

Basic Principles and Practices of Orthotics; A Course for Trainee Orthotists

By LEROY WM. NATTRESS, JR., M.A. and ROY SNELSON, C.O.

During the past few years the Prosthetics Education Program at the University of California, Los Angeles, in cooperation with the Southern California Society of Orthotists and Prosthetists, has offered an evening school program for both trainees and certifees. These courses have had general application for both orthotists and prosthetists.

A year ago, following many requests from the local profession, a new type of course was offered. It was called, "Basic Principles and Practices of Orthotics," and was the first course given specifically for orthotists at U.C.L.A. The course met for two hours on Monday and Wednesday evenings, from mid-September through June and was attended by between nine and twelve trainees each night.

"Basic Principles and Practices of Orthotics" was designed to augment the training given in the local orthotic facilities. It was intended to be the introductory course to an integrated four year program which would offer numerous courses, including such material as fitting and fabrication techniques, public and professional relations and biomechanics and anatomy.

This course, and the ones to follow, was not intended for pre-employment training. That is, individuals who are interested in entering the field of orthotics, but who are presently employed in other fields, are not eligible to enter this course in order to prepare to become orthotists. These courses are open only to those who are already training to become orthotists in recognized facilities.

After much consideration, it was concluded that the basic principles and practices of orthotics that should be included in an introductory course were those that involved the tools, equipment and materials used in fabricating orthopedic appliances. This knowledge is not only basic to the more advanced work in orthotics, but also is important in the proper service of the patient referred to a facility for an orthopedic appliance. Better patient service, of course, means a higher degree of patient satisfaction which will place the orthotic facility on a higher professional plane.

Since it was felt that this course adequately filled the need for basic training of orthotists it was requested that the experience gained from presenting it be shared with the O.A.L.M.A. in hopes that similar courses for trainee orthotists will be presented in other areas of the country.

How to Plan the Course

When the decision to support a course in "Basic Principles and Practices of Orthotics" has been made by a local group of orthotists, a *representative* committee should be formed. This committee should include certified employees as well as facility owners who are not only leading orthotists in the area, but also potential instructors for the course.

The prime responsibility of this committee is to assist in arranging to have the course taught through a recognized academic institution—a local university, college or high school. Once this has been arranged, the committee continues in an advisory role, advising and supporting the educational institution as it prepares and presents this program.

In this advisory role the committee should review the outline for the course which should be based on local needs, and suggest teachers for the units of instruction. Experience has shown that it is often advantageous to have the instructional units assigned alternately, so that no instructor is required to prepare and teach more than eight consecutive hours.

The committee may also be of help in securing a teaching facility that will permit the course plan to be carried out. The teaching facility should be equipped for machine and tool work, as well as for plaster, plastic and leather work. The size of this facility and the number of work stations in it will be the limiting factors in the number of students who will be able to take the course. In addition, provisions for a lecture area should be planned. This area does not necessarily have to have seating for the students, but should have a blackboard that is easily visible from the work stations. The teaching facility should also be easily adapted for the placement of movie projection equipment used in screening teaching films.

Finally, the committee must take steps to help obtain students for the program and advise the educational institution on the tuition fee for the course. The students must be trainee orthotists who are employed in the local orthotic facilities. Since the course is an outgrowth of local needs as established by the local profession through their advisory committee, it must be supported by each facility if its full value is to be obtained.

The tuition does not necessarily have to be based on the costs of the course. Some tuition should be charged, as people tend to value things in terms of what they pay for them. On the other hand, an exorbitant tuition should be avoided since it would tend to discourage students from taking the course. The cost of tuition to the student may be reduced if the employers subsidize their trainees, or if the local organization of orthotists offers traineeships.

Both of the above mentioned means for reducing trainee tuitions were used in the course that was given at UCLA. While few employers actually paid their trainee's tuition, a number indicated that when the trainee completed the course he would receive a salary increase in proportion to the skills that he acquired and the grade that he received. In addition, the Southern California Society of Orthotists and Prosthetists made available a number of traineeships for which trainees could apply.

Teaching Aids

The instructors, in preparing their instructional units, should not rely entirely upon their experiences and backgrounds. There are many sources of information for use as resource material in "Basic Principles and Practices of Orthotics," though few are prepared expressly for this purpose.

The following primary sources were used in planning and instructing this course:

1. *Orthopaedic Appliance Atlas*, Volume I, J. W. Edwards, Ann Arbor, Mich. \$10.00 a copy. (Available through OALMA, 411 Associations Bldg., Washington 6, D. C.)
2. *Machinery's Handbook*, The Industrial Press, 148 Lafayette St., New York, N. Y.
3. *American Machinist's Handbook*, McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.

More specific references for each instructional unit are listed in the accompanying course outline.



Leroy W. Nattress, Jr.



Roy Snelson

Mr. Nattress received his Bachelor of Arts Degree in Psychology from Hope College, Holland, Mich. in 1954 and his Master of Arts Degree in Education from UCLA in 1957. In September 1956 he received an appointment as Course Coordinator for the Prosthetics Education Program, UCLA.

Mr. Snelson is the Chief Orthotist for the Respiratory Center for Poliomyelitis, Rancho Los Amigos Hospital, Hondo, Calif. In September 1956 he received an appointment as Instructor in Clinical Orthotics for the Prosthetics Education Program under the UCLA School of Medicine.

The booklets and charts listed in the course outline are available without cost, unless otherwise specified, for teaching purposes. These should be ordered well in advance of teaching the unit. Sufficient copies of these should be requested so that each student may have his own copy for study and reference.

Movies can also be an important aid to the instructor as they graphically present many of the fine points of the subject under consideration. Educational films are available through local school boards, colleges and universities, film rental libraries and from the companies whose products are demonstrated. Small rental fees may be charged for films to defray mailing and maintenance costs. To be certain that the films desired will be available when the instructional unit is presented, they should be requested from three to six months prior to that time.

In addition, outside speakers are of value in presenting a course of this type. Many tools and materials that could profitably be used by the orthotist are unknown to him since he has neither the time, nor, in many cases, the background to keep up with these items. A man whose job it is to work with these every day can often lead a more integrated discussion of such subjects and even impart new information and knowledge to the instructor. Past experience with representatives of the aluminum, plaster, and leather industries was most rewarding. These men spoke to the class about the kinds of material that are available and their orthotic applications, not about the commercial products they desired to sell orthotists.

Examinations

Following each unit of instruction there should be an examination, either written, practical, or both, to show the instructor and his students how well they have covered the instructional unit. These examinations are an invaluable teaching aid for they serve not only as a check on the instructor, but also as an impetus to the student.

Written examinations should be devised by the instructor when he is preparing the instructional unit. They should be objective in nature, using either multiple-choice or true-false type questions, avoiding fill-in-the-blank and essay type questions. Experience has shown that the multiple-choice questions give the best picture of the student's mastery of an instructional unit.

Practical examinations should also be devised when the instructional unit is prepared. The following is an example of a practical examination given to a class of ten students working in teams of two:

Station 1—Drill six holes in aluminum bar stock, $\frac{1}{4}$ " from the edge and $\frac{1}{2}$ " apart. Two holes are to be tapped with an 8/32 tap; four holes for $\frac{1}{8}$ " rivets. Materials used: drill press, center punch, ball peen hammer, $\frac{1}{8}$ " and No. 29 drills, 6" scale and dividers.

Station 2—Tap two holes in the aluminum bar stock. Screw in two machine screws. Materials used: 8/32 taps, 8/32 machine screws, countersink, a variety of screw drivers so that the student must select the correct one.

Station 3—Rivet the four remaining holes in the aluminum bar stock and set the heads. Materials used: $\frac{1}{8}$ " iron rivets, a variety of rivet sets, rivet cutter, anvil and hammers.

Station 4—Remove two of the four rivets from the aluminum bar stock. Materials used: a variety of chisels, starting punches and hammers.

Station 5—Bend the aluminum bar stock to a prescribed shape. Materials used: aluminum bar stock, bending irons, vise, and a sample piece of bent stock.

This examination can be graded on a five-point scale according to the work done, time taken, tools selected for use, etc.

Another type of practical examination used to draw together the year's work was a year-end project in which the students were assigned to do various operations which were parts of a typical orthopedic appliance. Each operation called upon the trainee to put his learning about tools and materials into practice. This typical appliance was not meant to be a completed device, but was intended as a demonstration of fabrication techniques and skills.

Course Outline

Part A—TOOLS AND EQUIPMENT USED BY ORTHOTISTS

Student Greeting and Course Orientation—1 hour

Unit I—The Engine Lathe and Its Operations

Lecture $3\frac{1}{2}$ hours. Shop Practice: $5\frac{1}{2}$ hours. Review and Examination: 2 hours.

A. Skills and Knowledge to Be Taught

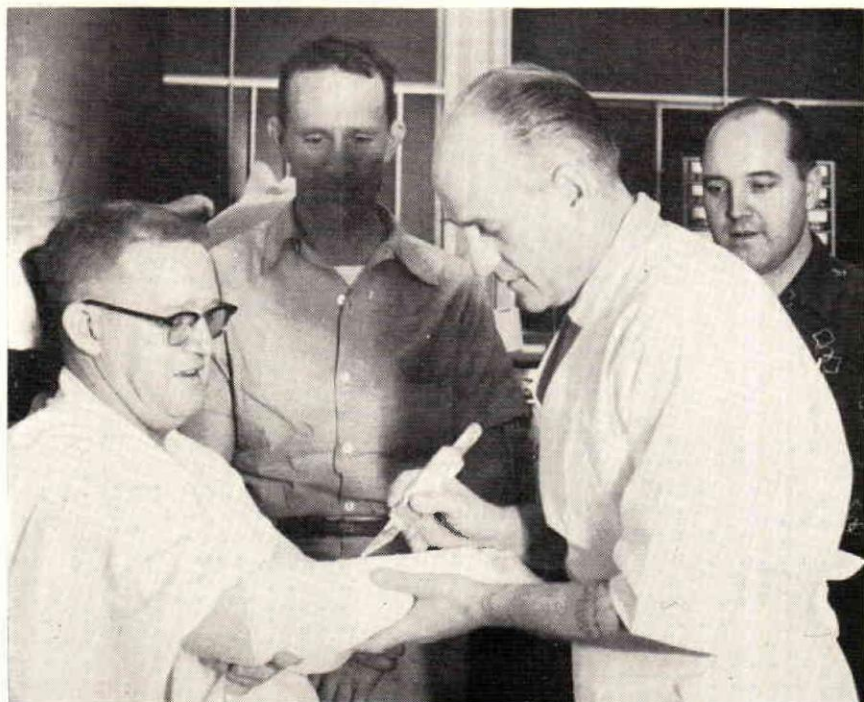
1. Principles of operation and parts of the engine lathe.
2. Set up of the engine lathe.
3. Layout of machine work.
4. Engine lathe operations including turning, boring, cutting screw threads, etc.

B. Materials and Equipment Needed

1. One engine lathe fully equipped.
2. Brass, stainless steel and aluminum stock.

C. Available Teaching Aids

1. Movies.
 - a. Elementary Operations on an Engine Lathe—Part I.
Encyclopedia Britannica Films
SOUND 10 minutes



Kenneth Dodd, C.O., Associate Instructor in Clinical Orthotics, UCLA School of Medicine, demonstrates plaster cast techniques to members of the class in "Basic Principles and Practices of Orthotics."

b. Elementary Operations on an Engine Lathe—Part II.
Encyclopedia Britannica Films
SOUND 10 minutes

c. The Lathe.
South Bend Lathe Works, South Bend 22, Ind.
SOUND 20 minutes

d. Grinding Cutter Bits.
South Bend Lathe Works, South Bend 22, Ind.
SOUND 20 minutes

e. Plain Turning.
South Bend Lathe Works, South Bend 22, Ind.
SOUND 20 minutes

f. How to Machine Aluminum.
Aluminum Company of America, Pittsburgh 19, Pa.
SOUND 32 minutes

2. Booklets

a. How to Run a Lathe—\$.50.
South Bend Lathe Works, South Bend 22, Ind.

Unit II—The Drill Press and Its Operations
Lecture: 1½ hours. Shop Practice: 2½ hours.

A. Skills and Knowledge to Be Taught

1. Principles of operation and parts of the drill press.
2. Operation of drill press in drilling various types of materials.
3. Care and use of drills.
4. How to sharpen drills.

B. Materials and Equipment Needed

1. Two or more drill presses.
2. Two sets of fractional drills, one set of number or wire gauge drills, and one set of letter drills.
3. At least one drill-sharpening grinder.
4. Steel and aluminum sheet and bar stock.

C. Available Teaching Aids

1. Movies.

- a. The Use and Abuses of Twist Drills.
Cleveland Twist Drill Company, 1242 East 49th Street, Cleveland 14, Ohio
SOUND 30 minutes

2. Booklets

- a. How to Run a Drill Press—\$.25.
South Bend Lathe Works, South Bend 22, Ind.
- b. The Use and Care of Twist Drills.
Cleveland Twist Drill Company, 1242 East 49th Street, Cleveland 14, Ohio

3. Charts.

- a. Tap Drill Sizes and Decimal Equivalents.
Any tool and supply company.

Unit III—Hand Tools, Their Care and Use

Lecture: 2 hours. Practice: 3 hours. Examination: 1 hour.

A. Skills and Knowledge to Be Taught

1. Types and characteristics of hand tools used by Orthotists.
2. The proper care and use of each tool

B. Materials and Equipment Needed

1. At least one set of hand tools for each pair of students.
2. Hardware and materials for shop practice.

C. Available Teaching Aids

1. Booklets.

- a. Basic Hand Tool Skills—\$1.00.
NAVPERs 10085, U. S. Government Printing Office, Washington 25, D. C.
- b. ABC's of Hand Tools.
Public Relations Department, General Motors Corporation, Detroit, Mich.
- c. Files, How to Select, Use and Conserve Them.
Delta File Works, James and Buckius Street, Philadelphia 37, Pa.
- d. File Philosophy.
Nicholson File Company, Providence 1, R. I.
- e. Disston Saw, Tool and File Manual.
Henry Disston Division, H. K. Porter Co., Inc., Philadelphia, Pa.

Unit IV—Hack Saws and Band Saws.

Lecture: 1 hour. Shop Practice: 3 hours.

A. Skills and Knowledge to Be Taught

1. Principles of operation and parts of the band saw.
2. Set up of the band saw.
3. The proper blade for each job.
4. The proper care and use of hack saws.

B. Materials and Equipment Needed

1. Two or more band saws with a variety of blades.
2. At least one hack saw and set of blades, for each pair of students.
3. A variety of materials for sawing.

C. Available Teaching Aids

1. Booklets.

- a. Disston, Saw, Tool and File Manual.
Henry Disston Division, H. K. Porter Co., Inc., Philadelphia, Pa.

Unit V—Abrasives

Lecture: 1½ hours. Shop Practice: 2½ hours.

A. Skills and Knowledge to Be Taught

1. Types and characteristics of abrasives.
2. The correct abrasive for the job to be done.
3. The care and maintenance of abrasive tools.
4. Principles of grinding and polishing.

B. Materials and Equipment Needed

1. At least one grinding or one polishing wheel for each pair of students.
2. One Burr-Master.
3. Samples of manufactured and natural abrasives.
4. A variety of materials for grinding and polishing.

C. Available Teaching Aids

1. Movies.
 - a. Manufactured Abrasives.
U. S. Bureau of Mines.
SOUND 24 minutes
2. Booklets.
 - a. Grinding Wheel Data Book.
Simonds Abrasive Co., Philadelphia 37, Pa.
 - b. A Primer on Grinding Wheel Safety.
Norton Co., Worcester 6, Mass.

Unit VI—Shop Mathematics

Lecture and Practice: 4 hours.

A. Skills and Knowledge to Be Taught

1. Basic mathematical skills, addition, subtraction, etc.
2. Decimals and fractions.

B. Materials Needed

1. Practical shop problems.
2. Theoretical shop problems.

Unit VII—Precision and Non-Precision Measuring

Lecture: 2 hours. Practice: 2 hours.

A. Skills and Knowledge to Be Taught

1. Principles of operation and parts of precision and non-precision measuring tools.
2. The use of non-precision measuring tools.
3. The use of precision measuring tools.

B. Materials and Equipment Needed

1. One set of measuring tools for each pair of students, (yard stick, tape measure, micrometer, vernier caliper, dividers, calipers and protractor).
2. An assortment of materials of predetermined measurements.

C. Available Teaching Aids

1. Movies.
 - a. The Tools and Rules for Precision Measuring.
L. S. Starrett Co., Athol, Mass.
SOUND 30 minutes
2. Booklets.
 - a. The Tools and Rules for Precision Measuring.
L. S. Starrett Co., Athol, Mass.
 - b. How to Read, Use, Care for Micrometers and Vernier Gauges.
L. S. Starrett Co., Athol, Mass.
3. Charts.
 - a. Micrometer and Vernier Caliper Charts, Brown and Sharpe Co., Providence, R. I.

Review of Course to Date—1 hour

Mid Semester Examination—1 hour

Part B—MATERIALS AND THEIR APPLICATIONS IN ORTHOTICS

Unit VIII—Steels

Lecture: 2 hours. Shop Practice: 4 hours.

A. Skills and Knowledge to Be Taught

1. Manufacture of steel.
2. Properties of various types of steel used in Orthotics.
3. Commercial aspects of steel.
4. How to machine various kinds of steel.

B. Materials and Equipment Needed

1. One well-equipped shop.
2. Various types of steel for machining.

C. Available Teaching Aids

1. Movies.
 - a. Stainless Steel.
U. S. Bureau of Mines
SOUND 29 minutes

2. Booklets.
 - a. The Picture Story of Steel.
American Iron and Steel Institute, 150 East 42nd St., New York 17, N. Y.
 - b. Stainless Steel Handbook.
Allegheny Ludlum Steel Corp., Brackenridge, Pa.

Unit IX—Aluminum

Lecture: 3 hours. Shop Practice: 5 hours. Review and Examination: 2 hours.

- A. Skills and Knowledge to Be Taught
 1. Manufacture of aluminum.
 2. Properties of various kinds of aluminum used in Orthotics.
 3. Commercial aspects of aluminum.
 4. How to machine various kinds of aluminum.
- B. Materials and Equipment Needed
 1. One well-equipped shop.
 2. Various types of aluminum for machining.
- C. Available Teaching Aids
 1. Movies.
 - a. This is Aluminum.
Aluminum Company of America, Pittsburgh 19, Pa.
SOUND
30 minutes.
 2. Booklets.
 - a. ALCOA Aluminum Handbook.
Aluminum Company of America, Pittsburgh 19, Pa.

Unit X—Forging and Brazing Surgical Steel

Lecture: 2 hours. Practice: 4 hours

- A. Skills and Knowledge to Be Taught
 1. Principles of forging and brazing.
 2. How to forge surgical steel joints.
 3. How to braze surgical steel.
- B. Materials and Equipment Needed
 1. One anvil, hammer and torch for each pair of students.
 2. Surgical steel bar stock.

Unit XI—Welding Steel

Lecture: 2 hours. Practice: 4 hours.

- A. Skills and Knowledge to Be Taught
 1. Principles of operation and care of welding equipment.
 2. Principles of welding steel.
 3. How to weld steel.
- B. Materials and Equipment Needed
 1. One welding outfit for each pair of students.
 2. Welding rod and steel for welding.

Unit XII—Welding Aluminum

Lecture: $\frac{1}{2}$ hour. Practice: $1\frac{1}{2}$ hours.

- A. Skills and Knowledge to Be Taught
 1. Principles of welding aluminum.
 2. How to weld aluminum.
- B. Materials and Equipment Needed
 1. One welding outfit for each pair of students.
 2. Welding rod and aluminum stock for welding.
- C. Available Teaching Aids
 1. Movies.
 - a. Torch Welding.
Aluminum Company of America, Pittsburgh 19, Pa.
SOUND
17 minutes
 2. Booklets.
 - a. Welding ALCOA Aluminum.
Aluminum Company of America, Pittsburgh 19, Pa.

Review of 1st Semester Instruction—3 hours

1st Semester Final Examination—2 hours

Unit XIII—Plaster and Its Application in Orthotics

Lecture: 6 hours. Practice: 14 hours. Review and Examination: 2 hours.

A. Skills and Knowledge to Be Taught

1. The manufacture of plaster.
2. Kinds and characteristics of plaster used by Orthotists
3. How to make plaster wraps of various parts of the body.
4. How to make and finish plaster molds of various parts of the body.

B. Materials and Equipment Needed

1. One well equipped plaster room.
2. Various kinds of plaster.
3. Various kinds of plaster bandages.
4. One subject for each pair of students.

Unit XIV—Leather and Its Application in Orthotics

Lecture: 5 hours. Practice: 13 hours. Review and Examination: 2 hours.

A. Skills and Knowledge to Be Taught

1. The processing and treatment of leather.
2. Kinds and characteristics of leather used by Orthotists.
3. Commercial aspects of leather.
4. Skills in working leather.
5. How to operate a sewing machine.
6. How to mold leather.

B. Materials and Equipment Needed

1. One well-equipped leather shop.
2. A variety of orthopedic leathers.
3. Cuffs or braces to be covered.
4. Plaster cast for molding.

C. Available Teaching Aids

1. Booklets.
 - a. Leather in Our Lives.
Leather Industries of America, 411 Fifth Ave., New York 16, N. Y.
 - b. Dictionary of Leather Terminology—\$.15.
Tanner's Council of America, 411 Fifth Ave., New York 16, N. Y.

Unit XV—Plastic and Its Application in Orthotics.

Lecture: 6 hours. Practice: 12 hours. Review and Examination: 2 hours.

A. Skills and Knowledge to Be Taught

1. Kinds and characteristics of plastics used by Orthotists.
2. Commercial aspects of plastics.
3. How to work plastics.
4. Plastic lamination techniques.

B. Materials and Equipment Needed

1. One well-equipped plastics shop.
2. A variety of commercially available plastics.
3. Resins for plastic lamination.
4. Plaster casts for lay up and lamination.

Year-End Project—8 hours

Review of 2nd Semester Instruction—3 hours

2nd Semester Final Examination—2 hours

Total—150 hours

Conclusion

Since this was a course in "Basic Principles and Practices of Orthotics," the aim was to instruct trainees in tools and materials. The major portion of this instruction was accomplished by demonstration and shop practice. The trainee who has successfully completed this course is ready to learn brace fabrication and eventually brace fitting techniques. These advanced courses are now in the planning stage and will be reported upon at a later date.