

Both the traction system and the suspension system are arranged differently, depending upon the level of the fracture of the femur. In general, the more proximal the fracture, the more the proximal fragment is held in flexion by the iliopsoas muscles. In this instance, the distal fragment is aligned with a sharply flexed proximal fragment, the orientation being best obtained with "90-90" traction. Read the last section, "90-90" Skeletal traction.

SKELETAL TRACTION (Cont'd)

G. 2. c. Balanced suspension skeletal traction.

(1) Clinical Use - (cont'd)

The more distal the fracture of the femur, the less the proximal fragment is flexed, and the more the distal fragment is flexed posteriorly by the gastrocnemius muscle. Therefore, when the fracture is located in the lower third or supra-condylar area of the femur, the thigh is not flexed much, but the knee should be more sharply flexed. In treating fractures of the lower third or supra-condylar area of the femur, the Pearson attachment should be fixed to the side bars of the traction splint at the level of the fracture, rather than at the knee joint. This creates a fulcrum around which the limb can be pulled to correct alignment of the fracture.

When the fracture lies in the middle third of the femur, a better balance of muscle pull and the bone fragments prevails, and the thigh should be supported at approximately 40 degrees of hip flexion, with less knee flexion. In this latter instance, the main traction rope should be aligned with the long axis of the thigh.

(2) Material and equipment needed. (For applying balanced traction for a mid-femur fracture).

One overhead frame.
One trapeze.
Four 18" traction bars with end clamps.
Eleven pulleys.
Eighteen yards of traction rope.
Five weight carriers.
Thirty-five pounds of weights.
Two 6 or 10" shock blocks.
One traction pin tray.
One local anesthetic tray.
Prepping material.
One full ring or half ring traction leg splint.
One Pearson attachment.
Two hand towels with 16 large safety pins or spring clips.
One foot plate.

SKELETAL TRACTION (Cont'd)

(3)

G. 2. c. Application of balanced suspension skeletal traction. (For treatment of a fracture of the mid-femur).

The traction pin or large traction wire is inserted through the distal femur or upper tibia. (See Part VIII, E., Sites of insertion of skeletal traction). It is best to insert the pin or wire in the operating room. The bed is then prepared. Bed boards should be placed beneath the mattress. Shock blocks should be placed beneath the legs of the bed. The overhead frame is attached to the bed, and the trapeze is attached to the overhead frame. The four crossbars are then attached to the overhead frame. The two crossbars to be used for support of the splint and leg should be placed directly above each end of the splint. The crossbar for the main traction line should be clamped either to the top of the distal upright pole or close to the foot end of the eight foot longitudinal pole of the overhead frame. The fourth crossbar is attached to the overhead frame at the head of the bed. Five pulleys are attached to the proximal crossbar, two pulleys are attached to the next crossbar, three pulleys to the next crossbar and one pulley is attached to the crossbar at the foot of the bed. (See Figure 31 on page 37 of the Traction book by Schmeisser). A traction splint of adequate length, breath, and design is next chosen. If a half-ring type is used, the half ring is turned downward so that it will lie over the groin rather than posteriorly against the ischial tuberosity. A Pearson attachment is clamped to the sides of the traction splint at the level of the femoral condyles. (If the fracture was a supra-condylar fracture, a Pearson attachment would be clamped to the sides of the traction splint at the level of the fracture). Small hand towels are then pinned to the proximal portion of the splint and onto the Pearson attachment, for use to support the thigh and calf. Then a three-yard traction rope is attached to each of the four corners of the splint, (i.e., from both sides of the proximal ring or half ring and from both sides of the distal end of the splint). The four rope ends are then threaded through the overhead and proximal pulleys and attached to four weight holders. A small strip of rope is used to tie the Pearson attachment to the end of the traction splint, maintaining an angle of about 30 degrees between splint and Pearson attachment. The remaining rope is threaded through the distal and overhead and proximal pulleys and is attached to a weight holder. This latter rope will be used as a main traction line.

SKELETAL TRACTION (Cont'd)

G. 2. c. (Cont'd)

The patient is then brought from the operating room and is transferred from the stretcher to the bed. The injured lower extremity is lifted gently and the traction splint with a Pearson attachment is then slipped into place. The main traction line is tied to the bow, and then 20 pounds of weights are attached to the weight holder. Adequate weights to suspend the splint and leg are then attached to the weight holders of the four supporting traction ropes. The weight needed for suspension and for traction will vary with the size of the patient. Finally a foot plate is attached to the Pearson attachment to maintain foot dorsi-flexion.

(4) Tips and Precautions.

(a) When the balanced suspension system is properly adjusted, the half ring should not press on the skin in the groin.

(b) Remember to provide counter-traction by placing shock blocks beneath the distal legs of the bed.

(c) The patient should be instructed in use of the trapeze and his other leg to move himself vertically, to use the bed pan, and longitudinally to adjust position in bed. His movements should be performed by movements of the trunk and not of the leg nor thigh. The patient should not attempt to turn from the waist down.

(d) When there is clinical evidence of healing, gentle knee and hip exercises may be started. When there is no longer motion at the fracture site, the patient may be removed from the traction and placed in a hip spica cast. He may then be sent home to await further healing.

(e) Read Part IX, Care of the Patient in Traction, and Part VIII, F., Care of the Patient in Skeletal Traction.

d. Combinations of skeletal traction in the lower extremity.

(1) Clinical use. Combinations of skeletal traction may be used to treat fractures of the lower extremity.

SKELETAL TRACTION (Cont'd)

G. 2. d. (1) Clinical use - (cont'd)
(Examples are: a distal femoral traction pin, plus a distal tibia and fibula traction pin for treatment of combined fractures of the mid-femur and tibia and fibula; a proximal tibia pin, plus a distal tibia and fibula pin or a calcaneal pin for treatment of combined supra-condylar femoral fracture and fractures of the tibia and fibula).

(2) Material and equipment needed. The material and equipment needed varies with the combinations of fractures being treated. Additions can be made to the list found on pages 37 and 44 of the Traction book by Schmeisser.

(3) Application of combinations of skeletal traction in lower extremity. The application of combinations of skeletal traction in the lower extremity can be learned by reviewing the figures and discussion of skeletal traction found on pages 29 through 48 of the Traction book by Schmeisser. Reference should be made especially to Figures 25 through 42.

(4) Tips and Precautions.

(a) These combinations of skeletal traction can be used with or without balanced suspension.

(b) When combinations of skeletal traction are used in the lower extremity, care must be taken to avoid distraction at one or both of the fracture sites.

(c) When combinations of skeletal traction are used, there is less chance of early joint motion, and a greater risk of subsequent joint stiffness.

(d) Review Part IX, Care of the Patient in Traction, and Part VIII, F., Care of the Patient in Skeletal Traction.

3. Skull Traction

a. Crutchfield Tong Skeletal Traction.

(1) Clinical use. Crutchfield tong skeletal traction is used to treat an unstable fracture, or fracture-dislocation of the cervical spine. Immediate immobilization of

SKELETAL TRACTION (Cont'd)

G. 3. a. (1) Clinical use (cont'd)
the neck is usually secured by using a head halter. However, this can be used only temporarily because of low tolerance of the skin over the chin and occiput to pressure. Skull skeletal traction is definitely indicated when there is also a fracture of the mandible, or when there are multiple lacerations of the face.

(2) Material and equipment needed.

One bed with bed boards, or a Stryker frame.
One adjustable Buck's extension frame (if a bed is used).
One yard of traction rope.
One weight carrier.
Fifteen pounds of weights.
One Crutchfield tong insertion kit, (see page 55 of the Traction book by Schmeisser), or one sterile Crutchfield tong plus one traction pin tray, plus one local anesthetic tray, plus prepping material.

(3) Application of Crutchfield tong skeletal traction.
Since the insertion of the tongs is painful, it is best to insert them in the operating room using either general anesthesia or heavy sedation and analgesia plus local anesthesia. (Read Part VIII, E., Sites of insertion of skeletal traction for a description of the technique of application of the Crutchfield tongs. After the tongs are inserted, one end of the traction rope is tied to the metal loop of the Crutchfield tongs, and the other end is threaded through the pulley and then is attached to the weight carrier. Ten to fifteen pounds of traction force is usually necessary initially. Counter-traction is maintained by the placement of 6" or 10" shock blocks under the legs at the head of the bed or by elevation of the head end of the Stryker, Foster, or other type of frame.

(4) Tips and Precautions.

(a) If a bed is used, the head should not be rolled up after application of this traction, because that would change the line of traction force.

(b) The patient should be discouraged from unnecessary movements of the head and neck or trunk to avoid possible neurologic injury.

SKELETAL TRACTION (Cont'd)

G. 3. a. (4) Tips and Precautions (cont'd)

(c) It is important, especially during the first few days after the insertion of the tongs, to be sure that the tongs maintain a firm hold on the skull. The tong tightness should be tested and fingertip tightness should be maintained.

(d) Read Part VIII, F., Care of the patient in skeletal traction.

b. "Halo" Skull Skeletal Traction.

(1) Clinical use. "Halo" skull skeletal traction may be used to treat a fracture, or fracture dislocation of the cervical spine. Many surgeons prefer to use a "halo" instead of Crutchfield tongs, because there is a more precise positional control of the head and neck in all three planes. The "halo" can be used alone, to treat cervical fractures or fracture-dislocations, or it can be combined with a body cast. The "halo" may also be used in combination with pelvic or femoral traction pins for immobilization and progressive longitudinal traction and lengthening and stabilization of the entire spine, in treatment of scoliosis. This latter use, in combination with other skeletal traction, will be discussed further in the following section.

(2) Material and equipment needed. (For treatment of cervical fracture or cervical fracture-dislocation).

One hospital bed with bed boards, or one Stryker, Foster, or other turning frame.
Three - one yard strips of traction rope.
Three weight carriers.
Ten to fifteen pounds of weights.
One - 5-1/2 foot traction pole to attach to the head end of the bed.
Three - 9" traction bars with end clamps.
Three pulleys.
One sterile "halo" ring.
One traction pin tray.
One local anesthetic tray.
Material to prep the scalp.
Two - 6" to 10" shock blocks.

G. 3. b. (3) Application of "halo" skull skeletal traction. It is best to insert the "halo" ring device in the operating room. (Read Part VIII, E., Sites of insertion of skeletal traction, for a description of the technique of applying the "halo" ring device). The bed or turning frame is prepared while the patient is in the operating room. If a bed is used, bed boards are placed under the mattress, and shock blocks are placed under the legs at the head of the bed. If a turning frame is used, the head of the frame is elevated. The 5-1/2 foot traction pole is attached vertically to the head of the bed. The three 9" traction bars are then clamped to this up-right pole or to the turning frame. They should be positioned to lie in line with the ring. A pulley is then attached to each of the 9" traction bars. The patient is then brought from the operating room and placed supine on the bed or turning frame. One end of each of the three traction ropes is tied to the "halo" ring. The ropes should be tied equal distance from each other. The three ropes are then threaded through the pulleys and tied to weight carriers. The 9" traction bars and pulleys are then adjusted so that the line of traction force is in line with the cervical spine. (A small pillow may be needed behind the neck). Three to five pounds of weight is then added to each weight carrier. The amount of traction force needed will vary with the fracture type and level.

(4) Tips and Precautions.

(a) If a bed is used, the head of the bed should not be changed in position after the traction is applied. (A change in position could result in neurologic injury).

(b) The side rails of the bed should be elevated at all times. If a turning frame is used, the patient should have a safety belt or posey belt applied, to prevent possible falls from the frame.

(c) Frequent x-rays should be taken initially to avoid distraction at the fracture site.

(d) If the fracture being treated is a stable fracture, or when there is clinical and/or x-ray evidence of healing at the fracture site, the "halo" ring suspension assembly and a body cast

SKELETAL TRACTION (Cont'd)

G. 3. b. (4) Tips and Precautions (cont'd)

(d)

may be added. (Refer to pages 1405 through 1409 of the October, 1968 issue of the Journal of Bone and Joint Surgery. In that article entitled, The Halo, authors Vern Nickel and Jacqueline Perry discuss the technique of applying both the "halo" ring and the body cast).

(e) Read Part IX, Care of the patient in traction, and Part VIII, F., Care of the patient in skeletal traction.

c. Combinations (Crutchfield tong-femoral traction, "halo" pelvic traction).

(1) Clinical use. Combinations of skull skeletal traction, and skeletal traction of the pelvis or distal femurs are used in the pre-operative, inter-operative, and post-operative management of scoliosis. (Refer to the last four articles in the Bibliography for further information).

(2) Material and Equipment Needed. The material and equipment needed to apply a combination of skull and distal femoral traction is similar to that listed for the application of Crutchfield tong skull traction, and distal femoral traction. The material and equipment needed to apply a combination of "halo" skull and pelvic traction is described in the last four articles listed in the Bibliography.

(3) Application of Combinations of Skull Skeletal Traction. The technique of application of "halo" ring-pelvic skeletal traction for use in the treatment of scoliosis is found in the last four articles in the Bibliography. The combination of Crutchfield tong, and bilateral distal femoral skeletal traction is used more frequently than "halo" ring-pelvic skeletal traction. (Read pages 1018 and 1019 in the 1967 American edition of the Journal of Bone and Joint Surgery, for a description of the technique of application of "halo"-femoral pin distraction in the treatment of scoliosis).

SKELETAL TRACTION (Cont'd)

G. 3. c. (4) Tips and Precautions.

(a) When skull skeletal traction is combined with pelvic or femoral skeletal traction to treat scoliosis, the attending physician must be aware that the distraction force can produce nerve palsy. Brachial plexus, recurrent laryngeal nerve, and cranial nerve palsies have occurred. If a nerve palsy occurs during the use of skull pelvic or skull femoral traction, the distracting force should be immediately lightened.

(b) When the "halo" ring is attached to a plaster cast or when "halo"-pelvic traction is used, this is a form of fixed traction. If continuous traction forces are used, as with Crutchfield tong skull-distal femoral skeletal traction, this is a form of continuous balanced traction.

(c) Read Part IX, Care of the patient in traction, and Part VIII, F., Care of the patient in skeletal traction.

IX. CARE OF THE PATIENT IN TRACTION

The patient who is placed in traction requires daily care and observation. He can not be left unattended for days at a time or complications are likely to occur. The nursing staff, and you the orthopaedist, must be constantly on the look out for complications that arise from traction procedures. Examples of complications to look for are as follows:

1. Bed sores frequently occur if precautions are not taken to prevent them. Constant pressure especially over the sacrum, heels and elbows must be avoided. Constant turning from side to side if possible, the use of an air mattress or local sheep skin pads, or "donuts" will help to releave the constant pressure in these areas. Excess moisture produced either by involuntary urination, defecation, or perspiration must be treated and the patient must be kept dry. The application of corn starch to the sheet to the bed helps decrease some of this excess moisture. Catabolism increases in the bedfast patient and should be combated with an adequate diet.

2. There is an increase phlebitis in the recumbent patient. Daily checks for calf or thigh tenderness should be a part of the rounding procedure. Complaints of chest pain associated with shortness of breath or should be investigated thoroughly.

3. Local pressure from the traction apparatus must be avoided. Pressure from the Thomas splint in the perineum may produce pressure sores or abrasion which will give the patient considerable discomfort until the pressure is relieved. Skin traction should be rewrapped daily to observe the condition of the skin and to ascertain whether or not any bloods are developing beneath the adhesive tape or traction tapes. Rewrapping of the skin traction helps to redistribute pressure to the skin.

4. Circulation distal to the skin traction wrap must also be carefully observed. If the circulation sensation or motion of fingers or toes appears to be impaired, the bandage should be removed immediately. If the neurovascular exam then returns to normal, the wrap can be reapplied less snuggly.

5. Skeletal traction pin, wire, or tong sites must be carefully and frequently checked for evidence of infection or loosening, should the wire or pin be found to be sliding back and forth, it should be removed and replaced elsewhere. The infected pin site should be treated by removal of the pin as soon as the infection is noted.

IX. CARE OF THE PATIENT IN TRACTION

6. Traction must be maintained at all times. The Thomas splint occasionally jams the pulley so that the rope cannot run freely thereby eliminating the success of the traction. Friends or relatives frequently raise the weights and place them on a chair in order to give the patients a "rest". Countertraction is not adequate and the patient slides toward the traction, the ropes may jam in the pulley or the weights may come to rest on the floor. All of these things should be avoided and corrected.

To facilitate good care of the patient nurse's aids, physical therapist, and x-ray technicians and others who come in contact with the patient should receive instructions as to the function of the traction device:

1. Nurses and aids. These personnel should understand the complications to be on the look-out for with the particular traction device used. They should be aware of the importance of maintenance of traction. They can help the orthopaedist greatly by answering questions friends and relatives of the patient have about traction and by giving these friends and relatives instructions not to take the weights off the traction, nor to bump the ropes, etc.

2. Physical therapist. The physical therapist can help the patient in traction by starting him on a vigorous physical therapy program to maintain strength and motion in muscles and joints not held in traction.

3. X-ray technicians. They should receive instructions not to take the patient out of traction while taking their x-rays. They should receive information as to what the patient can do to help them position their cassetts for the taking of the x-rays. It is helpful also for the orthopaedist to specifically state the particular bones or joint he wants included in the x-rays he orders.

The importance of a continuing physical exercise program cannot be over-emphasized. This can be started by the physical therapist, but should be continued by daily encouragement from the nursing staff and you the orthopaedist. Deep breathing and abdominal sitting exercises can be practiced from the start of the hospitalization. Muscle sitting exercises may usually be done in the injuried extremity as soon as pain permits. The patient should spend a few minutes several times a day going through a range of motion of joints of the extremities not placed in traction. He can also lift 5 to 10 lbs weights with the uninjuried arm or leg. Limited range of motion exercises of the joints immediately above and below the fracture site may be initiated when evidence of callous formation appears on the x ray.

The patient should also receive instructions as to the function and purpose of the traction. He should receive instructions as to how he may more easily use the bed pan and also how to use the trapeze. He should also receive instructions as to how he can avoid pressure sores and he should know the symptoms of the complications of encircling skin and skeletal traction. He should also receive instructions regarding the importance of a continuing active exercise program and should know specifically which exercises he should do. He should be kept informed regarding the progress of fracture healing, length of time necessary in traction, complications when they do occur, and the future rehabilitation program after he is taken out of traction.

<u>Reason Why Traction Needs To Be Adjusted or Modified.</u>

Traction needs to be adjusted or modified for the following reasons.

1. If it is improperly applied or aligned.

2. If there is a change in fracture alignment, or there is a need to improve fracture alignment, as shown by x-ray or examination.

3. If the patient becomes uncomfortable after the initial application of traction.

4. If there is a change in the traction by unqualified personnel, (such as, the patient, visitors, unskilled hospital personnel, etc.).

5. If there is a failure of a part of the traction, (such as, clamps becoming displaced, nuts slipping, or the ropes breaking).

6. If there is soiling of a part of the traction and modifications need to be made to keep the patient clean.

7. If there is development of decubitus ulcers, or for another medical problem.

8. If it is necessary to transport the patient to the operating room, x-ray, or to another part of the hospital.

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ORTHOPAEDIC TRACTION SKILLS LABORATORY

Laboratory Manual

PART I. The Traction Laboratory*

Ideally, the Traction Laboratory should be situated near the orthopaedic wards, or on the same floor of the hospital where the orthopaedic rooms or wards are located. In the room designated as "the laboratory" the following should be found:

1. A hospital bed of the type presently used.

2. Equipment attached to, or placed on the bed. (This includes the bed boards, shock blocks, traction bars, a trapeze, rope, pulleys, weight holders, weights, and a Bohler-Braun frame). This, ideally, should be placed on a traction cart.

3. Equipment attached to, or around the patient. (This should include several sizes of Thomas splints, several types of half-ring splints, several Pearson attachments, six to eight hand towels, a box of large safety pins, slings, spreader bars, head holders, pelvic slings, pelvic belts, anklets and the commercial type or bias type stockinette to make an anklet, a box of large tongue depressors, two-inch adhesive tape, or moleskin, or commercial traction tape for application of skin traction, a traction pin tray, a local anesthetic tray, a bottle of local anesthetic, several marking pencils, and materials used to shave and cut an extremity).

4. A small table, a slide projector, and carousels of slides to be used with the student manual.

5. A copy of each book listed in the Bibliography, if possible; a copy of each of the articles listed in the Bibliography, and an anatomy textbook.

6. Several copies of the student manual, and several copies of the laboratory manual.

7. Ten rolls each of three-inch and four-inch plaster, plus rolls of sheet wadding, a plaster bucket, and plaster cutting instruments (optional).

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*The orthopaedic resident, or the student, should have access to this room at all times. The room is situated near the orthopaedic wards, and is designed in such a way that any part can used at any time in the development of traction skills. No instructor is needed to "run" this laboratory.

PART II. Questions and Exercises

A. The Objectives and Limitations of Traction

1. What are the objectives of traction?

2. What are the limitations of traction?

B. The Principals of Traction and Counter-traction

1. List the principals of traction.

2. What factors influence the efficiency of traction.

3. List ways to provide counter-traction.

4. Why is counter-traction necessary?

C. The Traction Equipment

1. Why are bed boards needed?

2. Identify by name and function all the traction devices stored on the traction cart.

3. Practice tying the slip knot.

D. Encircling Traction Devices

1. List three advantages of using an encircling traction device.

2. List three disadvantages of using an encircling traction device.

3. List clinical situations in which a traction splint and anklet are applicable.

4. Apply a traction splint and anklet to your partner's right or left lower extremity.

5. List clinical situations in which a pelvic traction belt might be used.

6. Apply a pelvic traction belt to your partner and correctly construct the traction system.

D. Encircling Traction Devices - Continued

7. List clinical situations in which a pelvic sling might be used.

8. Apply vertical, and crossed, pelvic sling traction to your partner.

9. List clinical situations in which head halter traction might be used.

10. Apply head halter traction to your partner.

E. Skin Traction

1. List four advantages of skin traction.

2. List four disadvantages of skin traction.

3. List four things to check when checking a patient in skin traction on "rounds".

4. List clinical situations in which Buck's skin traction might be used.

5. Apply Buck's traction to your partner's right or left leg.

6. List the clinical situations in which Russell's traction might be used.

7. What is accomplished by adding two traction pulleys distally?

8. Apply Russell's traction to your partner's right or left leg using:

   a. the bed and overhead traction.
   b. the Bohler-Braun frame.

9. How does "split" Russell's traction differ from Russell's traction?

10. List clinical situations in which "split" Russell's traction might be used.

11. Apply "split" Russell's traction to your partner's right or left leg.

E. Skin Traction - (Continued

12. List clinical situations in which Bryant's traction might be used.

13. Apply Bryant's traction to a small child. (The child can be brought from the orthopaedic ward for this exercise).

14. List clinical situations in which Dunlop's traction might be used.

15. Apply Dunlop's traction to your partner's right or left upper extremity.

16. Apply double skin traction on your partner's right or left upper extremity.

17. Apply double skin traction on your partner's right or left lower extremity.

F. Skeletal Traction

1. List four advantages of the use of skeletal traction.

2. List four disadvantages of the use of skeletal traction.

3. Examine the traction pin tray.

4. List the essential components of the traction pin tray.

5. Examine the local anesthetic tray.

6. List the essential components of the local anesthetic tray.

7. With a marking pencil, mark the correct sites of insertion of skeletal traction on your partner, at the following sites:

   a. Proximal ulna.
   b. Distal radius and ulna.
   c. Metacarpals.
   d. Proximal femur.
   e. Distal femur.
   f. Upper tibia.
   g. Distal tibia and fibula.

F. Skeletal Traction - Continued

7. h. Calcaneus.
   i. Skull Crutchfield Tong.
   j. Skull - "Halo".

8. List five things to check, when examining the patient in skeletal traction on daily rounds.

9. List clinical situations in which lateral proximal femur skeletal traction might be used.

10. Set up the traction equipment for application of lateral proximal femur skeletal traction.

11. List clinical situations in which "90-90" skeletal traction might be used.

12. Set up the traction equipment for application of "90-90" skeletal traction.

13. List clinical situations in which balanced suspension might be used.

14. List two advantages of the use of balanced suspension.

15. Define the following and give an example of each:

    a. Balanced traction.
    b. Fixed traction.
    c. Balanced suspension traction.

16. Apply balanced suspension traction to your partner's right or left lower extremity using single, and double skin traction.

17. List three skeletal traction devices that might be inserted.

18. List clinical situations in which proximal ulna skeletal traction might be used.

19. Set up the traction equipment for application of proximal ulna skeletal traction.

F. Skeletal Traction - Continued

20. Apply skin traction to your partner's right or left arm and attach the traction equipment to simulate proximal ulna skeletal traction:

    a. in the lateral position.
    b. in the overhead position.

21. Apply combinations of skin traction to your partner's right or left arm and forearm to simulate combinations of skeletal traction in the upper extremity. Set up the traction in the lateral position.

22. Examine the Crutchfield Tongs.

23. List clinical situations in which Crutchfield Tongs might be used.

24. Read Part IX, E, Sites of Insertion of Skeletal Traction. Describe the technique of Crutchfield Tong insertion to your partner.

25. List three precautions that must be taken when a patient with an unstable, cervical spine fracture is treated in Crutchfield Tong traction.

26. Examine the Halo ring.

27. List clinical situations in which "Halo" ring skull traction might be used.

28. Read Part IX, E, Sites of Insertion of Skeletal Traction. Describe the technique of insertion of "Halo" ring skull traction to your partner.

29. List the advantages of "Halo" ring traction over Crutchfield Tong traction.

30. List three combinations of skull traction with other skeletal traction in the treatment of scoliosis.

31. Set up the traction equipment for application of:

    a. Crutchfield Tong skull traction for the treatment of a cervical spine fracture.

F. Skeletal Traction - Continued

31. b. "Halo" skull skeletal traction for the treatment of a cervical spine fracture.

c. Crutchfield Tong - distal femoral skeletal traction for the treatment of scoliosis.

d. "Halo" ring - pelvic skeletal traction for the treatment of scoliosis.

e. "Halo" ring - distal femoral skeletal traction for the treatment of scoliosis.

G. Adjustments to traction

1. Review slides Nos. ___ through ___. List adjustments or modifications necessary to correct each of these examples of improperly applied traction.

2. Incorrectly apply each of the following types of traction and ask your partner, or a fellow resident, to correct the mistakes:

a. traction, splint, and anklet.
b. pelvic traction belt.
c. pelvic sling.
d. head halter.
e. Buck's skin traction.
f. Russell's traction.
g. "Split" Russell's traction.
h. Bryant's traction.
i. Dunlop's traction.
j. "90-90" traction, (using skin traction).
k. Balanced suspension traction (using skin traction instead of skeletal traction).
l. proximal ulnar traction (using skin traction to the arm instead of skeletal traction).
m. combinations of skin traction to the forearm and arm, in the lateral and overhead position.
n. combinations of skin traction to the leg and thigh, in:

(1) balanced traction using the traction equipment
(2) balanced traction using the Bohler-Braun frame.
(3) balanced suspension traction.

G. Adjustments to traction - continued

2. o. a combination of head halter and bilateral Buck's traction to the legs to simulate skull-femoral skeletal traction.
   p. a combination of head halter and pelvic traction belt traction to simulate skull-pelvic skeletal traction.

H. Care of the Patient in Traction

1. List five complications of traction.

2. Give instructions for the patient in traction to the following personnel:

   a. Nurses and aides.
   b. Physical Therapists.
   c. X-ray Technicians.

3. List five general instructions given to the patient in traction that will help him understand and get along with his traction and will help avoid complications of traction.

4. Outline a rehabilitation program for the patient in traction.

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GB/mp
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