UNE, 1961

RTHOPEDIC & PROSTHETIC APPLIANCE JOURNAL

he Journal of the Limb and Brace Profession

NEW REHABILITATION CENTER—Architect's rendering of the new UCLA Physical Rehabilitation Center, on which construction is to start this year. When completed, the new Center will house the teaching and research activities of all the major disciplines involved in rehabilitation, including the Prosthetics Education Program so well known to AOPA members. (Welton Becket & Associates, Los Angeles, Architects)

See Story on Page 136.

publisher: **American Orthotics and Prosthetics Association**

INVITATION TO THE 1961 NATIONAL ASSEMBLY

All persons interested in the rehabilitation of the orthopedically handicapped are eligible to attend the 1961 Assembly of the Limb and Brace Profession. This meeting, sponsored by the American Orthotics and Prosthetics Association, will be held at the Eden Roc Hotel in Miami Beach, October 19-26, 1961. Registration forms and additional program information may be obtained by writing to: A.O.P.A., 919 18th St., N.W., Washington 6, D. C.

Exhibit Application Forms may be obtained from any member of the Exhibits Committee, or from AOPA, 919 18th St., Washington 6, D. C.

SEMINAR ON FLUID-CONTROLLED MECHANISMS ANNOUNCED

The Veterans Administration announces a *tuition-free,* three-day seminar for prosthetists, on Fluid-Controlled Mechanisms for Above Knee Artificial Limbs. The Seminar will be held at Miami Beach, Florida, October 26-27-28, 1961, in the Eden Roc Hotel immediately after the AOPA National Assembly. The special reduced rates for the AOPA Assembly will apply. ($12.00 a day per room, either single or double occupancy).

Arrangements for the session are being made by the Prosthetic and Sensory Aids Service, Veterans Administration with the cooperation of the American Orthotics and Prosthetics Association. The three universities now offering prosthetics courses have been invited to assist in the Seminar.

Registration for the Seminar is limited to prosthetists who have satisfactorily completed a university course in Above-Knee Prosthetics.

Evidence of satisfactory completion of this Seminar will qualify the participants for the fitting of fluid-control mechanisms under VA contracts.

This Seminar is scheduled for Miami Beach for the convenience of prosthetists attending the national AOPA Assembly. Consideration is being given to scheduling two or three other additional seminars in other parts of the country, at a later date.

Addition infformation and necessary applications may be obtained by writing to either (1) Prosthetics and Sensory Aids Service, U. S. Veterans Adm. Washington 25, D. C., or (2) American Orthotics and Prosthetics Association, 919 18th Street, N.W., Washington 6, D. C.

Orthopedic and Prosthetic Appliance Journal

(Title registered U. S. Patent Office)

VOLUME 15 • JUNE, 1961 • NUMBER 2

Second class postage paid at Washington, D. C.

TABLE OF CONTENTS

(Continued on page 5)

The *Orthopedic and Prosthetic Appliance Journal* is issued four times a year—in March, June, September and December. The 1961 subscription price payable in advance is five dollars a year, for delivery anywhere in the Western Hemisphere. The subscription rate elsewhere is six dollars a year.

Publication does not constitute official endorsement of opinions presented in articles. The *Journal* is the official organ of its publisher, The American Orthotics and Prosthetics Association (formerly Orthopedic Appliance and Limb Mfrs. Assn.) and of the American Board for Certification. All correspondence should be addressed to the Editor of the *Orthopedic and Prosthetic Appliance Journal*, 919 18th St., N.W., Washington 6, D. C.

Here's the INSIDE STORY on the new

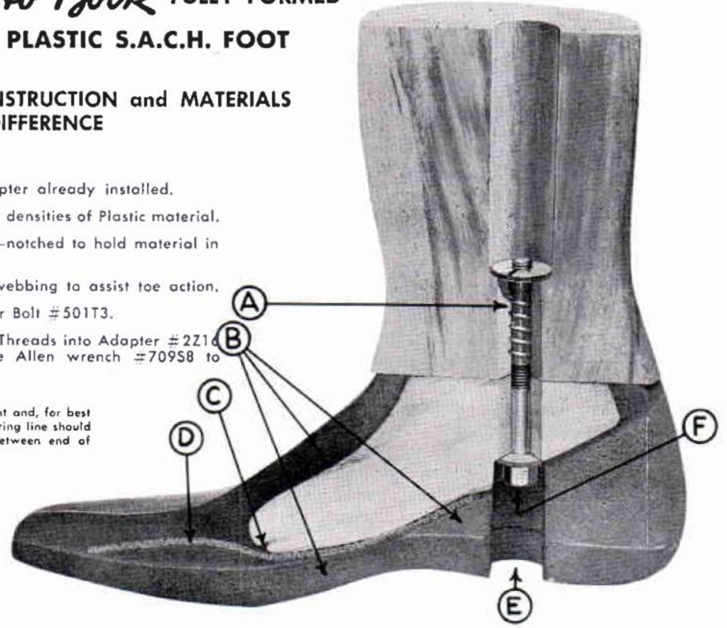
Otto Bock FULLY FORMED

PLASTIC S.A.C.H. FOOT

QUALITY CONSTRUCTION and MATERIALS MAKES THE DIFFERENCE

- A Threaded adapter already installed.
- B Three different densities of Plastic material.
- C Rounded keel—notched to hold material in place.
- D Special type webbing to assist toe action.
- E Access hole for Bolt #501T3.
- F Bolt #501T3. Threads into Adapter #2Z16 above it. (Use Allen wrench #709S8 to remove.)

Suggest ¾" Heel Height and, for best results, the weight bearing line should come down midway between end of toe and end of heel.



TWO STYLES OF *Otto Bock* PLASTIC S.A.C.H. FEET

SIZES

24cm . . . 9½ inches
25cm . . . 9⅞ inches
26cm . . . 10¼ inches
27cm . . . 10⅝ inches
28cm . . . 11 inches
29cm . . . 11½ inches
30cm . . . 11⅞ inches

Very little additional shaping required.
Large wooden keel molded into position—keel sized for each foot.
Tough, durable Plastic material, yet very resilient—remains ALIVE.

Combination #1S7
This foot, with ankle block attached and adapter nut installed is designed to SAVE YOU TIME. Use it with our B/K Block or any of our A/K set-ups, as well as for the P.T.B. prosthesis.

Combination #1S10
You may prefer this FOOT ONLY, which comes with the bolt and nut combination illustrated.

No. 1S10

No. 1S7

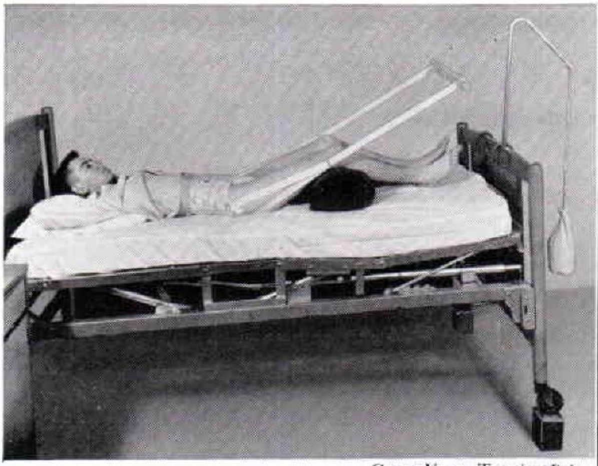
Otto Bock

ORTHOPEDIC INDUSTRY

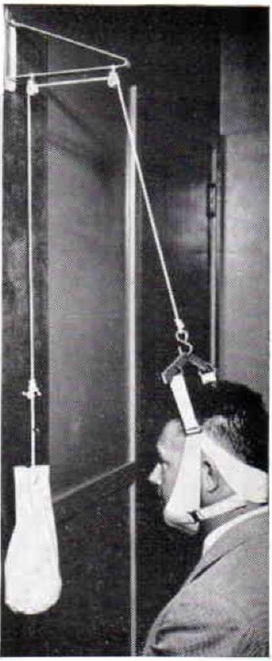
219-14TH AVENUE NORTH • MINNEAPOLIS, MINNESOTA

CONTENTS (Continued)

SUPPLIERS' INDEX — JUNE, 1961

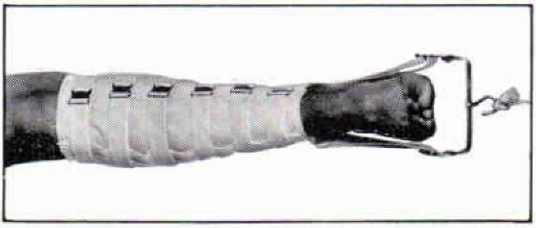


Camp-Varco Traction Belt



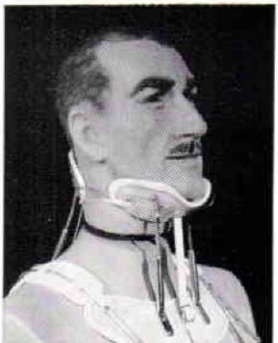
Camp Head Halter Kit

Traction apparatus



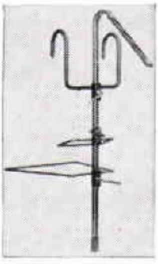
Anderson Traction Legging

Accepted As Superior Equipment by Many Doctors, Institutions and Hospitals.

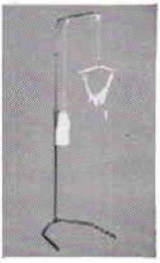


Cervical Traction Brace

Camp Offers A Complete Line of Traction Apparatus Kits and Accessories

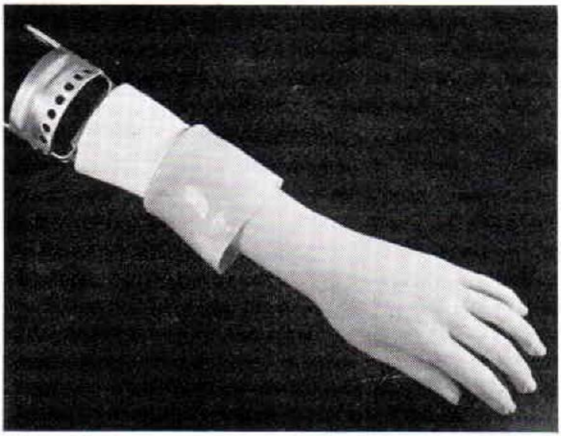


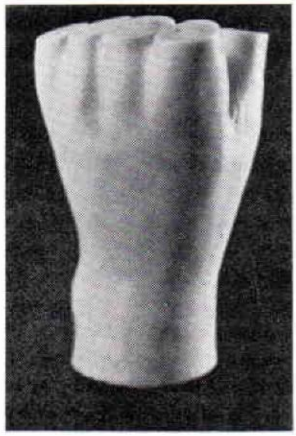
Buck's extension kits for use on hospital or hollywood type beds.



CervTract® with head halter kit. Unit can be supplied without halter.

Steel shot in 2, 3, 5 lb. bags available for use with any traction apparatus.





VARI GAIT
Fillauer

*VARI-GAIT V100 (Illus.)

The Quality knee providing
Knee Stability at low cost

*VARI-GAIT V200

Friction knee with swing phase

*VARI-GAIT V300

Economy Friction Knee

COMPLETE LINE OF PROSTHETIC SUPPLIES

Knee Shank Assemblies
Abachi and Pappel Quadrilateral Thigh Blocks
Kingsley Sach Feet—Male and Female
Plastic Materials and Resins

Fillauer

NIGHT SPLINT

DETACHABLE — DENIS BROWNE

*Fits any shoe

*Different settings

*All sizes — 6″ to 30″

*Attractively finished in color

Fillauer SURGICAL SUPPLIES, INC.
Manufacturers of Orthopedic Supplies ESTABLISHED 1914
Box 1678, CHATTANOOGA, TENNESSEE

Dedication To
The University of California at Los Angeles

This June 1961 issue of the *Journal* is dedicated to the University of California at Los Angeles—the first University to offer courses in prosthetics and orthotics in this country.

So much has happened in educational developments in our field since 1952 that it is difficult to appreciate the problems and the obstacles which had to be overcome before the first training course in upper extremity prosthetics was offered at Los Angeles nine years ago. The devoted efforts of the Prosthetics Education Staff at this well-known institution of higher learning have been a real contribution to the welfare of the handicapped. Orthotists and prosthetists not only of the United States but in many foreign countries have abundant reason to be grateful to this University and to be proud of the cooperative effort developed there.

Ten of the articles in this issue are contributed by specialists from the staff of the University of California at Los Angeles. The subjects are: Professional Education—A Nine-Year Report, New UCLA Rehabilitation Center, New Developments in Lower Extremity Prostheses for Children, Use of Community Resources in the Continuing Prosthetic Care of the Child Amputee, Developmental Factors in Infant Upper Extremity Prosthesis Fitting, Efficiency in Technical Teaching, The Goals of Child Prosthetics Research, A Half-Century of Progress—Editorial, Developmental Research in a Private Facility, Evaluation of Control Problems in Externally Powered Arm Prostheses.

This is the second of three issues of the *Journal* which will be in a sense "University Issues." The first was the issue for September 1960, devoted to New York University. An issue consisting of contributions from the Prosthetics Staff of Northwestern University is being developed for later publication.

RALPH STORRS, President
American Orthotics and Prosthetics Association
HOWARD R. THRANHARDT, *President*
American Board for Certification in Orthotics and Prosthetics.

Professional Education—A Nine-Year Report

Prosthetics from Classroom to Clinic

By MILES H. ANDERSON, Ed.D.
Director, Prosthetics Education Program
Department of Surgery—Orthopedics
School of Medicine
University of California, Los Angeles

Let us suppose that a revolutionary development in prosthetics should be perfected tomorrow that would make it possible to fasten a pylon into the bone in an amputee's stump, then fashion a light and serviceable prosthesis around the pylon, producing an artificial limb that would very closely resemble a restoration of the patient's lost limb, in appearance, function, and comfort. The techniques for fabricating and fitting this new prosthesis would be entirely different from anything that had ever been done before. What would be the best way to make this greatly improved prosthesis available to the amputees who could benefit from it?

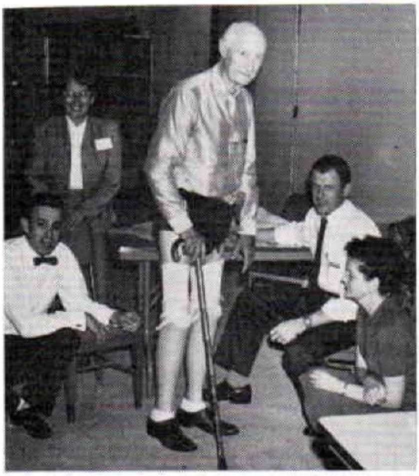
The problem faced by the Veterans Administration in 1952 was comparable to the one described in the preceding paragraph. They had spent millions of dollars on research to develop better artificial arms, and the arms were now available. but how could they get them to the veteran amputees who needed them? Various means of communication were used, such as distribution of research reports and brochures, articles in professional journals, demonstrations at scientific assemblies, and the like, with little or no results. The techniques and knowledge needed to successfully fabricate and fit these new arms of plastic, with their strange harnessing and power transmission systems, were too complex to be mastered by merely reading a report or seeing a demonstration. The prosthetists could not afford to experiment, as the risk of failure was too great. The doctors with whom they worked knew nothing about these new prostheses, and so could not prescribe them even if they could be made available. There were no therapists who knew anything about training amputees to use these new prostheses. Many hundreds of veterans who had lost their arms in the war were either doing the best they could without prostheses, or were getting by with ineffective make-shifts.

The Veterans Administration and the Advisory Committee on Artificial Limbs of the National Research Council saw by 1952 that drastic action would have to be taken to make better artificial arms available for the veterans. They decided that the answer was an educational program in which a school would be organized for the purpose of teaching the prosthetists, therapists, and physicians how to fit the new type arms, and how to train the amputees in their use. The upper extremities prosthetics research that had produced the improvements in artificial arms had been largely centered at the University of California at Los Angeles, so this institution was asked to set up the first prosthetics school.

The first prosthetics education program was a joint effort of the College of Engineering and the School of Medicine at U.C.L.A. The Medical Center was still an excavation and a mass of blueprints, so Engineering loaned part of their Mechanics Building Annex to house the new school. The Veterans Administration provided funds for materials and equipment, a staff was organized, a training plan formulated, manuals and lesson sheets prepared, and teachers trained. By January 1, 1953, the new prosthetics school was ready for its first class.

The primary mission of the school was to train a prosthetic clinic team for each of some thirty Veterans Administration Regional Offices in that many cities in various parts of the country. The clinic team idea had been tried in the San Francisco Regional Office, where it had been found that the joint efforts of the physician, therapist, and prosthetist were indispensable in providing efficient prosthetic service. To accomplish this, the educational program was organized so the prosthetists were in attendance for six weeks, the therapists were in class for the last three weeks of the six, and the physicians attended the last week of the six. During the last week, the three groups worked together as clinic teams, practicing prescription, check-out, and training. This experiment in team education of diverse professional groups, the members of which had in many instances very little relation with one another in the past, proved to be one of the most interesting aspects of the program, and one which encouraged other groups on the U.C.L.A. campus to attempt similar programs.

Twelve six-weeks schools were completed in quick succession between January 1953 and February 1955. A total of 120 prosthetists, 155 therapists, and 184 physicians completed their respective courses. Prosthetic clinic service was established in 46 cities; of these clinics 28 were for Veterans Administration personnel, 6 for the military, and 81 for rehabilitation facilities for the general public. The impact of this educational program on the amount and quality of upper extremities prosthetics service in the United States was felt almost immediately. The relative improvement was estimated by Veterans Administration officials to be at least on the order of 50%. The new type artificial arms were made and fitted for veterans as rapidly as they could be brought in to the centers and processed through the clinic procedures of prescribing, fitting, checking out, and training. In addition, the clinic personnel trained to give service to the general public were rapidly fitting the victims of industrial and agricultural accidents, as well as congenital and other types of amputees, with the new prostheses. Vocational rehabilitation agencies were quick to take advantage of the availability of more efficient artificial arms in the vocational rehabilitation of arm amputees, resulting in more placements of these handicapped people on productive jobs. A good case could be made for the assertion that the cost of the education research programs in upper extremities prosthetics was paid for many times over through income taxes collected from arm amputees made employable by the improved prostheses, and the savings in funds paid for their support when unemployed.



Clinic team checks out Mr. J. P. Mountain, age 78, bilateral wearer of patella tendon bearing below knee prostheses. Class in below knee prosthetics, U.C.L.A. Prosthetics Education Program.

Alex Frazer, bilateral AK amputee, demonstrates his ability to negotiate the ramp wearing two Hydra-Cadence AK Prostheses.

This experience provides the answer to the imaginary situation described in the opening paragraph. There can be little doubt in the minds of those who have followed the progress of the prosthetics education program through the years that if a revolutionary new method of fitting a lower extremity prosthesis directly to the amputated bone is developed, the most efficient way to get this improvement to the amputee is through the prosthetics schools.

While the prosthetics education program was almost entirely supported with funds by the Veterans Administration and certainly no child amputees could be found who would qualify as veterans of our armed forces, none the less it was felt that advantage should be taken of every opportunity to learn everything possible about the problems of fitting arm prostheses for children. Before the start of the first schools, the prosthetics education director and chairman of the Department of Pediatrics of the U.C.L.A. Medical School met and discussed a program in which the school would fit children sent by pediatrics, with the latter responsible for medical care, and follow-up a joint responsibility of both groups. As a result of this arrangement, children were included as clinical subjects in each school, and were fitted with artificial arms by the students. This was the start of the

Child Amputee Prosthetics Project at U.C.L.A., now a separate project in the Medical School, operated jointly by the Department of Pediatrics and Surgery (Orthopedics). During the twelve upper extremities prosthetics classes, a total of 51 children were fitted with artificial arms, and much was learned about the prosthetic, medical, and psychological problems of the child amputee.

When the twelfth "arm school" was completed, a study was made of the data on the application forms of the 120 prosthetists who had attended the classes, with the idea that some clues might be found that would serve as a guide to the planning of future educational programs for prosthetists and orthotists. The students were a comparatively young group, 80% being under 45 years of age. While certification was relatively new, 75% of the students were certifees. Their years of experience in prosthetics ranged from 1 to 30 years, with the actual distribution as follows:

Years Experience	*Number*
1-5	20
6-10	30
11-15	14
16-20	23
21-25	9
over 25	7
no data	17

The amount of formal education reported by the enrollees ranged from elementary school only, to university graduate work. The numbers in each category were as follows:

Educational Level	*Number*
Elementary school	4
Some high school	16
High school graduate	42
Some college	24
College graduate	15
Graduate work	2
No report	17

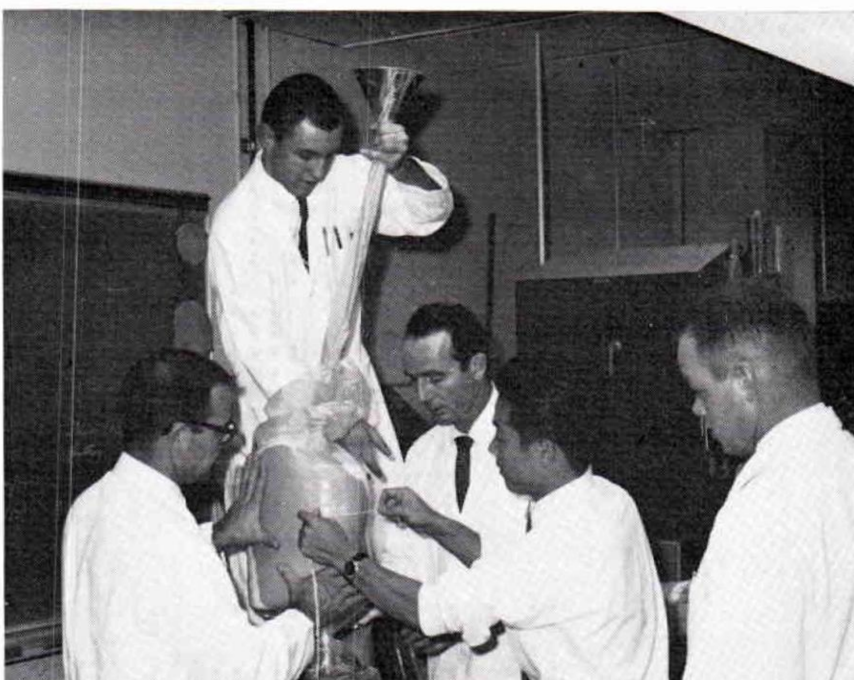
Such a wide range of educational background is typical of occupations which have no professional standards, no enforceable educational requirements for entrance, and no professional educational program or schools. Test results revealed another lack always found among those in occupations that have no educational standards, an almost universal weakness in scientific and technical knowledge, such as anatomy, kinesiology, and mechanics. This information proved conclusively the need for a program of college level professional education to provide prosthetists who meet or surpass minimum standards of technical competence.

The U.C.L.A. Prosthetics Education Program from its inception has always enjoyed good relations with the prosthetists' professional organizations, the Orthopedic Appliance and Limb Manufacturers' Association (now the American Orthotics and Prosthetics Association), and the American Board for Certification of the Prosthetic and Orthopedic Appliance Industry. The latter group is responsible for preparing and administering tests to candidates for certification to determine their competence as prosthetists and orthotists. In early 1954 they requested the U.C.L.A. Prosthetics Education Program to give technical assistance in the development of a battery of written and performance tests to cover all aspects of both prosthetics and orthotics. This was done, and in September of that year the first of these tests was given in Philadelphia. During the succeeding years the tests were refined and expanded at U.C.L.A. under the supervision of a member of the staff to whom this responsibility was assigned. By 1959 this work had almost become a full-time job, and the U.C.L.A. staff member who was in charge of the testing program accepted the position of Executive Director of the American Board for Certification in Washington, D. C. The certification testing program of the A.B.C. has been acknowledged by authorities to be one of the most effective ever developed for any professional group.

When the first plans were made for the Prosthetics Education Program at U.C.L.A. it was understood that when the twelve schools in Upper Extremities Prosthetics were completed, and the clinic teams for the Veterans Administration were trained, the program was to be disbanded, its mission accomplished. However, just as the last of the "arm schools" was completed, there was a demand for a similar educational program in Above Knee Prosthetics. A greatly improved suction socket above-knee prosthesis had been developed in the research program at the University of California in Berkeley, and it was felt that only through a series of schools similar to those in Upper Extremities Prosthetics could the skill and knowledge needed to fit these improved limbs be disseminated so that amputees could benefit from them. Instead of disbanding, early in 1955 the staff of the Prosthetics Education Program went to work on the development of an education program for prosthetists, therapists, and physicians in Above Knee Prosthetics. Many weeks were spent in preparing a Manual of Above Knee Prosthetics, various teaching aids, and films. The University of California at Berkeley gave a "Pilot School" in August, 1955, and the program was well on its way toward realization. It was not possible to start the first class until early in 1956, because the Medical Center had been completed, and the Prosthetics Education Program had been given a generous allocation of space in the new building. The time required to finish the space, purchase and install new equipment, and move from Engineering to the Medical Center made it necessary to postpone start of the Above Knee Prosthetics program until May, 1956. Since that date, thirteen additional courses have been given, training a total of 147 prosthetists, 186 therapists, and 204 physicians in the team approach to prosthetic service for above-knee amputees.

Within a year, experience in fitting several hundred amputees in the above knee prosthetics classes revealed a number of serious deficiencies in the procedures being taught. For example, no specific method for designing a socket to accomodate varying amounts of hip flexion contractures had ever been devised, and it became very clear that such a procedure was essential if serious contracture cases were to be fitted properly. There were no precise standards of stump-socket dimensional relationships, without which it was impossible to know whether a socket was right or wrong, a condition unacceptable in a teaching situation. It became apparent that the accepted rule of always making the medial socket wall vertical was responsible for trouble in a number of cases, and the trouble was traced to failure to adapt to abduction contractures. A means had to be devised for measuring such contractures, and for changing the socket design to accomodate them. Experience with the adjustable leg soon proved that it could not be used as a cure-all for alignment problems, because making very radical adjustments with it also made unacceptable changes in the socket angles, particularly the relationship of the ischial seat to the floor. These and other serious problems had to be solved immediately, and this the teaching staff undertook to do. Accurate records of all aspects of every case fitted had been kept, and these were carefully analyzed for clues to answers to the problems. New procedures were worked out, new standards established, more shaping and alignment factors were made subject to accurate measurement. As a result, socket-stump tension analysis, flexion-abduction contracture analysis, and socket shaping and fitting procedures were so perfected that the correct socket design and alignment for each amputee could be planned in advance and carried out with more assurance than ever before that the prosthesis would function correctly. Teaching was improved greatly by the ability of the instructors to check each student's work with precision methods, practically eliminating the "art" and guesswork that had been so commonplace before. Careful application of the principles developed made it almost completely unnecessary to make any changes in the adjustments of the adjustable leg after it had been set up in static alignment. The use of the "tilt screws" and other adjustments on the adjustable legs was completely eliminated in dynamic alignment.

The development of these improvements in above knee prosthetics made it necessary to conduct a series of courses in Advanced Above Knee Prosthetics, in which prosthetists who had previously taken the Above Knee Prosthetics course were brought back for a one week intensive session of instruction in the new principles and techniques. Since the new Hydra-Cadence hydraulic unit for above knee prostheses had been approved and made commercially available, the techniques for installing and adjusting it were included in the course. Thirteen classes were given between 1958 and 1961, for a total of 123 prosthetists. Since the advanced material has now been incorporated into the regular course, the advanced course will not be continued.



U.C.L.A. prosthetics instructors demonstrate lamination of Canadian Hip prosthesis socket for Dr. Sieshi Sawamura, from Kobe Medical School in Japan. An orthopedic surgeon, Dr. Sawamura spent six months at U.C.L.A. studying prosthetics and orthotics.

In response to a demand for research to improve below knee prosthetics, the University of California at Berkeley in April, 1957, held a four day symposium on the subject, attended by prosthetists who were thought to be representative of the best practice in the field throughout the country. The ideas and suggestions brought out in this meeting led to the development of the patella tendon bearing cuff suspension below knee prosthesis. After appropriate "pilot schools" a new course in this field was started in 1959. To date, nine classes have been given, for a total of 113 prosthetists, 117 therapists, and 165 physicians. A survey made in the spring of 1960 indicated that the new prosthesis was very successful, the chief problems being encountered in hot, humid climates where the soft sponge rubber liner created perspiration difficulties.

While the educational program had been of help to the prosthetists, the orthotists had not benefited at all, as no courses had been prepared for their particular needs in the field of bracing. It was felt at U.C.L.A. that the problems of the paralytic were as important as those of the amputee, and that if improved braces could be made available to help them, the orthotists who make and fit them, the physicians who prescribe them, and the therapists who teach the patient to use them, all should be trained to work together as clinic teams, just as had been done for prosthetics. Important advances had been made in functional bracing of the upper extremities in Southern California at Rancho Los Amigos Hospital, and by Dr. Edwin Schottstaedt and George Robinson, C.P., in Northern California. In November, 1957, a meeting was held with the two groups, and agreement reached on the development of a training program in upper extremities bracing. An instruction manual had to be prepared, and teaching aids developed, "pilot classes" for instructors given, and a combined course for orthotists, therapists, and physicians planned. The first class was given in September, 1958, followed by seven more, with total enrollments of 97 orthotists, 123 therapists, and 162 physicians. As a result of these classes, many victims of paralysis of the uper extremities have been rehabilitated by being fitted with hand splints and functional arm braces that enabled them to get their paralyzed hands and arms back into operation once more. "Outside power" was introduced for the first time in the form of the carbon dioxide driven artificial muscle, developed at Rancho Los Amigos. The application and use of outside power for flexor hinge splints and functional arm braces has been taught at U.C.L.A. for the past two years, with considerable success.

Earlier it was mentioned that the original Prosthetics Education Program had been sponsored by the Veterans Administration. Since the scope of the program had broadened as it progressed, the officials of the Veterans Administration felt that it would be more appropriate for an agency with broader responsibility for rehabilitation of the handicapped population to take responsibilty for the program. In September, 1956, the U.S. Office of Vocational Rehabilitation took over the sponsorship of the Prosthetics Education Program. Subsequently, in conferences with O.V.R. representatives, the idea of a short orientation course in prosthetics and orthotics for vocational rehabilitation counselors was suggested. Since these counselors are responsible for the management of many clients who are amputees, it would be to their advantage to know about the possibilities and limitations of the new prosthetic and orthotic devices now available.

A short, intensive five-day seminar was planned and given a trial at a "pilot school." After pruning unnecessary material and reorganizing the remainder, the course was streamlined to a three-day seminar that accomplished its purpose quite satisfactorily. Since starting the program in 1957,

Total Enrollments, UCLA Prosthetics Education Program, Jan. 1, 1953 to June 30, 1961

DATES	PROSTHETISTS									
	U.E.		A.K.		ADV.A.K.		F.B.U.E.		B.K.	
	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.
1952 1953	4	35								
1953 1954	6	61								
1954 1955	2	24								
1955 1956			1	6						
1956 1957	1	11	6	68						
1957 1958	1	6	3	30	5	38	1	12		
1958 1959	1	13	2	19			4	49		
1959 1960			1	11	5	64	2	24	5	64
1960 1961	1	14	1	13	3	21	1	12	4	49
TOTALS	16	164	14	147	13	123	8	97	9	113

DATES	THERAPISTS									
	U.E.		A.K.		F.B.U.E.		B.K.		O.T.-P.T.-W.S.	
	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.
1952 1953	4	44								
1953 1954	6	74								
1954 1955	2	37								
1955 1956			1	12						
1956 1957	1	11	6	58						
1957 1958	1	17	3	46	1	10				
1958 1959	1	19	2	28	4	56				
1959 1960			1	21	2	37	5	62		
1960 1961	1	18	1	21	1	20	4	55	1	20
TOTALS	16	220	14	186	8	123	9	117	1	20

Total Enrollments (continued)

DATES	PHYSICIANS								COUNSELORS	
	U.E.		A.K.		F.B.U.E.		B.K.		R.C.C.	
	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.	No. Classes	Enr.
1952 1953	4	47								
1953 1954	6	85								
1954 1955	2	52								
1955 1956			1	19						
1956 1957	1	20	6	67						
1957 1958	1	20	3	45	1	10			5	60
1958 1959	1	23	2	37	4	85			6	68
1959 1960			1	21	2	41	5	109	3	54
1960 1961	1	27	1	15	1	26	4	56	4	84
TOTALS	16	274	14	204	8	162	9	165	18	266

DATES	TOTALS
1952 1953	126
1953 1954	220
1954 1955	113
1955 1956	37
1956 1957	235
1957 1958	294
1958 1959	397
1959 1960	508
1960 1961	451
TOTALS	2,381

COURSE CODE: U.E., Upper Extremities; A.K., Above Knee Prosthetics; Adv.A.K., Advanced Above Knee Prosthetics; F.B.U.E., Functional Bracing of Upper Extremities; B.K., Below Knee Prosthetics; O.T.-P.T.-W.S., Occupational and Physical Therapist Instructors Workshop; R.C.C., Rehabilitation Counselors Course in Prosthetics.

18 classes have been given, for a total of 226 vocational rehabilitation counselors and other rehabilitation personnel, such as insurance company representatives, rehabilitation nurses, and the like. A similar course is being considered in conferences between representatives of the Bureau of Aid to the Totally Disabled of the California State Department of Social Welfare and the U.C.L.A. Prosthetics Education Program. In this case, the course content would be slanted toward the needs of the social workers in the bureau mentioned.

New programs planned for 1961-1962 are courses for prosthetists in the Canadian Hip Disarticulation and Canadian Symes prostheses, for orthotists in Functional Long Leg Bracing, and a workshop orientation program for faculty members of schools of occupational and physical therapy. The first named program is the result of a "pilot school" given at Northwestern University by the men who originated the Canadian Hip and Canadian Symes prostheses. The U.C.L.A. instructors who attended this class have subsequently organized the material into a concentrated three-week program. The course in Functional Long Leg Bracing is an application of the principles of socket fit and alignment of above-knee prostheses to produce a more functional long leg brace for the paralytic, and will require two weeks.

The workshop for OT-PT school faculty members grew out of a request from the Committee on Prosthetics Education and Information of the National Research Council. Its Ad Hoc Sub-commitee on Paramedical Prosthetics Education made a survey which indicated a need on the part of the faculty members of these schools for information and teaching aids on prosthetics and orthotics that they could incorporate into their curricula. It was felt at U.C.L.A. that an advisory committee made up of members of the professional associations of the two groups, authorized to speak for them, should be organized to counsel and advise as to what kind of program was needed, what it should include, how long it should be, and so on. This committee was appointed, and met February 16-17, 1961. They decided on the content to be taught, who was to be invited to attend, and settled all the other questions pertinent to getting this new project under way. The first workshop will be given at U.C.L.A. the last two weeks in June, 1961, for twenty OT-PT school faculty members. The June date was selected so the faculty members would be on vacation, which would avoid conflict with their regular teaching schedule.

Much thought has been given to the problem of offering an undergraduate professional program in prosthetics and orthotics at U.C.L.A. that would lead to the bachelor's degree. That there is a need for such a program is unquestionable, and there can be no doubt that a medical school and hospital environment combined with engineering biotechnology facilities, is essential for such a program to be efficient and realistic. Facilities and provisions for research must also be freely available, and all of these things can only be found in a situation such as that in the U.C.L.A. Medical Center, where prosthetics and orthotics have been a tradition since its establishment. The U.C.L.A. School of Engineering has been noted for its prosthetics research carried on in the Biotechnology Laboratory. The chief obstacle to starting a degree program is the lack of large enough laboratory facilities to provide for both the undergraduate students and the post-graduate or extension students who attend the courses that have been offered for the past nine years. Both programs are very important, but present feeling is that, if the choice had to be made, it would be unwise to give up the extension program to start an undergraduate degree program. The extension program, which improves the skills and knowledge of those already working in the field,

The Paramedical Education Prosthetics Advisory Committee, and U.C.L.A. Prosthetics Education Program consultants. Members of the committee, seated, consultants, standing, left to right. Miss Mary Frances Heermans, O.T.R., Clinical Director, Dept, of Occupational Therapy, University of Illinois, Chicago, Illinois; Miss Dorothy Baethke, R.P.T., Director, Div. of Physical Therapy, University of Pennsylvania, Philadelphia, Pennsylvania; Miss Elizabeth C. Wood, R.P.T., Educational Administrator, Course in Physical Therapy, Northwestern University Medical School, Chicago, Illinois; Miss Margaret Bryce, R.P.T., Assistant Professor, Dept. of Physical Medicine, University of Southern California, Los Angeles, California; Miss Guinevere Wright, O.T.R., Associate Professor, Occupational Therapy, San Jose State College, San Jose, California; Miss Martha E. Schnebly, O.T.R., Associate Director, Courses in Occupational Therapy, Columbia University College of Physicians and Surgeons, New York, New York; Mr. Robert J. Hickok, R.P.T., Clinical Instructor, The Jewish Hospital of St. Louis, St. Louis, Missouri; Miss Caroline G. Thompson, O.T.R., Director, Occupational Therapy, The University of Wisconsin Medical School, Madison, Wisconsin; Mr. Raymond Sollars, Associate Director, Prosthetics Education, U.C.L.A. Medical School, Los Angeles 24, California; Dr. Ralph E. Worden, Chairman, Dept. of Physical Medicine and Rehabilitation, U.C.L.A. Medical School, Los Angeles 24, California; Dr. Miles H. Anderson, Director, Prosthetics Education Program, U.C.L.A. Medical School, Los Angeles 24, California; Dr. Mary Reilly, O.T.R., Director of Occupational Therapy, Neuropsychiatric Institute, U.C.L.A. Medical School, Los Angeles 24, California; Prof. Bernard Strohm, R.P.T., Dept. of Physical Medicine and Rehabilitation, U.C.L.A. Medical School, Los Angeles 24, California; Mr. John J. Bray, C.P. & O., Associate Director, Prosthetics Education Program, U.C.L.A. Medical School, Los Angeles 24, California.

has a more immediate effect in improving prosthetic and orthotic rehabilitation services, and probably gives more aid to rehabilitation per dollar spent, and space occupied, than does any other type. For example, the prosthetics-orthotics laboratory facilities and equipment in the U.C.L.A. Medical Center will have been used for a total of 1,210 hours of organized instruction in 1960-61. An under-graduate program would not use the facilities more than approximately 600 hours during the same two semesters, but would serve to effectively prevent their use by extension students who could not afford to come for short courses consisting of half-days of laboratory work.

Construction of a new building for Physical Rehabilitation at U.C.L.A. has been approved, and in this new building Prosthetics Education will have double the present laboratory facilities. It is felt that in 1963, when this building should be ready for occupancy, it might be possible to have enough space for both an undergraduate and a post-graduate program. In the meantime, a compromise is going to be tried in the Spring of 1962. The 1961-1962 schedule of extension classes has been so arranged that each of the six different courses to be offered for prosthetists and orthotists will be given in quick succession, with only one or two weeks between each class. A student could start January 8, and complete all six courses on June 29. An attempt is going to be made to enroll individuals who are already college graduates in this six month series of courses. It is planned to give them additional course work in psychology, anatomy, and clinical experience between classes, and to have them work in selected facilities under supervision for an appropriate period of time after completing the courses. Not more than three or four such students would be enrolled in this try-out series, and the effect of mixing them with extension students would be observed carefully. If successful, it might be practical to expand this type of professional training, combining pre-professional and extension students in the same classes. An appropriate certificate would be granted to those students successfully completing the six months course. Enrollments in extension classes at U.C.L.A. have been excellent ever since the program started in 1953, and it is anticipated that the demand for this service to the prosthetics profession should continue indefinitely. If pre-professional education can be combined with it, so much the better.

U.C.L.A. Prosthetics Education has been happy to participate in the educational sessions arranged by the American Orthotics and Prosthetics Association for their regional meetings in various parts of the country. While in many instances these week-end meetings mean that the instructors must teach all week, then travel to a regional meeting to put on an educational program, then travel back in time to start teaching again without an opportunity to relax, they are all glad to be able to help with this worthwhile program.

No discussion of the part played by U.C.L.A. in prosthetics education would be complete without mentioning the texts and manuals that have been prepared for use by the students in the various classes. In the early days of the program the manuals were printed by the University and distributed by the program. However, the demand for these books became so great, with requests for them coming from all over the world, that it became necessary to turn the publishing business over to a firm that specialized in that work, the Charles C. Thomas Co. of Springfield, Illinois. All major manuals published are handled by this firm. A bibliography of all the books, manuals, and films published by the U.C.L.A. Prosthetics Education Program is appended to this report.

In conducting an activity of the magnitude of the Prosthetics Education Program, it must be recognized that an industrious, intelligent, and conscientious group of people are responsible for past and present successful operation and future development of the program. It is no exaggeration to say that the individuals who make up the staff of the U.C.L.A. Prosthetics Education Program are responsible for the testing and refinement of both teaching content and teaching techniques as seen today at U.C.L.A. Such supervision as this staff has needed has been more to provide them with time and facilities for the work they wanted to do than for any other purpose.

In a professional field where we do not even know for sure how many amputees there are in the population, it is difficult to assay the exact effects of an educational program such as the one in prosthetics. However, surveys made by the Committee on Prosthetics Education and Information of the National Research Council, the Veterans Administration, and other agencies that use prosthetics services, indicate that a great improvement in the quality of those services has resulted from the educational program. It is anticipated that the next nine years will see an even greater improvement, not only in service to amputees and paralytics, but in the professional status of the prosthetist-orthotist as well.

Bibliography

Books and Manuals

Anderson, Sollars, *Manual of Above-Knee Prosthetics for Prosthetists,* 1956, UCLA Prosthetics Education Program.

Anderson, Sollars, *Manual of Above-Knee Prosthetics for Physicians and Therapists,* UCLA Prosthetics Education Program, 1956.

Anderson, Sollars, Winston, *Manual of Arm Amputee Checkout and Training,* UCLA Prosthetics Education Program, 1957.

Santschi, et al., *Manual of Upper Extremities Prosthetics,* UCLA Engineering Dept., 1958, (Anderson, Chapter 9, Harness and Control Systems).

Anderson, *Functional Bracing of the Upper Extremities,* Springfield: Charles C. Thomas, Publisher, 1958.

Anderson, Bechtol, Sollars, *Clinical Prosthetics for Physicians and Therapists,* Springfield: Charles C. Thomas, Publisher, 1959.

Anderson, Bray, Hennessy, *Prosthetic Principles, Above-Knee Amputations,* 1960, Springfield: Charles C. Thomas, Publisher.

Anderson, Snelson, *Flexor Hinge Splint Supplementary Manual,* UCLA Prosthetics Education Program, 1960.

Anderson, *Hydra-Cadence Manual,* UCLA Prosthetics Education Program.

Anderson, Bray, Hennessy, Chapter 6, "The Construction and Fitting of Lower Extremity Prostheses," *Orthopedic Appliances Atlas,* Vol. 2, *Artificial Limbs, J. W. Edwards,* Ann Arbor, Michigan, 1960.

Anderson, Robinson, *How to Fit the Robin-Aids Partial Hand Prosthesis,* UCLA Prosthetics Education Program, 1961.

Films

The Canadian Hip Disarticulation Prosthesis, UCLA Prosthetics Education Program, 1956, 2400 feet, 16 mm., color, silent.

Some Aspects of the Smith-Peterson Hip Arthroplasty, UCLA Prosthetics Education Program, 1957, 300 feet, 16 mm., color, silent.

Slides

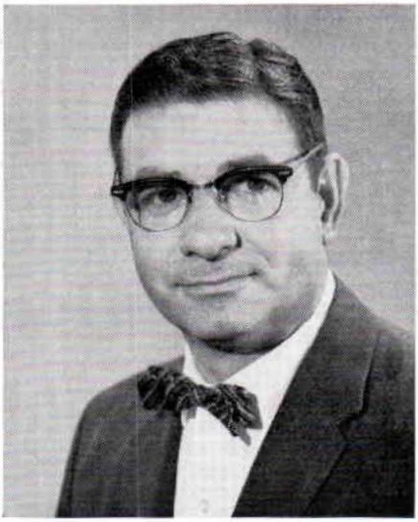
Below-Knee Prosthetics, 160 color slides, 2" x 2", Hall, Sollars, 1960, UCLA Prosthetics Education Program.

Functional Bracing of the Upper Extremities, 120 black and white slides, 2" x 2", Anderson, Bray, Snelson, UCLA Prosthetics Education Program, 1959.

Above-Knee Prosthetics, 120 black and white slides, 2" x 2", Anderson, Bray, Hennessy, Sollars, UCLA Prosthetics Education Program, 1959.

Functional Anatomy, 40 color slides, 2" x 2", Bray, UCLA Prosthetics Education Program, 1960.

New UCLA Rehabilitation Center to Feature Multi-Disciplinary Approach



By RALPH E. WORDEN, M.D.
Chairman, Department of Physical Medicine and Rehabilitation
School of Medicine
University of California, Los Angeles

Two years from now, the U.C.L.A. Prosthetics Education Program will expand into larger quarters in the new U.C.L.A. Physical Rehabilitation Center, on which construction is scheduled to start in September. The new Center will be located on the West Medical Campus, a 33-acre tract of land one mile west of the present Medical Center. This campus will be the site of a number of special medical service and research facilities, the first of which, Nuclear Medicine, is almost ready for occupancy.

The Rehabilitation Center will have a total of 130,000 square feet of floor space, will be of reinforced concrete construction. and will have five levels or floors. By taking advantage of the hillside building site, entrances to each floor are available from ground level, which will be a great advantage to handicapped people entering in wheel chairs, on crutches, or with artificial limbs. Adequate parking will be provided for both staff and patients in lots close to the building. Design of the buildings is being handled by Welton Becket and Associates, and the estimated cost is $5,500,000.

The U.C.L.A. Physical Rehabilitation Center was conceived ten years ago by Stafford L. Warren, M.D., Dean of the U.C.L.A. Medical School, when the plans for the Medical School were being made. Surviving many trials and tribulations, Dean Warren overcame obstacles that would have caused lesser men to concede defeat and turn their attention to other matters. The program in the Center will reflect the philosophy of rehabilitation which Dean Warren feels is the most efficient approach to providing the best possible care for nearly every kind of chronic disability.

Dean Warren firmly believes that rehabilitation of the chronically ill and disabled is the responsibility of all the major divisions of medical science. and that therefore a center dedicated to serve such patients must have within it an extension of each of these major medical divisions, each extension confining its efforts to the problems of the patients in need of rehabilitation. In effect, each of the services concerned would have in the Rehabilitation Center a branch which is an extension of the corresponding department in the main Medical Center on the East Medical Campus. The acutely ill would be confined in the hospital in the latter Center. If judged in need of rehabilitation service by a screening conference group, the convalescent patients would be transferred to the Rehabilitation Center, where 56 beds will be available for their use.

The Department of Surgery will have two services in the Center, although no provision is being made for more than very minor surgery in the building. Orthopedics will have a quota of beds for in-patients, and clinical facilities for out-patients who are being followed up after discharge home, and for other patients who come in for out-patient treatment of chronic disabilities that do not require bed care. The Prosthetics Education Program will have new quarters comprising approximately 8,000 square feet of laboratory, storage, classroom, and office space. These facilities should enable this program to conduct courses for full-time students working for a degree in the field of prosthetics-orthotics, while continuing their present program of short extension courses. Head and Neck Surgery will be in charge of testing and treating handicapping conditions in speech and hearing.

The Department of Pediatrics will have a wing in which they will work on chronic diseases of children. Included in this area will be the Child Amputee Prosthetics Project. which is a joint venture of Pediatrics and Orthopedic Surgery.

The Department of Medicine will maintain staff and facilities for three services of great importance in rehabilitation: rheumatology, cardiology, and geriatrics. Significant research is being done in the areas of arthritis and heart disease, and this work will be coordinated with the clinical activities of the Rehabilitation Center.

The actvities of medical-social workers will be supervised by the Department of Preventive Medicine and Public Health, and the Department of Physical Medicine and Rehabilitation will be responsible for physical medicine, physical therapy, occupational therapy, and vocational rehabilitation counseling.

The rehabilitation nursing program will be an extension of the School of Nursing, and the School of Social Welfare will be responsible for students assigned to the Center from that School. Hospital Administration will be responsible for physical facilities and housekeeping services.

While the Physical Rehabilitation Center will treat and rehabilitate many patients, this activity is not the primary purpose of the facility. Dean Warren has emphasized many times his conviction that this Center should be chiefly devoted to training rehabilitation personnel to go out into the field and staff the many rehabilitation facilities that will be needed in the future. The entire program, then, will be geared to do an educational job for medical students, internes, and residents, so that every physician trained at U.C.L.A. will receive basic training in the rehabilitation of the chronically disabled, and can specialize in this work if he so desires.

Paramedical personnel, including physical therapists, occupational therapists, rehabilitation nurses, speech and hearing technicians, prosthetists, and orthotists will be trained to work together and with the physicians as members of the rehabilitation team in an atmosphere and surroundings that accurately reflect the problems they will face when they graduate and start to practice their various professions. Medical-social workers, social welfare students, hospital administrators, and vocational rehabilitation counselors will learn how their professional skills fit into the rehabilitation center function, and into rehabilitation in general.

The field of prosthetics-orthotics is one for which U.C.L.A. is well-known for its work in both research and education. In the new Physical Rehabilitation Center, the opportunities to expand both research and education in prosthetics and orthotics will be almost unlimited. Large and well-equipped laboratories will make it possible to conduct larger classes, carry on testing and development work, and try out new materials and methods. It is anticipated that even closer liaison will be maintained between Prosthetics Education and the Southern California manufacturers of prosthetics equipment and prosthetics and orthotics service facilities to the benefit of all concerned, including the amputee and other orthopedically handicapped people.

INTERNATIONAL PROSTHETICS COURSE IN PARIS PLANNED

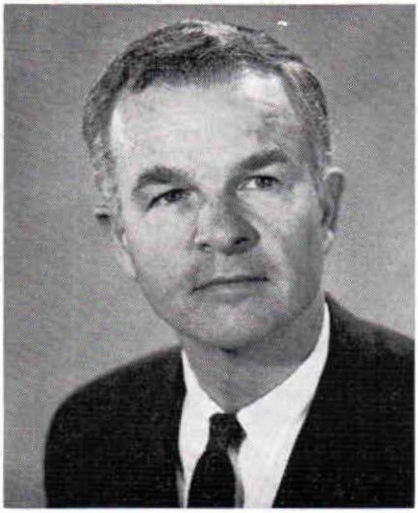
An international prosthetics course, jointly organized by the French Ministry of War Veterans and War Victims, The World Veterans Federation, and the International Society for Rehabilitation of the Disabled, is scheduled to be held in Paris, July 3 to 15, 1961.

The course has been initiated by the International Society's Committee on Prostheses, Braces and Technical Aids, and will follow the same pattern as those organized in Copenhagen in 1958 and 1959 and in New York in 1960. The Faculty will be selected from among world leaders in the orthopaedic field, and will include physicians, physio- and occupational therapists and orthopaedic technicians. The program will include the most modern aspects of prosthetic and orthotic techniques.

French will be the official language of the course, and any lectures delivered in English will be translated into French. The working sessions will take place at the Medical School of the Paris University. The Faculty and participants will be accommodated on the campus of the University. An inclusive fee of 400 N.F. ($80 in U.S. currency) for the course will cover registration, board and lodging, and one copy of the final report.

Further information may be obtained from the International Society for Rehabilitation of the Disabled, 701 First Avenue, New York 17, N. Y., or from World Veterans Federation, 16, Rue Hamelin, Paris 16, France.

Efficiency in Technical Teaching



By CAMERON B. HALL, M.D.
Assistant Clinical Professor of Surgery (Orthopedics)
Prosthetics Education Program
School of Medicine
University of California, Los Angeles

An educational program is only as good as its teachers, and the quality of teachers is largely determined by their mastery of subject matter and their ability to apply any of the many and varied teaching techniques that may be used for organizing and teaching the subject matter. One who knows his subject matter may "get by" without taking the time to learn some teaching techniques, but the teacher who wants to impart the greatest amount of permanent learning to his students in the least amount of time soon finds that a little help from an expert in techniques of teaching makes it possible for him to do a much more efficient job.

One of the most perplexing problems in medical and paramedical education today is how to teach the increasing amounts of scientific and clinical skills and knowledge without increasing the amount of time the student must go to school. Perhaps the answer is to increase the efficiency of the teaching, so the students will learn more in the time now allotted to their education.

When the Prosthetics Education Program was started nine years ago, it was agreed that it would be extremely difficult to lure practicing physicians to attend a class of greater duration than five consecutive days. In fact, many predicted that attempts to get physicians to attend prosthetics classes of any length were foredoomed to failure. Thus it became accepted that no matter what the subject—upper extremities prosthetics, above knee prosthetics, or below knee prosthetics, it had to be covered in five days—on the average about forty hours of classroom and laboratory time. It was quickly seen that the traditional leisurely lecture and note-taking methods would have to be supplanted with more efficient teaching techniques if the course objectives were to be achieved.

For example, in the session on upper extremities prosthetics components, the objective was to develop in the students knowledge and understanding of the nomenclature, appearance, function, and application of each of several dozen units such as terminal devices, elbows, hinges, wrist units, and the like. Hours were spent passing the parts around the class, lecturing about them, and trying to get the students to sketch and take notes about each one. The members of the class tended to sit passively, listening to the lecturer, after a few desultory attempts to make drawings and take notes. An objective test was given at the end of the session, and the results indicated that the students were only learning about half of the material presented.

The immediate reaction to the problem was, "We need more time!" However, examination of the schedule showed that no more time was available for this subject without seriously handicapping the sessions devoted to other equally important subjects. The only recourse left was to explore the possibilities of improving the quality of the teaching, so that the students could learn more in less time. It was observed that in the lecture-note taking situation the students were seldom very adept at making sketches quickly and accurately, and much time was wasted in trying to do this. After a few attempts most of them gave up. Sitting passively, they soon grew bored and paid less and less attention to the lecturer. Perhaps here was an opportunity to apply one of the principles of the psychology of learning—"There is no learning without activity, either physical, or mental, or both." What was needed was some "learning by doing," but how was it to be done?

The solution to this problem hinged on providing the student with some kind of "do-it-yourself kit" learning material. It was decided that "lesson sheets" would be prepared consisting of drawings of the various upper extremities components in a column down the left side of the page, with parallel columns on the rest of the page. These columns were headed "Name," "Function," and "Application." (See Fig. 1) The teacher drew similar columns on the blackboard. He would show a component, write its name, function, and application in the columns on the board, and the students wrote this material in the corresponding columns on their lesson sheets, along with any additional details they might wish to add, gleaned from the discussion of each unit that was encouraged by the teacher before going on to the next one.

The lesson sheet system provided the students with a planned procedure to follow in learning about upper extremities components, it required them to be alert and active, both mentally and physically, and it led them into becoming active participants in the class discussion, rather than mere passive listeners. The teacher quickly learned to adapt his speed to the ability of the students to follow him· as he could easily watch their progress in filling in their columns and giving them time to finish before proceeding to the next item.

Objective tests given to classes taught by this method showed an excellent improvement in learning, as compared to the test results obtained previously. Using the traditional lecture and note-taking procedure, the highest scores made on the test were by two students in the 70-74 interval; the median was fifteen students at 35-39. Using the lesson sheets, the lowest

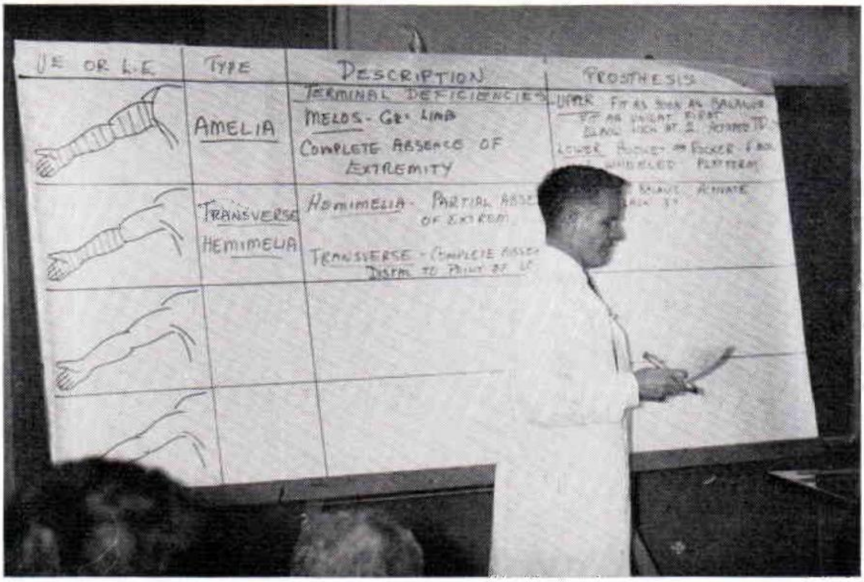


Figure 1. The instructor works with a "giant copy" of the lesson sheets used by the students.

scores were made by two students in the 70-74 interval, and the median was fifty students at 90-94. The differences in the groups would not account for such a large difference in scores, as they were both highly selected groups of physicians and therapists, well screened through a number of years of educational experience.

The "lesson sheet" principle of "learning by doing" was soon put into practice in as many presentations as possible, after the success of the initial trial of this technique. The result was an immediate increase in learning efficiency, as proven by test scores. As a result of improved teaching technique, much more learning was being accomplished without increasing the amount of time.

Not all topics were found to be directly amenable to the illustrated "lesson sheet" approach. For example, a presentation on "Pre- and Post-Operative Care of the Amputee" did not lend itself readily to the lesson sheet treatment. However, greatly increased efficiency of instruction was achieved through the simple device of organized blackboard outlining. The teacher listed the eight or ten major teaching points in his presentation down the extreme left hand side of the board. This gave the students an over-all picture of the topic, and a basis for outlining their notes. Seeing all the teaching points listed encouraged them to want to take notes as each one was developed. The teacher in his presentation took the first topic and outlined the sub-points for it on the right hand portion of the board, discussing each point as he lettered it in chalk, and giving the students enough time to get the points in their notes. (See Fig. 2) When he finished point one, he erased the sub-point material, and repeated the procedure with point two, and so on through the entire series of teaching points. This technique conserved time by keeping the teacher on the topic instead of wandering off into unrelated subject areas, it organized the material for the student, and it made it easy for him to direct questions to points he failed to understand.

Still other teaching situations arose in which words and drawings were not enough to enable the students to get a clear understanding of the teaching points in the presentation. In the lecture on "Normal Human Locomotion" the path followed by the body's center of gravity is very complex, and the maze of curved lines drawn on the blackboard to illustrate this phenomenon helped, but did not quite develop, clear understanding. A simple model of the pelvis and legs, hinged to duplicate the hip joints, made it possible to demonstrate the rise and fall of the center of gravity so the students could actually see it happen. (See Fig. 3) The simple model eliminated all of the distracting movements that made it difficult to observe in a live model the particular movement being analyzed, and as a result, the students understood what was being presented much more clearly than before.

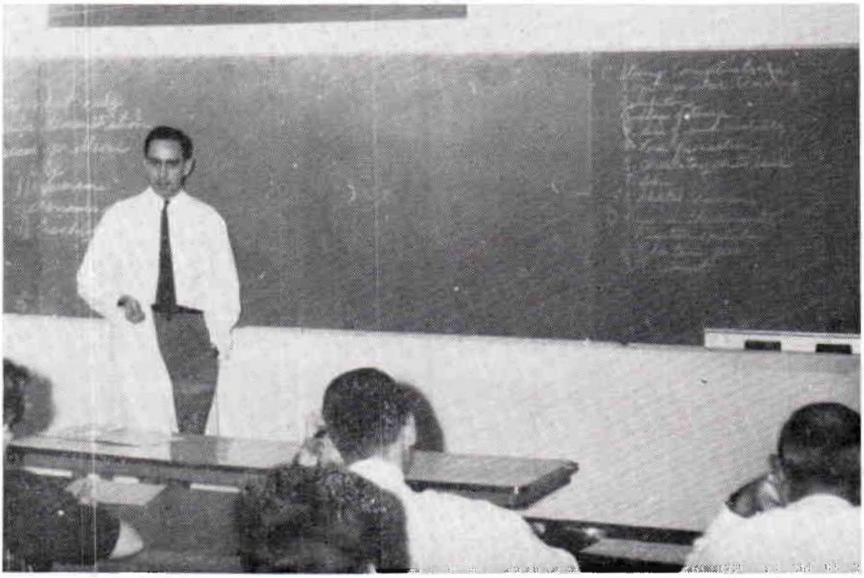


Figure 2. Organized blackboard outlines give the students a good idea of the basic outline form to use in their own notes, and also help the instructor to avoid wandering from the main topic.

Other models have been designed to demonstrate the relationship between moments of force around the ankle joint on a prosthesis with the forces tending to buckle the knee joint, and the relationship between the toe and heel lever lengths in the foot and the forces developed around the ankle in the foot. These ideas can be drawn on the blackboard with arrows and diagrams, without getting a clear idea across to the students, but when they see the spring scale readings on the model, they quickly get the point. Carefully planned working models provide a dynamic demonstration that cannot be equalled by static drawings, slides, or pictures.

The newest development in instructional technique, supposed to revolutionize teaching, is the "teaching machine." At first glance, this idea sounds wonderful, all you have to do is put the students in front of the machines, and they do the work. On more careful investigation, however, it turns out that the element that makes the machine work is the "programming"—the sequential presentation of information, arranged in the best learning order, with maximum clarity for clear understanding. It seems that developing the "program" is the big job, of course, and it turns out to be exactly the same job all good teachers have been doing for years, except they call it "lesson planning." So things haven't changed much after all, neither the teaching machine nor the human teacher is much good without "programming" or "lesson planning," and neither can be done well through knowledge of the subject matter alone.

There are few experiences more enjoyable than teaching. The good teacher enjoys seeing his students gain new knowledge and understanding, and develop new skills and abilities, as a result of his efforts. In the Prosthetics Education Program at U.C.L.A. we feel that our students are important enough to"program" every presentation so they will learn the greatest amount possible in the least amount of time. We enjoy teaching that way, and we think our students enjoy learning that way.

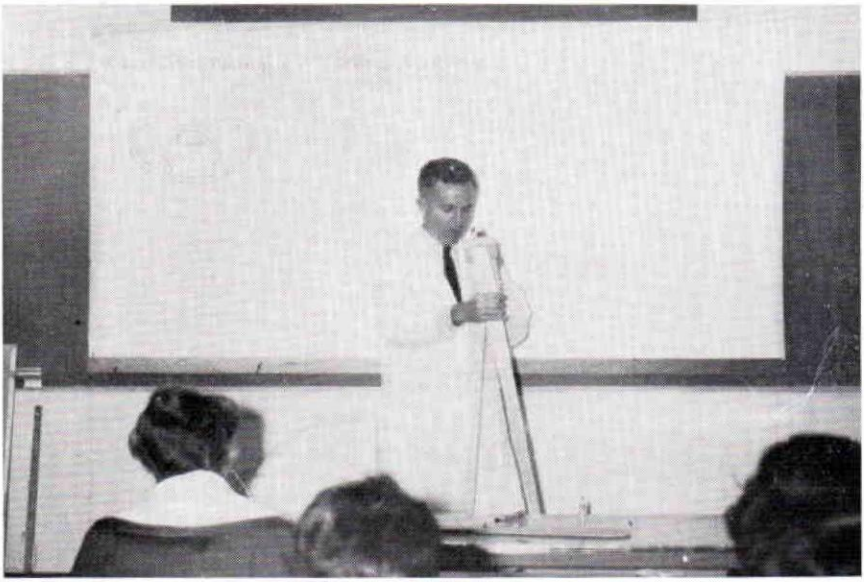


Figure 3. A simple working model of the pelvis and legs helps the students to understand difficult or complex mechanical concepts. The students "see what happens" and the instructor does not have to use up valuable teaching time in lengthy verbal explanations.

A Half-Century of Progress—Editorial

RAYMOND E. SOLLARS
Associate Director, Prosthetics Education Program
School of Medicine, University of California, Los Angeles

"Surgery has changed; the methods of half a century ago are unlike those of the present day. Toxic germs, the bane of the surgeon, have yielded to antiseptics and the mortality attending amputations for the removal of diseased and mangled parts has become minimized. Many lives are now saved by modern surgery which in former times would have been lost. All these have served as important causes in creating new fields and enlarging old ones for the prosthetist."

The preceding paragraph might have well been written last month—but it was actually written more than sixty-three years ago. It will be found as the closing paragraph of the first chapter of "A Treatise on Artificial Limbs," copyrighted in 1898 by A. A. Marks of New York. It is certainly as timely and true today as it was at the turn of the century.

As the reader proceeds through this book of 544 pages, he is brought to the conclusion that many of the devices and concepts now being taught and applied were already being considered at the time the book was written. In many cases it is quite apparent that Marks was stopped more by the lack of materials than by the feasibility or workability of his ideas. If polyester resin, neoprene, anodized aluminum and other such modern materials had been available in his day, the field of prosthetics would have made giant strides forward.

This writer is sorely tempted to refer to the period from about 1900 to the end of World War II as the "Dark Ages," since the advances during that time were minor. The art and science of prosthetics was relegated to the shop, and the voice of the salesman was heard throughout the land.

The salesman is still with us, and no doubt will always be—but the art and science of prosthetics is moving forward again, toward the goals envisioned by such men as A. A. Marks.

Yes, Mr. Marks was a man of vision. Just as we must give him credit for many of the ideas that we consider new today we must also acknowledge that he foresaw the need for prosthetics education.

Again we quote . . . "The schools of medicine and surgery should add to their curricula the subject of prosthesis . . . there is today no textbook upon the subject whereby the student can be tutored upon advanced American methods . . . education is needed, and legal protection should be granted. No man should be permitted to construct artificial limbs until he has given evidence of his fitness. The laws of the state and the country should be as rigid in licensing prosthetists as they are in licensing dentists."

It took a long time, much longer than Mr. Marks might have thought, but today that needed education is available. Just as fast as new materials are making old ideas workable and creating new ideas, new knowledge (and the good "old knowledge") is being disseminated to all prosthetists who have a desire to improve themselves and a will to learn.

The Office of Vocational Rehabilitation of the United States Department of Health, Education, and Welfare is sponsoring the prosthetics education programs now offered, "to enlarge the supply of trained personnel for the rehabilitation of physically or mentally handicapped persons, to improve the knowedge and skills of personnel already engaged in rehabilitation services, and to develop an increased awareness of rehabilitation philosophy and methods on the part of personnel in all fields contributing to the total rehabilitation process."

We have only pity (and little of that) for the prosthetist who still insists that A. A. Marks was wrong, that everything has already been discovered and nothing should change. He is as ridiculous as the man who insists that the automobile must go because it has ruined business for the buggy whip factories.

The man we want to meet is the one who exists somewhere in the United States today—the prosthetist who will make use of all the knowledge and education available to him, and who will then go beyond that to take his place alongside such men as A. A. Marks in the history of prosthetics.

MORE LIMBS FOR OVERSEAS

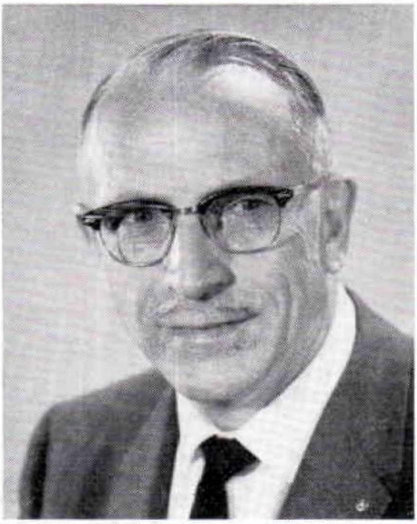
We have recently received a report from Mr. Eugene J. Taylor, Secretary-Treasurer, World Rehabilitation Fund, concerning response to the article in the March issue of the Orthopedic and Prosthetic Appliance Journal by Howard A. Rusk, M.D., President, World Rehabilitation Fund, appealing for contributions of used but serviceable orthotics and prosthetics.

Within the first few weeks after the article appeared in the Journal, the World Rehabilitation Fund had had approximately 20 inquiries from readers of the Journal interested in making contributions.

Mr. Taylor reported that CARE, Catholic Relief Service — National Catholic Welfare Conference, Church World Service and the American-Korean Foundation are participating in the project. Organizations which wish to make contributions are urged to write to the World Rehabilitation Fund, Inc., 400 East 34th Street, New York 16, N. Y., sending them two copies of a list of items being contributed (e.g. 5 AK prostheses, 4 BK prostheses, 1 uper extremity BE prosthesis, one child's bilateral leg brace, etc.). The World Rehabilitation Fund will then write the contributor the name and address of the warehouse to which the contribution is to be sent. The contributors are asked, if possible, to pay the shipping costs, which are tax deductible. If this is not possible, the items may be sent freight collect, or smaller shipments may be sent parcel post and the World Rehabilitation Fund will reimburse the contributor the cost of the postage.

Thus far, shipments have been sent to the following countries: Bolivia; Chile; Colombia; Costa Rica; Ecuador; Egypt; Greece; Haiti; India; Iran; Israel; Italy; Korea; Lebanon; Pakistan; Philippines; Peru; Turkey; Viet Nam; and Yugoslavia.

The Goals of Child Prosthetics Research



By MILO B. BROOKS, M.D.
Medical Director, Child Amputee Prosthetics Project
School of Medicine, University of California, Los Angeles

Adult amputees have been fitted with some type of prosthesis since early historical times. The chief incentive or goal for prosthetic fitting has been to allow the amputee to carry on a vocation and to earn a living. Thus, the goal was to rehabilitate the amputee with a specific job or type of work in mind.

Such an immediate goal is not directly applicable to children. Therefore, the fitting of children with prostheses has raised a number of questions:

1. How could the frequent changes for growth and rough wear be accommodated?
2. What material could be used for the prosthesis that would be light and yet strong enough to withstand active use?
3. How could the cost be justified when the fitting would not immediately or directly provide income?
4. What kinds of components would be needed and what would be available?
5. How and for what purpose should a child be trained?
6. What would a prosthesis do for the child?
7. What would a prosthesis do for the child's family?

Despite these questions, requests for prosthetic fitting were coming from parents and physicians. The U.S. Children's Bureau was aware of these requests and the need for more understanding of the feasibility and benefit of fitting young children.

As a result, the Child Amputee Prosthetics Project at the University of California at Los Angeles and other similar groups were given the unique opportunity of exploring the many aspects of the problem of fitting children with prostheses. These problems included the surgical, medical, mechanical, training, social and emotional problems of the child, his family, friends, and associates.

Several principles of treatment have evolved during the last six years at the Child Amputee Prosthetics Project, where more than 200 amputee children have been treated on an out-patient basis. These principles have included taking advantage of the natural patterns through which a child develops, such as being able to grasp before release or pulling up before walking. These patterns can be used to advantage in timing the fitting and training procedures.

It has been found that many scaled-down adult components work fairly well for children. There is also a wide range of very strong and light plastic materials, which can be well suited to a child's needs. Still, adaptations made necessary by the special problems of children are actively sought and provided. Frequently, these have been found to have useful application for adult amputees too.

Fabrication and fitting of a child's prosthesis must be planned so that adjustments for growth can be made. In most cases, its use can then be prolonged for one, two or three years.

A consistent and sustained training program and good medical care is necessary for a satisfactory and satisfying prosthetic experience. Such a program enriches the child's life as he sees himself able to compete adequately with his playmates. An interdisciplinary treatment group has been found to furnish the best approach to these multifaceted and complex problems.

The staff at the Child Amputee Prosthetics Project have found that children and their families do benefit from early fitting of prostheses. A well-rounded prosthetic program enables the child amputee to be comfortable and at home with his prosthesis. He obtains satisfying experiences from his own achievements and in his relationship with his family, playmates, school and community. Without these experiences, he can develop a hostile, defensive attitude which could interfere more with his success and usefulness than the amputation itself. A prosthetic program is successful to a child when it helps him grow into a mature and productive adult.

Developmental Factors in Infant Upper Extremity Prosthesis Fitting

by
JULIE WERNER SHAPERMAN, O.T.R.
MILO B. BROOKS, M.D.
HARRY E. CAMPBELL, C.P.

The Child Amputee Prosthetics Project (CAPP) at UCLA has been fitting upper extremity prostheses to young child amputees for the past six years. Special attention has been given to those under two years of age—the infants. This Project has realized the necessity of exploring the optimal age for fitting upper extremity prostheses to infants. The motor development and pattern of prosthesis use of thse infants has been followed closely. Ways of fitting and follow-up care for these infants have evolved which make use of clues in his development that determine how and when he should be fitted. Results of this experience continue to be evaluated.[2]

First Attempts at Infant Fitting

In 1955 the available armamentarium and techniques of fitting infants gave no indication that his needs were different from adult needs. The first infants fitted at CAPP had size 10 or larger hook terminal devices with complete control systems. These scaled down adult type arms with large hooks, heavy leather work and harnessing were gross in appearance and unwieldy for use. The infant did not actively operate the terminal device and it was soon apparent that more suitable armamentarium and/or fitting technique was needed. The infant was not just a small adult. His special needs had to be met.

Developmental Considerations

During the first two years of life the neuromuscular control of arms and legs undergoes profound change. Development proceeds in a cephalocaudal (head to toe) direction and the arms develop control and skill, starting from the shoulder and progressing to the hand. At first, normal infants do not use arms and hands with good coordination and they have dffiiculty with fine motions. Shoulder motions during the first year are primarily abductive-adductive. Early reaching motions are poorly directed but the approach toward objects is gradually straightened showing gain in control of distance and angle. Studies have shown that the angle of approach is under the influence of the type of object to be grasped and its placement. Approach receives its direction from the hand going to do the grasp. By the end of the first year the infant can reach for objects with enough arm control to place the hand in good position for grasp.[6] Hand patterns also undergo change in a sequential developmental pattern. By one year of age the infant can use a precise forefinger tip grasp.

The developmental pattern proceeds through a sequence of acts. The occurence of each act in the series is contingent upon those which precede it. Thus it is obvious that considerable learning occurs while performing the acts which precede the emergence of the ultimate skill. These seemingly-crude early reaching and body movements are important for giving the infant a concept of visual space and of his body and arms within it. When the infant amputee wears a prosthesis during this time, he comes to accept it as "part of himself." He uses the prosthesis with the same arm movement patterns as are natural to his stage of development.

When the tools needed for an act in the developmental pattern are not present, the infant must find some compensatory way to perform it. If the infant amputee has no prosthesis when he goes through the stages of development involving his arms, he compensates by learning to rely on what he has for all his activities. Without a prosthesis the child avoids some bilateral activities or appears awkward in performing them.

Age of Fitting

On the basis of this knowledge and in order to properly evaluate the optimum age for fitting, the CAPP is currently fitting upper extremity prostheses to infants when they achieve independent sitting balance. Developmental studies have shown that this usually occurs at approximately 7 to 9 months of age. A prosthesis is applied at this time because:

1. *Body Control:* An infant has sufficent body control to keep the prosthesis from interfering with his normal activities of rolling and crawling.
2. *Arm Control:* First experiences in the upright position for any infant begin to occur at this time. After achieving upright posture, an infant rapidly extends his play area and begins rapid development in control of arms and hands.
3. *Wearing:* Infants accept wearing prosthesis more easily when fitted at this early age and tend to carry through with a full time wearing pattern in the years that follow.
4. *Arm Patterns:* Experience has shown that infants fitted when they achieve independent sitting balance develop arm patterns which parallel those of the sound arm, and they carry these spontaneous and natural arm patterns over into their later prosthesis use. The child who has developed prosthetic skill performs activities requiring two hands in a fashion common to all persons and does not resort to knees, teeth, or axilla holding.

The Infant Passive Hand or Mitt

The special needs of the infant amputee were considered in the national prosthetics research program. A terminal device which did not require operation by a cable was needed. The device designed was a hand in a simplified abstract form. It was referred to as an infant passive hand or mitt (see Figure 1). It was assumed that by not making the mitt too anthropomorphoid it would be psychologically easier to change to a hook when active grasp was needed. This stylized form also allowed better function than a purely cosmetic hand as it had a cupped shape and deep thumb cleft.

Eighteen infants were fitted at CAPP with various experimental and commercially available models of the mitt. They were well accepted by parents and the infants used them for activities appropriate to their developmental level. The light weight of the mitt and the friction offered by the glove were of advantage to the infant. It was very satisfactory for scooping, lifting, holding large objects bilaterally, and for holding down objects. However there were serious limitations in the function of the mitt.[4, 5]

Limitations of Mitt in Gross Activities

1. Infants needed a more secure hold than the mitt offered when pulling up to a standing position and supporting themselves with such things

as the rails of a crib or play pen. Although initial design criteria specified at least 70 degrees or more of digital flexion in the mitt for this purpose, it did not meet this need.[7]

2. Infants needed a more secure way to hold objects which were placed in the mitt. Pull toy cords, rattles, and balloon strings had to be taped or tied to the mitt. The thumb cleft of the mitt provided a precarious 2 point hold for a limited number of objects.

Limitations of Mitt in Transition to Hook

1. The infants did not develop bilateral prehensile awareness. About the age of 2 infants began to develop compensatory grasp patterns. They held toys and other objects between their knees, in the axilla, or in the bent elbow while manipulating them with the sound hand. To prevent these compensatory patterns from becoming established habits, the child's terminal device was then changed from the mitt to a plastisol coated hook, Dorrance 10P, with cable (see Figure 2). The hook with cable is referred to as an active hook. It is operated by a body motion of the amputee transmitted through the harness and cable.

   An initial period of intensive training in the use of the active hook was given. These children who had changed from mitt to hook learned active hook operation quite slowly. They were slow to realize that their new hook terminal device could hold an object. Even after they had learned to open and close the hook actively, they persisted in holding objects in the elbow, axilla, or between the knees. It required a considerable period of un-learning and re-learning before they would hold objects spontaneously with the active hook.

2. At the time of the transition from mitt to hook, many parents had

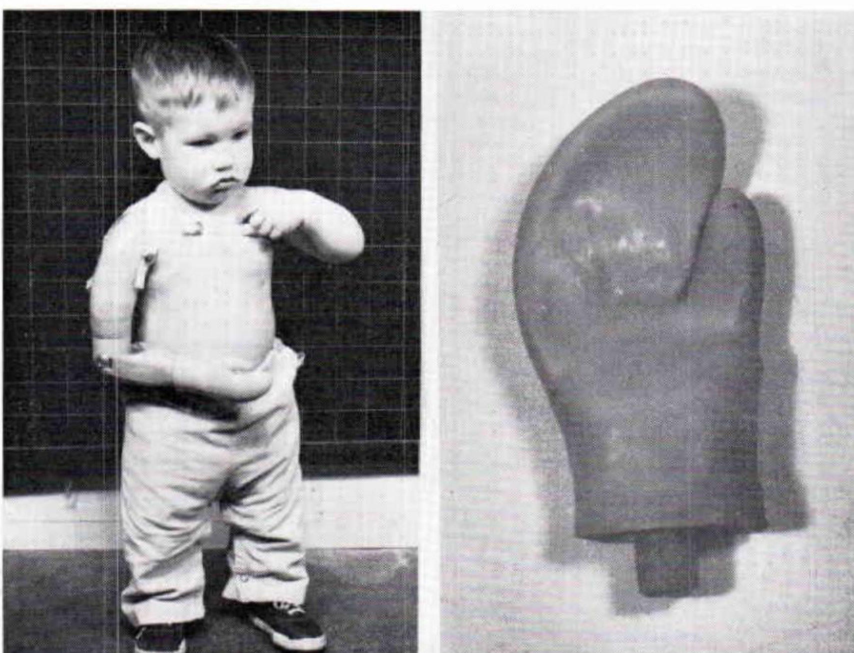


Figure 1. The infant on the left is wearing the commercially available model of the Infant Passive Mitt. On the right is the UCLA model of the mitt.

difficulty in accepting the appearance of the hook. Even though they could see the need for increased function, they resisted change because they had found the color and shape of the mitt sufficiently cosmetic to meet their own needs and to satisfy their feelings of having done something for their child.

Observations made of infants wearing the mitt and following the change to the hook with cable showed they were able to perform all of their gross activities of scooping, lifting, holding down objects, and holding large objects bilaterally with a skill equal to that of the mitt. Parents reported new activities their children could perform better with the hook such as hooking over bars or hooking over furniture while climbing. These observations, along with the developmental factors known about the learning of prehension by the infant, led the CAPP to look for an infant terminal device which would not have the deficiencies noted with the mitt.

Figure 2. The Dorrance 10P hook with cable is worn by this infant.

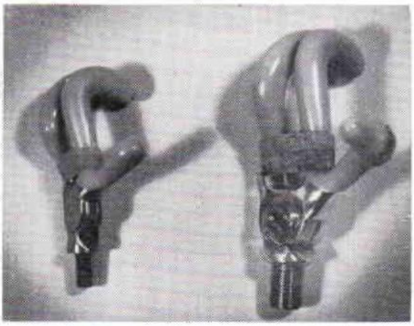


Figure 3. The smaller Dorrance 12P hook is seen on the left and the larger Dorrance 10P hook is seen on the right.

The Infant Passive Hook

Evaluation Procedures

Evaluation was undertaken of the effectiveness of fitting infants having attained independent sitting balance, with a very small plastic covered hook which was commercially available, the Dorrance 12P (see Figure 3). This hook was applied without a cable and is called a passive hook. It could be pulled open by the sound hand of the infant or by an adult to have an object placed into it. It was reasoned that even though the infant would not actively operate this terminal device, he would learn that it could hold objects.

At first the staff thought a hook might get in the infant's way or he might accidently hurt himself with it or get it caught on things. Also it was questioned whether the protruding hook tips and thumb lever would inhibit palmar prehension. It was also thought the parents might reject a prosthesis because of the immediate introduction of a hook. The problems the staff had anticipated did not occur. Twenty-three infants ranging in age from 7 months to 22 months have been fitted with this infant passive hook on their initial prosthesis.

In the two and one-half year period since this study was begun these infants have been observed in relation to pattern of development, manner of use of prosthesis, and pattern of learning active terminal device operation. Following fitting, checkout, and a brief period at CAPP for observation of the infant and orientation of the parents, the infant was seen once or twice a month by a therapist in his local community where his development and pattern of prosthesis use were observed. Movies were taken at regular intervals of all children so fitted. Parental reactions were recorded by the social worker. Prosthesis fitting and maintenance information was recorded by the prosthetist.

Results of Fitting the Infant Passive Hook

Parents who were motivated toward a prosthetic program accepted the small plastic covered passive hook for their baby's prosthesis. Some said that since the child would eventually wear a hook, it was easier to start out with one. A number felt that its appearance was more acceptable than the stylized mitt. By using a passive hook for the first fitting, parents learned to handle the questions and stares of others from the beginning. It was part of facing and dealing with the reality of their baby's amputation and the potential use of a functional prosthesis.

The pattern of motor development of the infants fitted with the infant passive hooks followed closely that seen in non-amputee children. There were no functions performed by infants wearing the mitt which infants were not able to perform equally well with the Infant Passive Hook. As young infants they had no difficulty using both arms together for gross activities such as scooping objects toward themselves, lifting large balls, and holding down objects while manipulating them with the sound hand (see Figure 4). They were able to use both arms to support their nursing bottles. (When the bottle rested in the angle between the passive hook fingers and the hook thumb it gained additional support.) When teething a number of infants enjoyed chewing on the plastisol covering of the passive hook. This plastisol covering also provided friction for stabilizing objects and body support.

Body support activities were also performed in their expected developmental sequence. Sveral of the infants crawled on the sides of the hook tips. Some crawled on their flexed forearms. At first some got "hooked" on furniture legs while crawling but quickly began allowing for this added length and shape and were able to free themselves. When sitting on the floor many of the infants leaned upon the passive hook tips for support while reaching out for a toy with the sound hand. When pulling to standing position a number of the infants did hook over a rail or piece of furniture gaining support on the prosthesis side. At first they did not trust the prosthesis enough to support their standing weight with it, but were soon able to develop enough confidence in it for this activity. When learning to walk and taking those inevitable first falls, the infants were observed to put both arms out to catch themselves and landed on the hook tip and sound hand. They then pushed themselves up from the floor with both arms. For these activities the infants with the infant passive hook had equal or better function than those who had worn the mitt.

Objects placed into the Infant Passive Hook were not noticed at first by some infants under one year of age. Their earliest responses were to put the infant passive hook into their mouth and suck it; to pull an object out of the passive hook; to shake their arm and listen to the sound of the object in the passive hook, or simply to bang the passive hook against the floor or other hard object (see Figure 5). Later most of the children went through a period when they would not allow any object to remain in their infant passive hook for more than a moment. The parents were advised to place appropriate objects into the passive hook as long as the infant would tolerate this.

At about 18 months of age the therapist directed the infant's play toward increasing his attention span and encouraging him to follow directions. At some time during the infant's second year he shows interest in playing with and holding some small objects. The infant amputee used his axilla, bent elbow or teeth for this purpose. From the time this was first seen parents and therapists began placing objects into the infant passive hook and the infant began to experience some success in playing with these smaller objects. Parents reported that infants tried to place objects into the passive hook themselves but needed to ask someone to open it for them, or they pulled the hook open with their sound hand and then needed someone else to put the object into it. Some developed compensatory ways of holding the infant passive hook open to get an object into it such as holding it open with the mouth.[3]

Transition from Passive to Active Control

The cable was added when the infant showed an interest and desire to hold objects in the infant passive hook; was able to follow simple instructions; and had a sufficient span of attention to play with one toy at a time for a few moments. This usually occured at around the age of 2, but the period of excess negativism which most children have at around this time was avoided if possible.

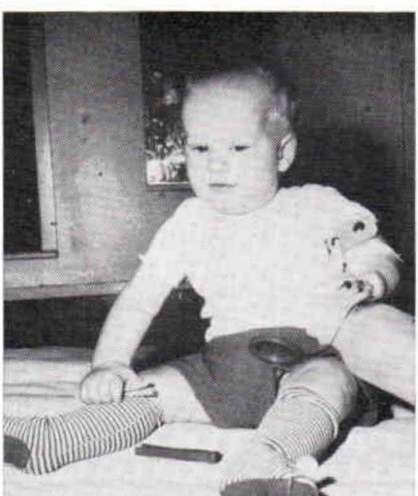


Figure 4. The infant holds down a plastic bottle with the prosthesis and places objects into the bottle with his sound hand.

Figure 5. The infant learns that his passive hook can hold objects and enjoys a simple bilateral activity.

It was found that usually by this time the child's prosthesis was slightly short and the 12P hook appeared small for the child. The Dorrance 10P hook which is three-quarters inches longer than the 12P was applied in its place. The 10P hook was applied with a cable. Except for the greater holding potential of the 10P hook, the shape, friction quality, and other features of the two hooks were the same. Even the weight was not markedly different as the 12P has a steel core and the 10P an aluminum core (see Figure 3).

Parents showed eagerness for the change from passive to active hook to occur. Some considered it a "promotion" for their child. The parents' eagerness had to be controlled and the activation prescribed when the child showed sufficient span of attention and ability to take instruction to be able to profit from the training period. At the time of this writing, about one-half of the infants fitted with infant passive hooks have matured sufficiently to have the terminal device control system added to the prosthesis.

Training which followed the addition of the cable was in some ways similar and in some ways different from that observed following change from mitt to hook. Those children who had worn the infant passive hook proceeded to learn active operation more rapidly but in the same controls sequence as has been observed with infants who had worn the mitt.[5] *The major difference occured in the spontaneous application of their skill outside the training situation. These children had learned that the hook was a holder of objects. They did not need to break old habits before they would use it spontaneously.* Follow-up training confirmed this and was continued to help the child refine his skill and develop the full potential of the device.

Infant Sockets and Harnessing

An infant's rounded contours, tender skin, and small size present challenges to effective fitting and harnessing. The gross use of his extremities in infant activities adds further complications. CAPP Prosthetists have found some ways of effectively fitting and harnessing the infant, making his prosthesis less bulky, and making it last longer than was previously anticipated.

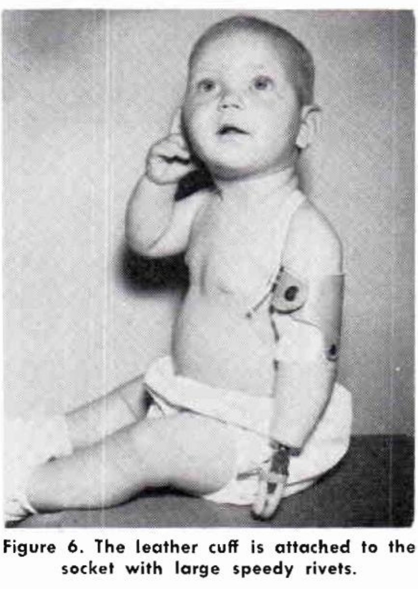


Figure 6. The leather cuff is attached to the socket with large speedy rivets.

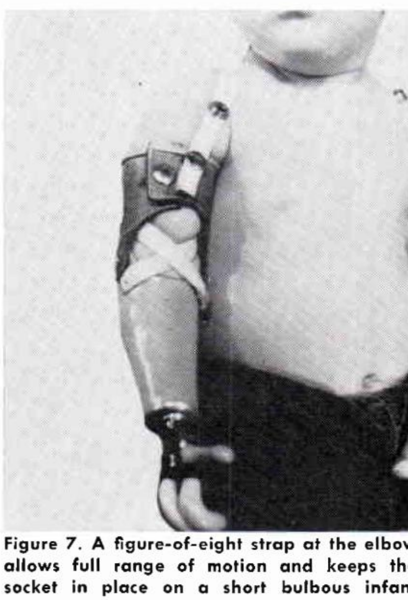


Figure 7. A figure-of-eight strap at the elbow allows full range of motion and keeps the socket in place on a short bulbous infant stump.

Socket

As much bulk as possible was eliminated from the elbow hinges. Leather cuffs were attached with rivet inserts or glove snap hinges (see Figure 6). Short and very short below elbow amputees were fitted with double walled sockets rather than with split sockets. The sockets were pre-flexed to provide as much range as possible with no attempt made to provide full range of elbow flexion on unilaterals with very short stumps. Some infants with very short bulbous below elbow stumps temporarily needed an accessory figure-of-eight strap at the elbow to hold the socket on (see Figure 7). The double-walled socket provided the infant with a rigid pillar for crawling and with a secure means of holding down objects. Additional weight and bulk were eliminated for the long below elbow amputees by using dacron tape for flexible hinges and eliminating the leather cuff (see Figure 8).

Baby fat is gradually displaced by muscle tissue as the infant develops. As this occurs socket shape adjustments can be made by heating the plastic to change its contour. The socket can be ground out and sanded at the distal end, over the olecranon, or humeral epicondyles as the infant's stump changes shape. This is possible when the socket has been made thick enough in these areas. If the arm is short a larger hook can be substituted.

Harness

An infant's shoulder area is so small that little space is available for a harness. Even the "simple" below elbow figure-of-eight harness is not simple to balance on the infant's prosthesis. It must suspend the prosthesis so it stays on the infant, does not excessively mark tender skin, and remains in correct alignment. For example, there is a temptation to attach the front

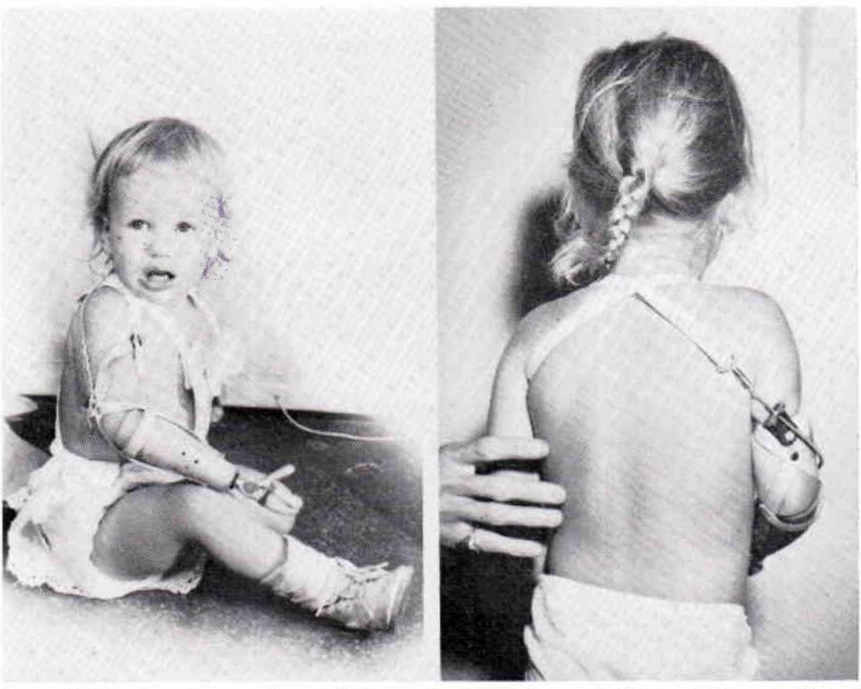


Figure 8. The long below elbow infant prosthesis can be made light weight and efficient by the use of dacron tape flexible hinges and "cuff." The infant on the left wears a passive hook. The cable has been added to the prosthesis shown on the right.

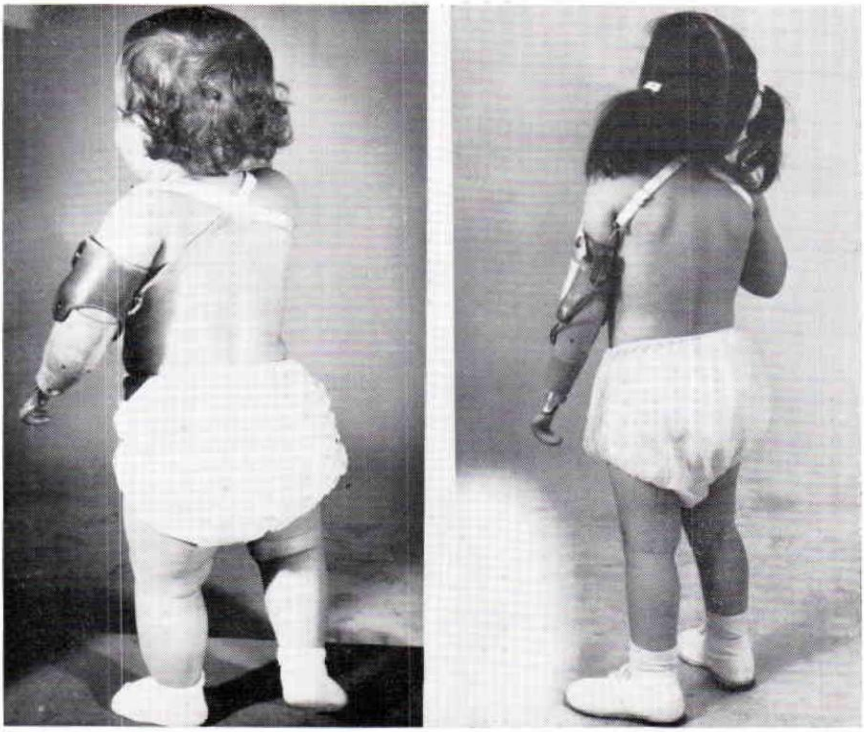


Figure 9. The infant below elbow passive prosthesis is shown on the left with the elastic strap substituting for the control strap and cable. At right the cable and control strap have been added. Note that the harnesses are stitched at cross points and attach to the cuff at front and back with glove snaps.

support strap on the medial side of the cuff and to pull it tight to keep it from sliding off the infant's rounded shoulder. This arrangement tends to rotate the prosthesis externally so that it is outside the infant's area of vision.[1]

The control attachment strap on the infant harness is replaced by an elastic strap as a substitute for the control strap and cable. (The elastic strap is used to keep a good balance on the harness when the hook is passively operated.) It attaches to a reaction point on the cuff for the below elbow or on the humeral section for the above elbow amputee (see Figures 9 and 10).

Maintenance

The socket and harness must be kept clean and in correct adjustment. Harness adjustments were easily lost when buckles were undone for laundering. A satisfactory solution has been to provide two harnesses to interchange while one is laundered and also to make all harnesses with fixed attachments (see Figure 9). CAPP prescribes all harnesses so they are stitched at cross points and attach to the prosthesis with large glove snaps. (A drop of oil on glove snaps after laundering keeps them working well.) Socket and harness fit and function need to be checked by the prosthetist at approximately three-month intervals to take care of any needed adjustments for the growing and changing infant amputee.

Conclusion

Habilitation of the infant upper extremity amputee can be accomplished through the application of prosthesis if detailed attention is given to his developmental needs and achievements. Experience at the Child Amputee Prosthetics Project in fitting forty-one infants with passive terminal devices has raised a number of questions and suggested some possible solutions.

1. Infant upper extremity amputees do benefit from the application of prosthesis. Far from being a nuisance it helps him develop more normal and natural gross arm patterns, more normal motor development patterns, and more useful two-handed grasp patterns. Prostheses can be applied with good results and surprisingly few problems from the time the infant has achieved independent sitting balance. A prosthesis becomes incorporated into his body growth and developmental patterns when applied early and worn consistently.
2. The infant passive mitt is a satisfactory terminal device for gross palmar prehension and for some body support activities. However, it is seriously lacking in some respects. It does not provide hooking over objects for support when pulling to standing—this is an important need for the infant. It does not allow the infant to hold a variety of small objects or to develop bilateral prehensile awareness. The infants who had worn the mitt did learn to actively operate the hook but were slow to realize that it could hold objects. Parents had difficulty in accepting the shift from a mitt to a hook at the time active grasp was needed.
3. An infant passive hook, Dorrance 12P, appears to be a more functional infant terminal device than the mitt for the following reasons:
   a) It provides for gross palmar prehension and body support activities with equal skill to the mitt.

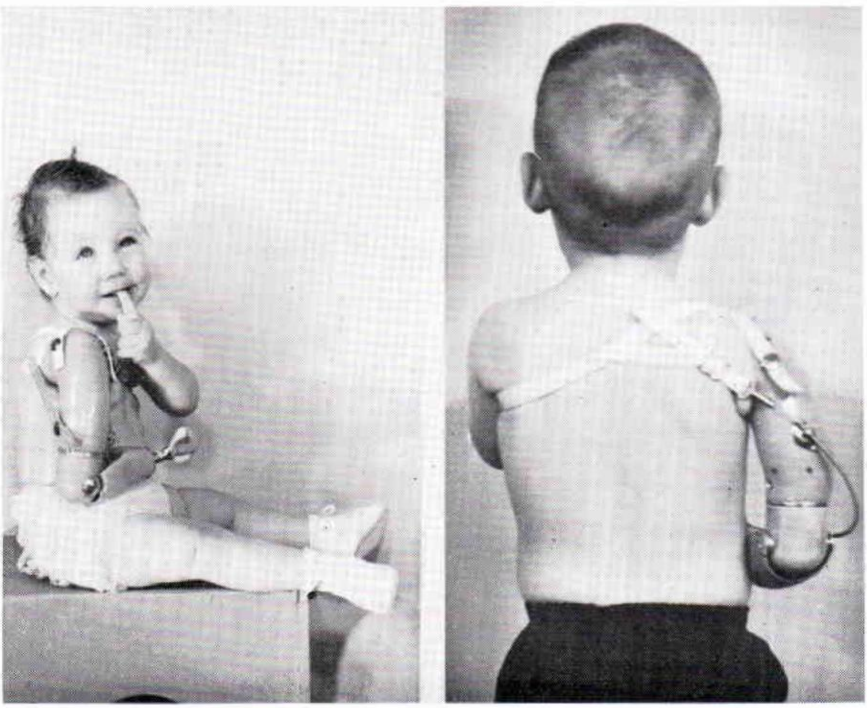


Figure 10. The infant's above elbow prosthesis is shown on the left with the elastic strap substituting for the control strap and cable. At right the control cable and strap have been added.

b) It allows the infant to hook over objects for support in pulling to a standing position.

c) It provides a holder for small objects which are placed in it.

d) It helps the infant develop bilateral prehensile awareness. He grows up in a two-handed world where equipment and facilities require a "holder" or "manipulator." The infants who had worn the infant passive hook and later received active control used the hook spontaneously for holding objects for their activities.

e) Parents who were willing to accept any prosthesis for their child readily accepted the infant passive hook terminal device.

4. The active control for the terminal device can advantageously be added when the child shows interest and readiness for this operation. This is usually sufficient some time between the ages of 2 and 3. Training should be given in the use of the active control to develop the potentials of the device. Early operation is crude but becomes refined in a relatively short time and the habit patterns of holding in the hook are retained.

5. Harnessing, socket design, and fitting of infant upper extremity amputees requires skill and knowledge. There are ways of making prostheses last longer which can make fitting the infant amputee economically feasible. These have been discussed in the text.

6. The infant and growing child and his family can be more successfully habilitated by a cooperating interdisciplinary treatment group. Good family orientation and patient evaluation, skillful fitting and harnessing, consistent training, and good medical, surgical and follow-up care are needed. Together they provide the infant upper extermity amputee with the kind of prosthesis experience from which he can grow and develop in a fashion parallel to a child with two arms.

List of References

[1] Campbell, Harry E., "Report of Problems of External Rotation." University of California at Los Angeles, Child Amputee Prosthetics Project. May 15, 1957. (Mimeographed Report.)

[2] Child Amputee Prosthetics Project. *Fourth Annual Report.* A Report Prepared by the School of Medicine, Los Angeles, University of California, December, 1958.

[3] "A Comparison of the Functional and Psychological Effectiveness of the Infant Passive Mitt with the Plastic Covered Hook." University of California at Los Angeles, Child Amputee Prosthetics Project. (Report in Preparation.)

[4] Dennis, Jeannine F., "Report on Observations of Six Amputees Wearing the Army Prosthetics Research Laboratory Type of Infant Passive Hand." University of California at Los Angeles, Child Amputee Prosthetics Project. May, 1957. (Mimeographed Report.)

[5] Dennis, Jeannine F., "Report on Observations of Sixteen Amputees Wearing the University of California at Los Angeles Type of Infant Passive Hand." University of California at Los Angeles, Child Amputee Prosthetics Project, May 1957. Mimeographed Report.)

[6] Halverson, H. M., "An Experimental Study of Prehension in Infants by Means of Systematic Cinema Records," *Genetic Psychology Monograph*, X, (August-September, 1931), 107-284.

[7] Jones, Robert, *et al.*, "Preliminary Design Criteria for Infant Passive Hands." *Memorandum Report No. 32.* University of California at Los Angeles, Department of Engineering, Artificial Limbs Project, April, 1956. (Mimeographed Report.)

[8] Shaperman, Julie W., *The Child Amputee: Observations of the Sequence of Learning Active Terminal Device Control.* Master's thesis on file with Librarian, University of Southern California, Los Angeles, August, 1960.

New Developments in Lower Extremity Prostheses for Children

by
HARRY CAMPBELL, C.P.
BETTY KITABAYASHI, R.P.T.
CARL SUMIDA, C.P. & O.

The staff members of the Child Amputee Prosthetics Project (CAPP) at the University of California at Los Angeles are working constantly on improving and developing prostheses for the child with an amputation or anomaly. This article discusses two recent developments in the area of lower extremity prostheses: (1) a hip disarticulation type prosthesis for preschool age children, and (2) a child's size adjustable below knee leg.

The cooperation and assistance of the engineering and prosthetic consultants from the Prosthetics Devices Study at the University of California at Berkeley (UCB) have been invaluable in the development of our lower extremity program. James Foort, engineering consultant, and Leigh Wilson, certified prosthetist, were instrumental in much of the work on the hip disarticulation type prosthesis.

A HIP DISARTICULATION TYPE PROSTHESIS FOR PRE-SCHOOL AGE CHILDREN

A year old infant with a left hip disarticulation amputation was referred to CAPP for his prosthetic care. Rather than fitting this child with the more frequently used pylon type fitting, the staff attempted an articulated prosthesis using the basic bio-mechanical principles utilized in the Canadian type hip disarticulation prosthesis.[1]

Two major factors were taken into consideration in design and fabrication:

1. The components used in fabrication had to be very small. Scaling down adult components would be difficult and there would be no assurance the finished product would be satisfactory.

2. The prosthesis had to be made easily adjustable for lineal and circumference growth.

The Socket

A socket was made using the same UCB techniques described by Foort.[2] The cast was taken over the diapers. This was done to provide a padding for the ampuation site and to protect the socket from constant wetting.

A webbed strap and buckle attached to the waistband of the socket was provided for suspension. Later, snaps were put directly on the flexible waistband, but the mother preferred the webbed strap and buckle because it permitted easier removal when changing diapers. The webbed strap and buckle

[1] Radcliffe, Charles W. "The Biomechanics of the Canadian-Type Hip Disarticulation Prosthesis," *Artificial Limbs*, Prosthetics Research Board, National Academy of Science, National Research Council, Washington. Vol 4, No. 2, Autumn 1957, pp. 29-38.

[2] Foort, James. "Construction and Fitting of the Canadian-Type Hip Disarticulation Prosthesis," *Artificial Limbs*, Prosthetics Research Board, National Academy of Sciences, National Research Council, Washington. Vol. 4, No. 2, Autumn 1957, pp. 39-47.

also allowed better adjustment of the waistband as a more positive means of suspension without resorting to shoulder straps. The snaps also came off frequently.

The child has had three sockets during a fifteen month period. The original socket was replaced because of growth. The second socket received hard wear through increased activity and was too large when the child no longer wore diapers. He is presently wearing the third socket.

The Hip Joint

The child's size hip disarticulation hip joint available commercially was too large for the child when the first prosthesis was made so a small door hinge was used. Later, when the second socket was made, the commercially available hip joint was used. The door hinge seem to function satisfactorily in the initial prosthesis.

The Thigh-Knee-Shin Unit

The pre-school age child has a rapid rate of lineal growth. The cost of replacing a prosthesis each time the child outgrew it would be exorbitant. The engineers at UCB designed a thigh-knee-shin unit which could be adjusted easily for growth. (FIGURE 1)

The knee joint was designed to be as near "pinch proof" as possible to prevent harm to the child and clothing during rough play. The knee joint had no friction control in this case, but could be added if desired. The knee was left unlocked. If a patient were having difficulty controlling both the hip and knee joints, the knee could be stabilized by means of knee

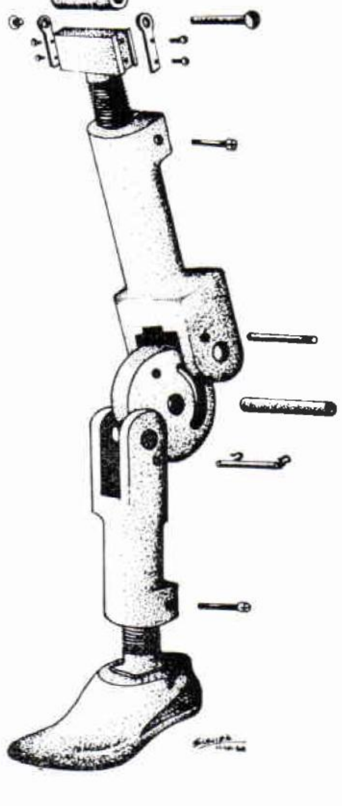


Figure 1. The thigh-knee-shin unit with hip joint and SACH foot attached.

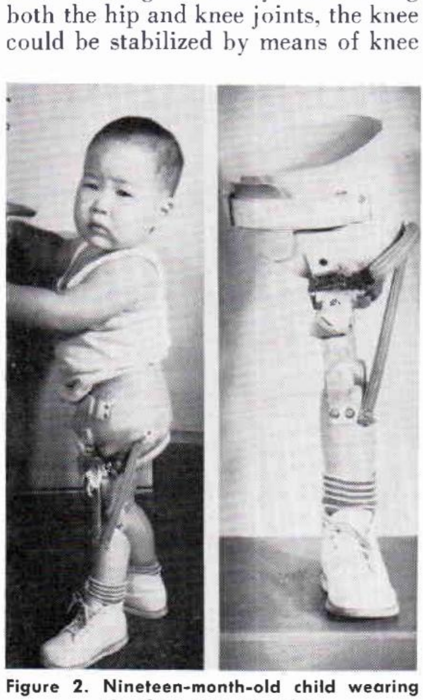


Figure 2. Nineteen-month-old child wearing the first unit of nylon.

flexion control strap. It is recommended that some flexion be allowed to acquaint the child with the potential flexion and extension of the knee joint. Allowing ten to fifteen degrees of flexion seemed adequate for stability and still allowed the child to experience the sensation of knee flexion. However, the knee control strap should be removed as soon as possible.

Threaded extensions projected from the knee joint into which threaded aluminum rods were inserted. This allowed for growth adjustments in both the shin and thigh sections. Collar type clamps on the knee joint extensions were used to keep the aluminum rods from rotating.

Two thigh-knee-shin units were made for testing. The first was made of nylon and the second of micarta. The child has worn both units. The nylon unit was worn first (FIGURE 2) and the micarta unit, which was a little larger, was used when the second socket change occured. (FIGURE 3)

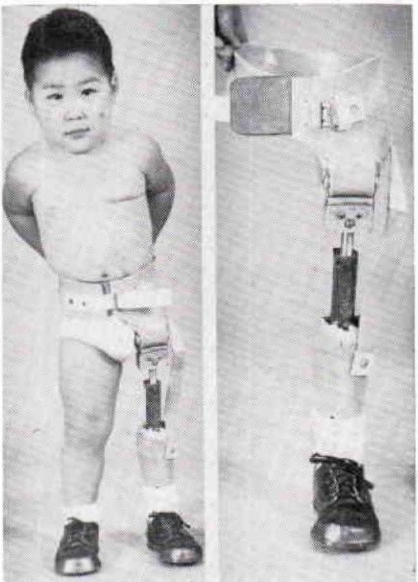


Figure 3. Child wearing second unit of Micarta.

Figure 4. Training activity to establish two-legged standing balance.

Both units worked equally well and were durable enough to withstand a great deal of scuffing, kicking, and general hard wear. No maintenance was required on the units. The micarta unit is less expensive to make than the nylon and may be preferred because of this. The same units may be re-used for other patients.

The Foot

The SACH foot was worn during the entire time with no difficulties encountered.

Control Straps and Alignment

The control strap and alignment for the prosthesis were essentially the same as with the Canadian type hip disarticulation prosthesis.[3]

Cosmetic Covering

A cosmetic covering was put over the shin section for cosmesis and to have a point of attachment for the control strap or straps. The thigh section was left uncovered as it was quite short and the family did not object to

[3] Ibid, pp. 48-51.

the unit being exposed. If a cosmetic covering were desired on the thigh section, it could be applied easily.

Adjustments for Growth

Adjustments for growth were made about once a month, taking about five minutes of the prosthetist's time. At no time did the patient have to walk with a prosthesis that was too short. Extension spacers were added to the cosmetic shin covering as growth adjustments were made. When about two inches of adjustment had been made in the shin section, the whole cosmetic covering was relaminated.

Training

The patient received his prosthesis at the age of one year, seven months. Since this child had never walked, it was necessary to give him an awareness of the prosthesis for standing balance as well as for walking. He received intensive daily gait training for two weeks with follow-up training sessions occuring three times a week until he was able to walk independently.

The primary goal in the initial phase of training was the establishment of basic skills needed for prosthesis control and walking. Balance, prosthesis control training, and reciprocation were stressed. The therapist assisted the child in the pelvic motions necessary for control of the prosthesis until the child could accomplish these motions independently. Play activities such as catching and throwing a ball, and hitting a balloon suspended from the ceiling were used to gain balance and to teach proper weight shifting on the prosthesis and the sound leg. The child established good balance and fair prosthesis control in three weeks and then attempted a few independent steps on his own. By eight weeks, he was walking, running, and jumping. He had learned to climb stairs and was not restricted in any of the climbing activities he attempted. (FIGURES 4, 5, 6) The child wore the prosthesis during all of his waking hours from the day it was received. Full time wearing was encouraged in order to accustom the child to the prosthesis and to check the fit of the socket for pressure areas.

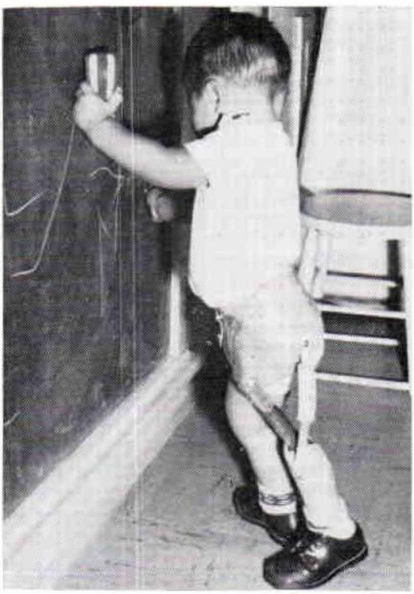


Figure 5. Training activity to establish body and prosthesis control in different positions.

Figure 6. Training activity to establish reciprocal walking pattern.

Conclusions

The hip disarticulation type prosthesis has proved feasible for the pre-school age child from a fabrication and training standpoint. The cost of fabrication and maintenance of the prosthesis has been reduced by the use of the adjustable thigh-knee-shin unit. It is worthy to note again that the thigh-knee-shin units may be re-used for other patients.

The prosthetists at CAPP are now modifying the thigh-knee-shin unit for use with the above knee amputee. A subject has been chosen to test the unit and fabrication of the prosthesis will begin shortly.

The adjustable thigh-knee-shin units are not available commercially at this time. Before approaching a manufacturer, CAPP would be willing to suggest sizes in which these units could be made so that the child could get a maximum period of wearing before changing to another unit.

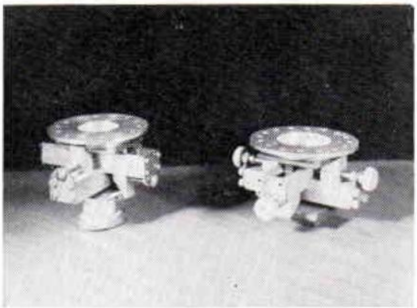


Figure 7. Left: child's adjustable below knee unit designed by Harry Campbell, C.P. Right: commercially available unit.

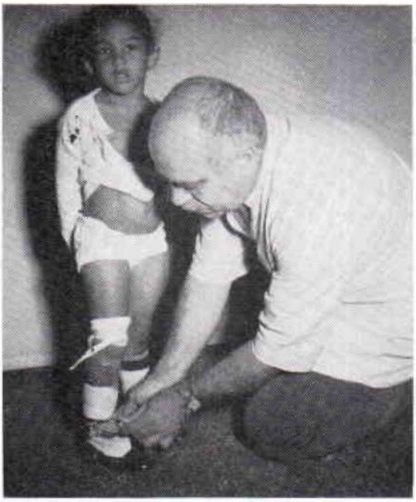


Figure 8. Adjustable below knee leg being used to gain optimum alignment.

THE CHILD'S ADJUSTABLE BELOW KNEE LEG

Many questions have arisen regarding the patellar tendon bearing type of below knee fitting in the growing child. Some of these questions are: "What are the effects of this type of fitting on bone growth? Will this type of fitting cause or increase deformity? How will the absence of knee joints in the prosthesis affect knee stability?"

In order to find answers to these questions and others, it would be necessary to fit a number of children and follow them over a period of several years.

Proper alignment of the prosthesis is important. Although a skilled prosthetist could align this prosthesis without the aid of an adjustable leg, it is desirable to use the adjustable below knee leg during the fitting stages to rule out as much error as possible.

A great majority of CAPP patients are too small to use the adult model of the adjustable leg. Harry Campbell, research prosthetist at CAPP, scaled down the adult type to meet the needs of the children. (FIGURE 7)

CAPP has five children between the ages of one year and six years wearing the patellar tendon bearing below knee prosthesis with cuff suspension. CAPP will continue to fit other children as they are referred to the Project. (FIGURES 8, 9, 10) Three of the children presently wearing this type of fitting have bilateral amputations. Two have below knee and Symes type amputations, the third has below knee and above knee amputations.

The child's size adjustable below knee leg is available commercially.

Figure 9. Twenty-four month old toddler with patellar tendon bearing prosthesis. Child was initially fitted at age of one year with same type of fitting.

Figure 10. Four-year-old bilatteral above knee, below knee amputee fitted with quadrilateral suction socket above knee prosthesis on the right, patellar tendon bearing prosthesis on the left.

Use of Community Resources In The Continuing Prosthetic Care of the Child Amputee

by
WILMA GURNEY, M.S.W.
JEANNINE F. DENNIS, O.T.R.

More than 70 per cent of all children receiving prosthetic care at the Child Amputee Prosthetics Project have their continued training with occupational or physical therapists near their homes. Nearly all the children in the Los Angeles area receive their initial training as well as their continued training near their homes. Approximately 50 per cent of all prostheses are made and maintained in private limb shops located within reasonable traveling distance of the patients' homes.

The use of these community resources did not come about quickly and was not motivated exclusively by the expediency of saving project staff time. As the needs of patients and their families became more clarified and working relationships with the resource personnel in the communities better established, the benefits of stimulating and supporting continued treatment on a decentralized basis became apparent. It was also recognized that the community itself, with all of its activities and demands on the patient, provided a real laboratory for the testing of equipment and the evaluating of treatment methods.

Prosthesis Training

In 1955 only a very few children who were active in CAPP received training on a local basis. These children were severely involved, necessitating attendance in special schools. These schools were set up primarily for children with cerebral palsy. The therapists responsible for these children made direct requests to the CAPP occupational therapists for assistance in prosthetic training methods.

During this time the other children in the CAPP program received their initial training from the project therapist and were scheduled for periodic follow-up at CAPP. The initial training consisted of approximately five to fifteen sessions over a one to three week period. The number of sessions was determined by the severity of the problem and the complexity of the device. Parent and child stayed in a nearby motel when the distance from home was too great for daily commuting. Frequently the follow-up training proved impractical because the distance to be travelled from their homes to the project precluded sessions on a weekly or in some instances, even a monthly basis. For some children a loss of skill occurred during the interim between sessions. This resulted in questions from parents, child, and staff about the feasibility of fitting children when motivation to use prostheses could diminish so easily. Other children retained their initial skill but did not improve their skill in keeping with their developmental level. With the prosthesis they remained at the developmental level at which they were trained while the rest of the body and mind had moved on to more complex tasks.

The CAPP therapist believed that with consistent training a child develops and maintains skills that would make the prosthesis a useful device for him. Those few local therapists who were training children continued to express interest in knowing more about working with child amputees. With the CAPP therapists' belief in the benefits of consistent training, with the interest expressed by the local therapists, and with the investment (in money and energy) of the State Bureau of Crippled Children Services, a plan was worked out for all CAPP patients to receive prosthetic training on an outpatient basis in the special schools.

As first each therapist received detailed instructions of training methods whenever a referral was made. A form was prepared so that each therapist could report progress and difficulties at periodic intervals. Despite the efforts of the project therapist to provide detailed instructions, the local therapists expressed considerable apprehension about their work with CAPP patients. They saw an upper extremity prosthesis as extremely complicated, requiring a skill and understanding they did not have. It was necessary for the CAPP therapist to explain terminology, principles of bio-mechanics, and step-by-step training methods to each therapist. Therapists coming individually to the project, or the project therapist going to the special schools, proved impractical because of the heavy time involvement. For a period of time the local therapists were invited to attend the clinic when their patient's program was reviewed. Although these therapists contributed information valuable in a better understanding of the patient's progress or difficulties and they took with them additional information about the patient's potentials and limitations, the time involvement raised questions about the practicality of continuing with this individualized type of procedure. In addition only those therapists who were within reasonable travelling distance of the Project could participate in this way.

Early in 1957, after a year's experience of referring children for their continued training, plans for conducting workshops for participating therapists were worked out with the Los Angeles County therapists and the Project. Since that time, 16 workshops have been conducted. These workshops have been extended to include geographical areas other than Los Angeles County. Workshops have been conducted for those who have not had previous experience with prosthesis training and for those with considerable experience. Some of the advanced workshops have had separate sessions for physical therapists working with children having lower extremity problems.

Presently more workshops are in preparation. New therapists are coming into the field constantly and the previously prosthetically trained therapists see their need for additional knowledge more acutely. Almost all children below the teenage group are receiving their continuing training in their communities and this group is enlarging as referrals in the pre-school aged group have increased during the past few years. The therapists continue to prepare reports that are sent to the project prior to the patient's clinic visit at UCLA.

Prosthesis Manufacture

In 1955 during the first year of the Project's operation, a question was raised about having the standard types of prostheses fabricated in the private limb shops in order to free the project prosthetists to concentrate on more difficult problems. The Southern California Orthotists and Prosthetists Association appointed a special committee, known as the Prosthetics Industry Participation Program, to work out agreements with the project. Some of these agreements were that the prosthetist would be selected on the basis of his certification, proximity to the patient, and graduation from an approved Upper Extremity Prosthetics School. All prostheses would be sent to the project after completion, with the check-out taking place there. During the first two years the project did all upper extremity harnessing, but the present practice is to have the local prosthetist complete the entire prosthesis with the project providing only the terminal device. The private industry participation program has been in effect since the middle of 1956. Many of the prosthetists in the Los Angeles area attend the check-out and some have done the harnessing at the project in order to benefit from the experience of the project prosthetist's years of experience in fitting children. The local prosthetist has a card which he mails to the project whenever he completes any adjustment or repair on the prosthesis. The nature of the work and the date it was accomplished is recorded on the card which is then transferred to a master record kept by the Project prosthetist. A study is in progress to determine the average life of prostheses for various age groups, as well as the nature and extent of repairs and adjustments.

Medical Care and Social-Psychological Services

The increased use of community resources has given the Project staff a more realistic view of the patient's needs. At the same time the community has gained a better understanding of the complexity of problems inherent in children with amputations or malformed extremities. Through the medical director's consistent communication with the family physician, working relationships have been developed that are of benefit to individual patients and have led to earlier referrals of patients with acquired and congenital amputations. Parents and their children, who present social-emotional problems requiring treatment on a continuing basis, are helped to accept referral to appropriate resources within their communities. Although many of these problems are not solely related to the child with the disability, it is apparent such a disability heightens already existing disturbances making family adjustments difficult.

Conclusion

The goal of any prosthetic program of this kind is to assist children to grow up into responsible adults who can make a contribution to the community. The more closely the community can be involved during a child's growing years the more likely the community is to have a place for him during his productive years. At the same time all of these community services that meet or supplement training, prosthetic, medical and social-emotional needs are feeding back to the project information about the realistic requirements for these patients so that in the future more effective ways of treating these children with amputations or malformed extremities will be achieved.

Developmental Research in a Private Facility

By JOSEPH E. TRAUB, C.P.
Research Prosthetist, Prosthetics Education Program
School of Medicine, University of California, Los Angeles

Editor's Note: The following article is presented as an example of how research may be carried out and its findings reported by a private facility. Mr. Traub's article provides enough data for other prosthetists to study the case for development of their own hypotheses, as well as using its principles in the management of similar problems.

CASE REPORT—LEFT ABOVE KNEE AMPUTEE—POST POLIO

35 year old white male, married and the father of seven children ranging in age from 2 through 16 years. Family living on welfare as a result of the inability of the father to work following the amputation of his left leg above the knee.

This patient was born in Texas, and states that he was completely normal at birth. At the age of five he was stricken with infantile paralysis and confined to a respirator for the period of one month during the acute phase of the disease. Following this he was gradually able to regain the use of the greater part of his body, residual paralysis affecting only his left leg and hand.

The involvement in his lower extremity was so marked as to require an ischial-bearing long leg brace with pelvic band for any ambulation. The patient was fitted with a brace of this type and was able to use it successfully. In later years, with additional growth of the rest of his body, the affected extremity had a 2 inch shortening, 45 degrees equinus of the foot with a marked varus. Special shoes were fabricated to accommodate these deformities which naturally made the brace much more cumbersome and difficult to use.

During the summer of 1955, the patient moved his family to California, where he was employed as a service station attendant. With increased age and activity it gradually became more difficult to be comfortable and perform adequately with the brace. On the advice of his physician, feeling that he could perform more adequately on a prosthesis, a supracondylar amputation of the left leg was performed, leaving a $12\frac{1}{2}$ inch stump with excellent surgical characteristics. (See Figure Ia & Ib)

The patient referred himself to a private certified prosthetist for prosthetic help after two years of repeated disappointments. After careful evaluation of his prosthetic problems, and consultation with Charles O. Bechtol, M.D., of the U.C.L.A. Division of Orthopedic Surgery, it was decided to prescribe a completely new prosthesis, incorporating certain principles of fitting and selected component parts to offset the physical difficulties encountered. The physical difficulties, the fitting, and the prescription of component parts will be discussed in detail later in this report.

Since the fitting of any prosthesis to this patient was a calculated risk at best, and the condition of his finances as previously mentioned was not good, it was decided to fabricate and fit this prosthesis as a private facility research project.

Initial Evaluation

When first evaluated, the patient showed the following: *Complete absence of any active hip or stump musculature, with the exception of what could be classified as a fair-plus Psoas Major.* Severe atrophy of all the hip and stump musculature and sub-cutaneous tissue, and a marked differential between the sound and amputated side in growth of ilium and femurs.

Again, it must be stressed that this patient could exhibit no active range

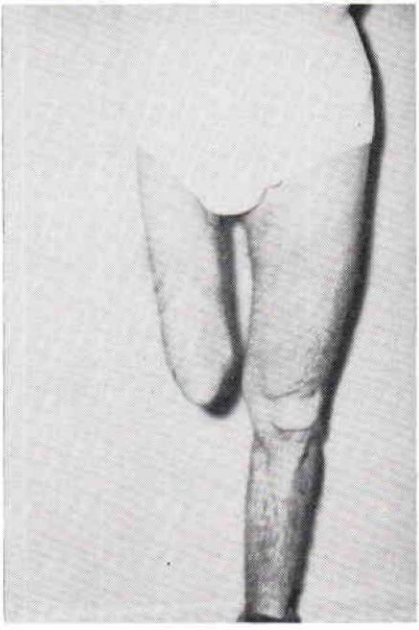


Figure Ia

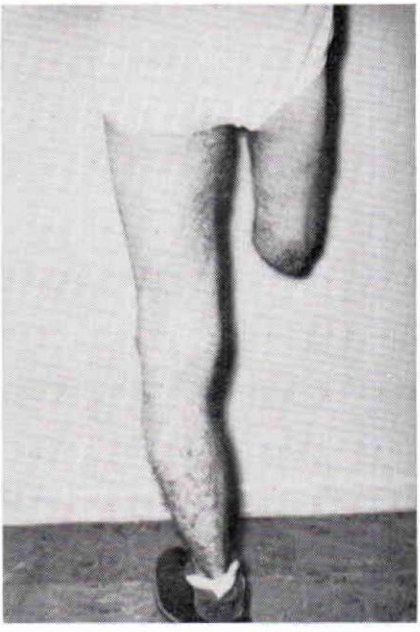


Figure Ib

of motion in abduction, adduction, or extension, and had only a fair-plus hip flexion grading. In addition, the absence of any extension power in conjunction with the fair-plus Psoas Major, had produced a flexion contracture of approximately 15 degrees. (See Figure II.)

The vital statistics of this amputation stump were as follows:

1) A.P. Dimension at ischial level $2\frac{1}{2}$ inches
2) Circumference measurements
   - 0" — $12\frac{1}{2}$"
   - 2" — $11\frac{1}{2}$"
   - 4" — $10\frac{7}{8}$"
   - 6" — $10\frac{1}{2}$"
   - 8" — 10"
   - 10" — 8"
   - 12" — $7\frac{1}{4}$"
3) Stump length—$12\frac{1}{2}$ inches.
4) Hip extension—15 degrees anterior to midline.
5) Hip adduction—3 degrees.
6) Ischium, extremely pressure-sensitive.
7) Very little, if any, subcutaneous tissue.
8) Rectus Femoris-Adductor Longus relationship—Flat.
9) Greater Trochanter position—Posterior.
10) Almost non-existent Gluteous Maximus bulk.

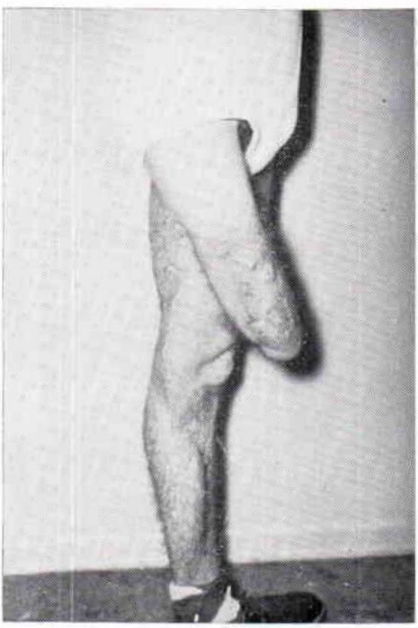


Figure II

Figure III

With the above statistics at hand, the prosthetic prescription was as follows:

"Left above knee prosthesis for long supracondylar amputation of paralytic hip and thigh stump. Combination suction socket and single axis pelvic joint suspension. Quadrilateral socket, with extreme caution advised in fitting M-L, friction lock knee with knee extension control regulator. Single axis ankle joint, wood foot with toe joint."

Socket Plan

a) Top circumference of pattern	11½ inches
b) Bottom circumference of pattern	6½ inches
c) A-P of top pattern	2 inches
d) M-L of top pattern	3¾ inches
e) Initial flexion of socket (Planned reduction to assist flexion of hip at toe-off)	8 degrees
f) Adduction of lateral wall	3 degrees

Initial Fitting

Inside Perimeters of Socket

Perimeter Stump	Initial Shaping	Final Shaping	Socket Tension
0″ — 12½″	11½″	11¾″	¾ inch under
2″ — 11½″	11″	11″	½ inch under
4″ — 10⅞″	10¼″	10⅝″	¼ inch under
6″ — 10½″	10″	10¼″	¼ inch under
8″ — 10″	9½″	9¾″	¼ inch under
10″ — 8″	7½″	7¾″	¼ inch under
12″ — 7¼″	6¾″	7″	¼ inch under

During this initial fitting it was found that in order to give support to the ischial tuberosity, an inch and one-half shelf would have to be added to the posterior-medial corner of the socket. This was as a result of the absence of any adductor or hamstring bulk to position the ischial prominence on the seat lateral to the medial wall where it normally would be located. It was also necessary to undercut the lateral wall, at ischial level, ¾ of an inch to maintain contact in the area of the greater trochanter. Without muscle bulk posteriorly, it was necessary to channel a relief for the upper third of the femoral shaft to evenly distribute posterior wall pressure. A gentle flattening of the lateral bulge in the area of Scarpa's Triangle served to eliminate femoral artery and nerve pressure.

Dynamic Alignment

Dynamic alignment was completed using the actual knee-foot setup instead of the adjustable leg, as the stability of the knee was of paramount importance and, because of the missing extensor power, was attainable only through the use of a friction lock knee. Because of the posterior location of the greater trochanter, the mechanical hip joint was located approximately 1½ inches anterior and ½ inch superior to the palpable anatomical center. A metal iliac band (very rigid) was *closely fitted* just inferior to the iliac crest, extending from one inch medial to the anterior-superior iliac spine to one and one-half inches medial to the posterior iliac spine. A pelvic belt, 3 inches wide, of ten-ounce strap leather with a joining ring over the area of the lumbar vertabrae, was then attached to the pelvic band and joint. This belt was laced anteriorly to prevent forcing socket rotation when tightened. It was determined that placing the trochanter-knee-ankle axis in its ususal relationship required great effort to "break" the knee at toe-off because of the nature of the knee friction lock. The solution used, was to locate the knee center one inch anterior to the normal trochanter-knee-ankle axis and allow the friction lock coupled with the dorsi-flexion bumper in the foot to supply all the knee stability. (See Figure IV) This knee center location, together with the reduction of the initial socket flexion from 15 to 8 degrees, produced excellent hip flexion at toe-off. A major problem was to reduce as completely as possible all piston action between the ischial seat and the unpadded, extremely pressure-sensitive ischial tuberosity. Close fit-

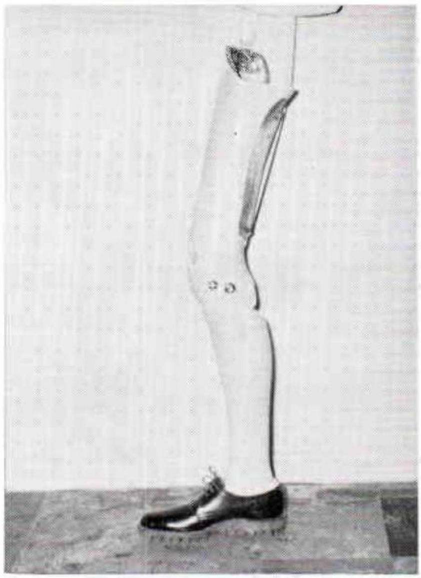


Figure IV

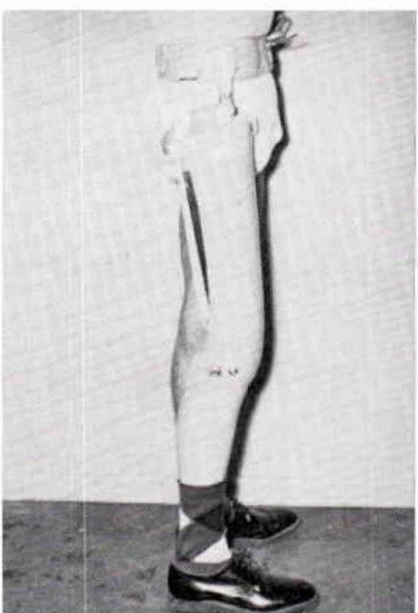


Figure Va

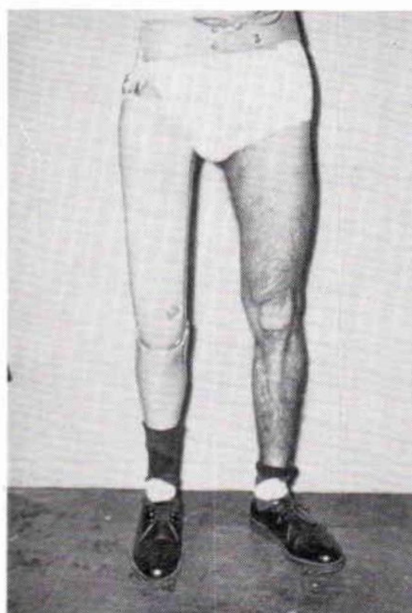


Figure Vb

ting of the pelvic band, the proper positioning of the hip joint, and the use of the suction socket produced most of the desired result, but the addition of an elastic gluteal strap finally helped to accomplish the goal. This addition also supplied a certain amount of involuntary extension power to the hip. At this point the patient was ambulating well, but had a decided Psoas-Major "sinking" upon full weight bearing. It was decided that the addition of a 178-degree extension stop to the hip joint might help. This completely eliminated the problem. The completed prosthesis is shown in Figure V.

It must be mentioned in conclusion that any success achieved on this most difficult case must be ascribed to the coordinated team approach. Repeated consultations between the orthopedic surgeon and the prosthetist were the birth place of all the ideas which eventually bore fruit in the completed prosthesis. Prescription and check-out were only the beginning and the end, and although they are essential, the crux of the problems encountered and solved were found during the actual fabrication and fitting of this prosthesis.

Institute on Prosthetics and Orthotics For State Rehabilitation Personnel

The School of Medicine, Department of Orthopedic Surgery of the University of Virginia, and the Woodrow Wilson Rehabilitation Center, presented an Institute on Prosthetics and Orthotics for state Rehabilitation personnel in cooperation with the Office of Vocational Rehabilitation Department of Health, Education, and Welfare, Region III. This was held at the Woodrow Wilson Rehabilitation Center, Fishersville, Virginia, March 20 through 24, and a second Institute was held April 4 through 8, 1961.

The course included concise presentation of the anatomy and biomechanics of both the upper and lower extremities. Amputation sites were described with the resulting functional loss. Prosthetic components for both upper and lower extremity prostheses were demonstrated and their functional implications discussed. The fabrication of both upper and lower extremity prostheses was discussed, and essential fabrication techniques demonstrated. Clinical demonstration of the fitting of prostheses and the training of the amputee in their use were given. Special emphasis was placed on pre-prosthetic care, gait training, and the vocational use of the prostheses. Vocational possibilities and limitations of the various amputee groups were explored with illustrative cases.

A general view of the field of bracing was given with demonstration of typical braces. The most frequent conditions requiring bracing, including poliomyelitis, spinal cord lesions, hemiplegia, and spinal syndromes were discussed and the appropriate braces demonstrated. The vocational possibilities and limitations of each group were emphasized. Representative cases in the groups were seen illustrating the various types and their functional possbilities and limitations.

There were twenty members in each class, including counselors, supervisors, and one State Director. Among visitors and observers were, Dr. Robert D. Wright, Assistant Director of Health and Medical Activities, Office of Vocational Rehabilitation, Department of Health, Education, and Welfare; Dr. Sidney Fishman, Director, Prosthetic Education, New York University; and Dr. Floyd Kefford, Rehabilitation Supervisor for Pennsylvania.

Evaluation of Control Problems in Externally Powered Arm Prostheses

By HILDE GROTH, Ph.D. and JOHN LYMAN, Ph.D.
Biotechnology Laboratory, Department of Engineering
University of California, Los Angeles

More than a decade has elapsed during which limited research and development efforts on externally powered arm prostheses have been directed primarily toward solutions of associated technical problems. The major objective has been to provide the severely handicapped arm amputee with a prosthesis whose operation would require a minimum of physical effort for a maximum of functional replacement. Emphasis in the past was placed on technical components without giving due consideration to the total man-machine system. In this discussion we shall attempt to suggest a different approach, one oriented toward recognition of the need for comprehensive evaluation that includes the detailed problems of control and sensory feedback as well as the primary mechanisms of force and motion.

The rehabilitational value of any arm prosthesis is determined by the degree of accuracy and reliability with which the amputee can guide his prosthesis movements. Mechanisms that can effectively reduce the energy requirements of the amputee and also provide an adequate range of motion are well within current technological capabilities. Regardless of the excellence of the engineering design, however, none of the existing externally powered prostheses can be considered to be a fully satisfactory replacement of a lost arm. In the opinion of the authors, the current situation must be attributed in every case to the neglect of an evaluation of the capabilities and limitations of the control site and of the interactions of the wearer with the mechanism. Satisfactory function depends directly and fundamentally upon the adequacy of the control coupling in terms of the appropriate selection of mode of operation and site of actuation.

For any type of prosthesis two basic requirements must be satisfied by the control source: (1) It must show adequate physical signal characteristics with respect to transmission lags, phase, and sensitivity; and (2) It must provide the amputee with reliable sensory feedback for controlling the movements of the arm and terminal device.

From a review of past experience we find that a variety of body sites and transducer types have been utilized for controls. The choice of a particular control site has apparently been determined largely by the factors of easy accessibility for harnessing, and adequate motor output characteristics in terms of force and displacement.

Sensory feedback has received only secondary attention; it is largely by chance that adequate visual and force feedback have occurred in some models of conventional prostheses. Operation of the IBM-Alderson IV-E electric arm design for very short above-elbow stumps depended on an extremely complex system of nine spatially separated selector controls. For operation the amputee first had to select the correct switch for a given movement by blind "feel" with his stump on the inside of the socket. The next step was to "turn off" the switch after completion of the motion. Laboratory studies showed that the complexity of the control system, with respect to both physical signal characteristics and sensory feedback as well as the number of required decisions, was by far too great for satisfactory amputee performance.

A German development, the Heidelberg pneumatic prosthesis, is also equipped with a sequential control arrangement. In this case, the controls consist of a series of selector valves for power and function. After considerable training the amputee can achieve a certain level of reliable performance, but the performance is limited to a specific range of tasks, and control tends to break down under moderate stress conditions. Despite its shortcomings, the arm provides much greater function for extreme above-elbow amputation or shoulder disarticulations than any other development to date.

Both the IBM-Alderson arm and the Heidelberg arm employ a position-velocity control that produces a rate of movement by moving the control to a given spatial position. Such a control-action transfer is well known to require an excessive number of decisions on the part of the operator. Accordingly, in terms of good biotechnical engineering design the arrangement with both types of arms has been found to be unsatisfactory.

A unique contribution to the explicit recognition of the importance of sensory feedback is made in the French electric hand. Both a following-type position feedback and a force feedback are provided by back pressure on the pneumatic bladder actuator that controls prehension. The device is complex in electromechanical design and provides only prehension as an active function. The development is a significant contribution, however, as it has been fitted to many amputees and can provide a limited amount of laboratory information on feedback requirements.

Experience at the UCLA Biotechnology Laboratory with past developments and currently representative externally powered and conventional prostheses has enabled us to establish some criteria for an "ideal" control site. These criteria can be assigned to the three major categories of: (1) signal criteria, (2) noise criteria, and (3) coding criteria. Although the terms "signal," "noise," and "coding" are formally defined within the framework of information theory, they will be used only in a descriptive sense for the present purpose.

Signal Criteria

1. The signal output by the amputee must be reliable, clear, and unambiguous to the control signal pickup, i.e., a high signal-to-noise ration must obtain.
2. The signal should be capable of quantitative modification by the amputee over as wide a range of perceivable differential discriminations as possible.
3. The effect of the signal on the mechanism output must be free of transmission time lag in order to produce maximum error feedback to the senses of the operator.

Noise Criteria

1. A stable functional relation must be maintained between the control site and the signal pickup mechanism, independently of required arm loading and postural adjustments.

2. Operation of one control must not affect other control operations, i.e., there must be sufficient separation of controls to prevent inadvertant actuation of each control by the others.
3. Controls must be immune to actuation by environmental conditions such as vibration and electromagnetic radiation.
4. Controls must not induce "psychological noise," that is, the amputee should be free of discomfort, pain, and fatigue from proximity to the control signal pickup mechanism during periods of normal use.
5. Controls must be capable of effective function in relation to other features of the prosthesis, such as socket design and fit, stability of prehension, etc.

Coding Criteria

1. Coding of the relation between control action and its result should require a minimum of learning by the amputee; it should conform to population stereotypes for expected relations.
2. There should be close coupling between the discriminations made by the amputee at the control site and the magnitude of the mechanism action; the operator should act as a simple amplifier.
3. For maximum functional regain, integrated control actions as well as serial control actions that are coordinated in parallel should be possible, following the criteria for individual controls with emphasis on requiring a minimum of computing operations by the amputee.

For the purposes of developing actual equipment to achieve these somewhat idealized criteria, it seems reasonable to dichotomize the control site problem for externally powered prostheses into two categories of practical problems: (1) human (or "software") problems, and (2) hardware problems. The human factors that appear to be important are as follows:

1. Amputation level functional requirements
2. Control modes available
3. Number and location of control sites
4. Neuropsychological separation of controls
5. Multiple function coordination capability
6. Training
7. Site hygiene
8. Sensory feedback modes available
9. Sensory adaptation

At the present state of the art, the types of control modes available—namely, force and excursion from the muscles at relatively few body sites—are the most important limiting factor for further practical developments. It seems imperative to continue to direct major research efforts toward making new control modes available. The long term aim for significant advances seems to be achievement of neuropsychological separation of controls in order to provide the amputee with combination motions. Separation of controls may be attempted by various methods such as surgery, psychological conditioning, and electrical coupling, depending on the type of control modes that research makes available.

The associated hardware problems can be summarized as:

1. Type of control actuators and sensory feedback mechanisms
2. Weight
3. Size
4. Sensitivity
5. Reliability
6. Maintenance

Optimization of the hardware components will depend heavily on the solution of the human factors problems. Integration of the human and hardware leads inevitably to the interface or interaction problems characteristic of systems design. Some of these additional problems are:

1. Stability of coupling
2. Transmission dynamics
3. Function coordination
4. Interfaces with power and harnessing

A comparison of the relationship of cost and time for necessary research and development to solve the sensory and control problems of externally powered prostheses must be faced realistically. A conceptual diagram for backup research and hardware development as a function of time and money is shown in Figure 1.

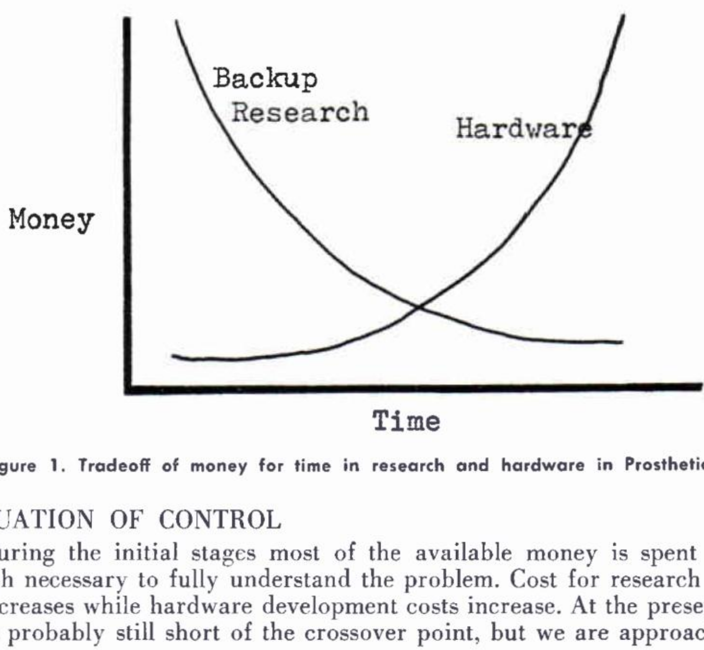


Figure 1. Tradeoff of money for time in research and hardware in Prosthetics.

EVALUATION OF CONTROL

During the initial stages most of the available money is spent on the research necessary to fully understand the problem. Cost for research gradually decreases while hardware development costs increase. At the present time we are probably still short of the crossover point, but we are approaching it rapidly.

From what has been learned so far, choice of satisfactory control sites clearly must be based on the compatibility between the input signal and the prosthetic function. The present status is that specific consideration to the man-machine-systems concept is given in current research studies and engineering analyses of externally powered prostheses at the UCLA Biotechnology Laboratory. In this program technical problems are not studied in isolation but are considered in conjunction with the associated medical, physiological, and psychological variables. While at this time it appears virtually impossible to locate or surgically create a full complement of ideal control sites for the severely handicapped amputee, there is every reason to believe that a prosthesis prototype will evolve, based on sound human factors and engineering principles which will be a satisfactory functional replacement for all levels of amputation. As with other complex system developments, an adequate solution eventually will be the result of the coordinated effort and competence of specialists in diverse fields.

The Rocker Soled Shoe

By CHARLES LEROY LOWMAN, M.D.
Los Angeles, California

For many years we have been using two types of soles with rockers. One is a fast roll and the other is a slow roll. In cases of stiff knee, hip or ankle where there is no chance of the knee buckling we use the former—when there is a more or less unstable knee with insufficient gluteus maximus and hamstrings we then use the latter or slow roll.

1) In the first instance as the opposite side passes thru the swing phase, the rocker rolls the affected side forward so that the pelvis is balanced smoothly in the advanced position without any hitch or lurch. When the slow roll is used, the leg and pelvis are held in the stance phase long enough for the opposite foot to be planted and accept the weight—then the rocker rolls the foot off the toe.

2) In the case of a polio with a flail leg, a pan arthrodesis of the foot will stabilize it and prevent the knee from buckling forward. The lateral stability of the hip can be improved by lateral fascial straps from the trochanter to the body—sometimes to the 10th rib, or otherwise to the rectus abdominis, or external oblique in front and the latissimus dorsi, or sacrospinalis muscles behind. Or in the case of good abdominals the external oblique may have its insertion shifted to the greater trochanter.

In this way a flail leg with reasonably good posterior capsular ligaments of the knee to allow enough backward pressure from the foot, may make it possible for the individual to be brace free or use a cane.

The major indications for the increased heel and sole thickness is to level the pelvis and thus reduce back strain, and as stated above roll the patient forward without pounding down on an affected hip from fracture; congenital hip; or Legg Perthes disease, etc., and to reduce fatigue by getting an improved cadence in the gait and equalizing the amount of time spent on each foot during the stance phase.

3) With hips in a stiffened or flexed position and corresponding shortening with a lurching limp and the extreme toe drop, there may be a too

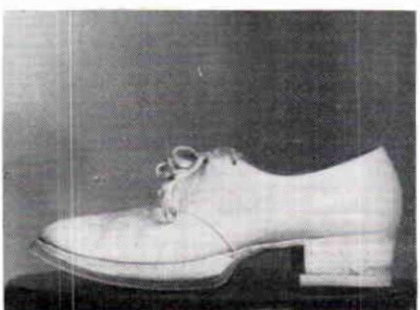


Figure 1. Smooth tapered roll to make it faster. Narrow the filling layer down to nothing at the front so that the two soles come together.

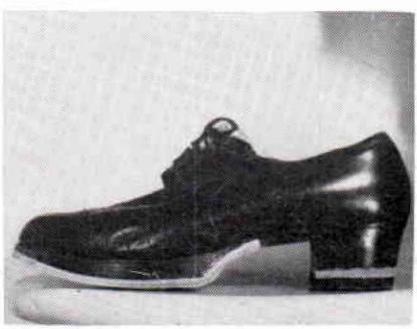


Figure 2. Slow roll. Note flatness out to the breaking point of the toes.

great forward thrust on the ankle joint which is quite ungainly. The smooth taper of a proper rocker greatly improves the gait.

4) When fractures occur in hip, knee or ankle leaving partial movement there is almost certain to develop a painful joint, because a little motion is worse than none at all and leads to an arthritis sooner or later.

Proper training in the use of a rocker sole is very essential. Especially is it hard to break the bad habit of the sudden forward shift of the weight of the affected side, onto the ball of the metatarsals with a quick upward lift in order to overcome the deficient reciprocity between the hip joints in rotation. This is a substitutionary movement and really is an effort to roll off the toe.

Some tend to swing the leg outward and twist the opposite foot in the stance phase. Some try to rotate the pelvis by rocking at the lumbo-sacral junction and thereby forcing the affected leg forward like some amputees do.

Many surgeons who do a lot of hip-joint work simply raise the heel and sole for a shortened leg without realizing that an appropriately shaped heel and sole combination will reduce the trauma of walking.

Another satisfactory detail is the boost in morale a patient receives when he learns how to alter an old bad pattern of movement and gait, and rolls along with a smoother cadence. A limp calls attention of every passerby to the person, whereas when the limp is reduced and the gait improved there isn't much occasion for close scrutiny.

Many women patients would rather have a high heel on a conventional shoe and take the grief, but when they are properly fitted and the correct heel and sole relationship is obtained, the smoothness of gait is so improved they may accept it. Usually we tell a woman to wear the correction 75% of the time and then for parties and evening wear to use their dress-up shoes.

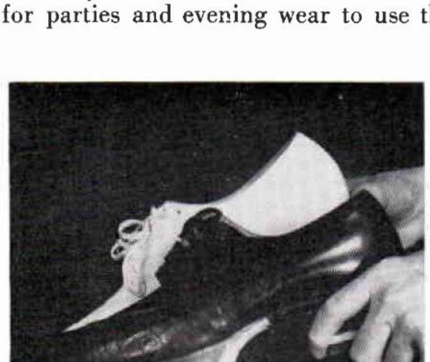


Figure 3. Comparison of the two soles, showing the difference between the fast roll (white) and the slow roll (black).

In the case of a stiff hip the patient can swing forward on the bad side, because in the stance phase on the good side the pelvis rotates on the standing hip. But the reverse is difficult because there can be no rotation on the ankylosed hip. In consequence, they may rise on the toe, bend the knee and snap the foot forward—in which case as mentioned above, they are trying to roll over the ball of the foot while the good side is being advanced. When the ankle is stiff and the integrity of the thigh muscles is good, a smooth-fast roll is indicated and will markedly improve the gait as well as reduce strain and arthritic changes.

The ankylosed knee, especially in full extension is the most difficult to shoe, as the movement in hip and ankle doesn't give smooth compensatory movement. In such cases there being no worry as to knee buckling, the forward roll of a smooth rocker can minimize stress on foot and hip, altho not entirely eliminating the limp. Getting the adjustment requires study, observation and patience.

Good follow-up work with a physical therapist helps in obtaining the best results—the first exercise is very important, namely, stepping forward on the heel of the affected side—rolling forward while step is made on the good side, and letting the rocker roll up to the toe but not lifting it. Then pressing down on the rocker with the ball of the foot step back to the starting point, pausing with toe up, but heel remaining fixed—thus roll back and forth many times to get the feel of the motion.

Next—trying to pause an equal time on each foot, take alternate steps with a completely smooth cadence or rhythm—preferably, at first walking with another person—keeping in step.

In construction the main point of importance for the smooth fast roll is to make the high point diagonal down and back of the head of the first metatarsal about $\frac{1}{2}$ to $\frac{3}{4}''$ then smoothly tapered to as little thickness at the toe as the sole will permit. For the slow roll keep the sole flattened out to the point where the rolloff is smooth after the stance phase on the opposite is about finished.

AUTHOR'S SUMMARY OF RESEARCH REPORT

The Evaluation of Restrained Bellows as Torque Elements in Prosthetics and Orthotics, by Robert T. Gage and John G. Gamble, Gamble and Gage, 84 Broad Street, Milford, Conn., 1960, 22 pp.

The purpose of this study is to determine the feasibility of using bellows as force elements in prosthetic and orthotic devices. We recognize that there are many types of power sources which may be used, such as electric, pneumatic, mechanical, and hydraulic, or any of these in combination.

The evaluation of bellows as components is merely a part of the overall system which we originally proposed, as an alternative to the McKibben Actuator. It is obvious that a gas or a liquid can only push, it cannot pull. It seemed logical therefore, that the most efficient utilization of a fluid (either gas or liquid) would be in a device which utilizes this push directly.

We felt that an orthotic device attached to a flail hand should be flexible in itself, and that harness rather than control should support and restrain. This implied either bellows or pistons as the force or torque elements to effect the desired displacements.

Consequently, this study has been undertaken to provide data with which to compare work elements within gas powered systems in orthotics. From this study we have concluded that corrugated bellows are feasible as force elements and in our opinion continued investigation as to physical configuration, materials and specific application is merited.

AOPA Survey of Prosthetic and Orthotic Services

By BERTRAM D. LITT
Associate Project Director

As this article is being written, several teams of prosthetists are traveling throughout the country administering the first segment of the long awaited, vital Survey of Services Available to Amputees and Other Orthopedically Disabled Persons. It was the hope of Glenn Jackson and the officers of the Association that this Survey would be an opportunity for practicing prosthetists and orthotists throughout the country to have their voices heard in the councils of research and education. A grant was obtained from the Federal Office of Vocational Rehabilitation approximately two years ago to initiate the present Survey. The questions which this Survey is attempting to answer include:

(1) Types of orthotic and prosthetic equipment in use.
(2) Methods and techniques employed.
(3) Techniques and devices restricted to local use.
(4) Modification in techniques taught by prosthetic schools resulting from practical application.
(5) Additional education programs desired.
(6) Areas of research most needed.
(7) Percentage of amputees handled on a clinical basis; consultation with doctor; etc.
(8) Who pays for artificial limbs and braces.

The Survey was initially placed under the guidance of the Association's Committee on Advances in Prosthetics. This body established an Advisory Committee for the Survey under the chairmanship of M. P. Cestaro. Mr. Cestaro was fortunate in obtaining the services of Dr. George Young, Research Director of the Mellon Institute in Pittsburgh, and Dan McKeever, a Past President of the Association, as committee members. The initial staff of the project consisted of Glenn Jackson as Director, LeRoy Nattress (who was then Director of the Examinations for the American Board for Certification), and A. Bennett Wilson (then Secretary of the Committee on Advances in Prosthetics).

A pilot questionnaire was developed to determine the practicability of conducting a nation-wide survey and the type of questions which might best be used in such a survey. The subject material included Facility Identification, Clinic Team Data, Prosthetic Components, Prosthetic Techniques, Orthotic Components, Orthotic Techniques, and Personnel Data. This questionnaire was developed by the Survey staff and the Advisory Committee with the assistance of many prosthetists and orthotists throughout the country.

The Pilot Survey was conducted in the State of Ohio where all of the shops were contacted by mail or telephone. Approximately half of them were surveyed by LeRoy Nattress and Ben Wilson during the spring of 1960. Their report showed considerable personal interest. Orthotists looked forward to a research and education program similar to that which had been established in the prosthetic field. The prosthetic techniques were found to be more standardized than orthotic techniques. Future information to be collected in prosthetics would be of a different nature than that indicated for orthotics. They thought it desirable to obtain information from State Vocational Rehabilitation Bureaus to reflect changes in prosthetic and orthotic practices. It was recommended that Survey data should be interpreted in terms of facility size, type of entity, type of patient served, background of the facility's staff, and geographic location.

About the time that the report of the Pilot Study was completed, Mr. Jackson announced his retirement from the Association and Ben Wilson returned to the National Research Council as Staff Engineer for the Committee on Prosthetics Research and Development. As a result, the Survey's activities during the summer and fall of 1960 were largely limited to a search for a Project Administrator.

In November, 1960, Mr. Bertram D. Litt joined the staff as Associate Project Director. He had been connected with the New York University, "Prosthetic Devices Study Project" since 1954.

During the summer of 1960 a telephone directory search of cities of over 7,000 population was conducted to prepare a list of all of the shops that manufacture or fit artificial limbs or braces. After Mr. Litt joined the staff, this facility list was checked against the Certifee, Association Member, and Publication listings and other files in the Washington office. The shop list was further refined by circulating appropriate portions of it to Association officers, regional directors and a group of shop owners and managers representing each of the 50 states. These men cooperated by adding the names of firms which had been omitted and deleting others which were no longer in existence or did not actually deal in artificial limbs or braces per se.

At a meeting of the Advisory Committee with Mr. Nattress and Mr. Litt, it was decided to conduct the Survey by first visiting shops and preparing a report on prosthetics; secondly, on spinal orthotics; then lower extermity orthotics, etc. This procedure will facilitate the preparation of timely reports. It will also mean that interviews can be limited to a three hour period while still allowing time to collect a meaningful quantity of information.

At this meeting it was agreed that it would not be possible to visit all of the shops who are engaged in the fitting and making of prosthetic devices, and that the selection of shops should be based on geographical location, size and shop type, including members and non-members, certifees and non-certifees. It was felt that institutional and private shops should be included in the metropolitan areas (pop. 750,000 or more), medium sized cities (pop. 15-250,000), and smaller towns (pop. 60,000 or less) in each major geographical location. These geographical locations include New England, Central Atlantic, Southern, North Central, Mid-Western, Rocky Mountain, California, and the Pacific Northwest states.

The results of the Pilot Survey were used as a basis for constructing the present Questionnaire for use in the National Survey of Prosthetic Services. The materials relating to the Identification of the Facility and its Personnel have been incorporated into a separate questionnaire which is being sent to shops before they are visited by a two-man team of interviewers. The interviewers, using this first questionnaire as a guide, spend approximately 2 hours with the shop owner or manager completing the Prosthetic Survey Questionnaire. The questions relate to clinic relationships; prosthetic techniques used for each amputation type; variations required for age, sex and multiple involvement; information as to how the facility has learned the technique and of their own improvements on standardized techniques. Information is also being collected on the types of components used, the reasons for selection of these components and the way in which the shop would like to see components improved.

A group of 9 prosthetists were brought to Washington, D. C., during the last week of April for a training course conducted by Mr. Litt and Mr. Nattress in the administration of the prosthetic forms. These men are all professional prosthetists between 23 and 31 years of age who are firmly established in a family business. They are well trained in terms of experience. They have each attended several of the prosthetic courses and are either certified or plan to become certified in the near future. They include William Brady of Kansas City, Missouri; James Stanford, III, of Birmingham, Alabama; Frank Malone, Jr., of Philadelphia, Pennsylvania; Thomas Bidwell of Madison, Wisconsin; Jack Gold of Newark, New Jersey; Gene Filippis of Detroit, Michigan; Claude Lambert of Baton Rouge, Louisiana; Donald Hedges of Indianapolis, Indiana; and Ralph R. Snell of Memphis, Tennessee.

Following the training course, these men have begun the field trips to collect the prosthetic information. Approximately 135 shops in more than 50 cities are being visited in the Prosthetic Survey. Six of these men, traveling in two-man teams, have visited more than 80 shops during the month of May. Approximately 55 additional shops will be visited by four of the interviewers during the month of June.

It is planned that a report on the Prosthetic Service Survey will be ready for presentation at the Association's Annual Meeting in Miami this coming October.

The Survey of spinal orthotics and lower extremity orthotics will follow in succession and will be conducted in a similar manner. We are planning to have a different group of interviewers, trained professional orthotists, conduct these portions of the Survey. We look forward to reporting on these areas at the 1962 Annual Meeting.

Left to right, standing, William Brady, James Stanford, III, Frank Malone, Jr., Thomas Bidwell, Jack Gold, Gene Filippis and Claude Lambert; front row, Donald Hedges, Bertram Litt, and Ralph R. Snell.

The Committee on Prosthetics Education and Information

National Academy of Sciences—National Research Council A Report

By HAROLD W. GLATTLY, M.D.
Executive Secretary, Committee on Prosthetics Education and Information

The initial report concerning the Committee on Prosthetics Education and Information that appeared in the March 1961 issue of this Journal was devoted to an historical outline of the origin of this committee as an integral part of the Artificial Limb Program of the National Academy of Sciences. It was pointed out that the Office of Vocational Rehabilitation and the Veterans Administration requested the Prosthetics Research Board to organize an Academy-Research Council committee to supplement the programs of the University of California at Los Angeles and New York University prosthetics schools in the broad field of prosthetics education and information. This report will be devoted to certain of the initial activities of the group that were primarily of a planning and fact-finding character.

The committee early recognized that by its very nature CPEI could best serve the interests of the supporting agencies by assuming an advisory and coordinating role in developing and executing a program for the purpose of extending the potential benefits deriving from the Artificial Limb Program to our amputee population. It was therefore agreed that a major effort be directed toward enlisting the assistance and cooperation of other individuals and organized groups who have an interest in improving amputee rehabilitation services in this country. This technique has been the essence of success of almost every educational movement. By this means, the influence of the committee can be magnified many, many times. To initiate a campaign of this character, it was necessary to make liaison with the relevant medical and paramedical organizations, to locate interested individuals throughout the country, to develop practical plans and to provide a focal office for intercommunication and staff support. During their first year, the committee made very satisfactory progress in these general areas.

In considering the development of specific plans for a national prosthetics education program, the committee recognized the need for factual information concerning the status of prosthetics services that are presently available for non-veteran amputees in the United States. For this purpose, a questionnaire survey was directed to the physician graduates of the UCLA and NYU prosthetics schools in the fall of 1958. The physicians were invited to include in their replies suggestions and comments in the interest of assisting CPEI in developing its program. Some 300 physicians from all sections of the country contributed to this survey that provided the committee with factual information upon which to base their plans and establish priorities of effort. The following areas of activity in the field of prosthetics education were emphasized by the reporting physicians as being of major importance:

a. The introduction of appropriate prosthetics materials into medical education at both the graduate and undergraduate levels, in order that the oncoming generation of physicians will be oriented with respect to the modern concepts of amputee care and management.

b. The development of a prosthetics informational program for the practicing physicians who perform amputations in the interest of providing these patients with the opportunity to achieve a maximum of functional regain through proper surgery, post-operative care, preprosthetic training, and referral to an organized amputee clinic for the prosthetic prescription, the fitting of the device to the individual and his training in the use of the prosthesis. This activity has been termed the "grass-roots" program and will be the subject of a subsequent report in this series of articles.

In addition to providing information with respect to the status of prosthetics services in various regions of the United States, the survey was the means of locating the majority of the amputee clinics in this country, together with their composition and case load. Of especial importance to the committee was the identification of physician members of prosthetics clinics who hold faculty postions in medical schools and/or are engaged in residency training programs. The high percentage of physicians who responded to this survey and their evident desire to keep current with newer knowledge relating to the care and management of amputees testifies to the fact that individuals who have received specialized training in prosthetics retain an active interest in this field of disability.

In view of the varied type of educational activities that it was essential to develop for the members of the various disciplines involved in amputee rehabilitation, in the spring of 1959 it was decided to organize *ad hoc* subcommittees that would devote their efforts to specific areas of the program. By this means, the base of support for the committee in terms of participating individuals would be materially increased without enlargement of the parent committee. The first of these groups, the *Ad Hoc* Committee on Prosthetics in Medical Education, was formed in April 1959. There are today four *ad hoc* subcommittees, each with its own specific program. Subsequent articles in this Journal will report upon the activities of these groups.

CPEI was originally organized as a standing committee of the Prosthetics Research Board. That body, at a meeting in Washington on May 5, 1959, recommended to the Academy-Research Council that their Board be dissolved as of June 30, 1959, and that the responsibilities of the PRB in the field of prosthetics research and development be transferred to the Committee on Prosthetics Research and Development. The Prosthetics Research Board further recommended that the Committee on Prosthetics Education and Information, by reason of the fact that its entire program of acivities lay in the broad field of medical education, be transferred from the Division of Engineering and Industrial Research to the Division of Medical Sciences. With Academy approval, these organizational changes were effected on July 1, 1959, and the Committee on Prosthetics Education and Information assumed an autonomous status. At this time it was agreed by all of the principals in the Program that close liaison between CPRD and CPEI would be maintained. For this purpose, the Academy staffs of the two committees occupy the same suite of offices in Washington and the Chairman of CPEI is a member of CPRD.

A Surgeon Comments

By EVERETT J. GORDON, M.D.
Washington, D. C.

The Research and Development Program for Amputees received added impetus from a recent conference in Washington, D. C. of the Committee on Prosthetics Research and Development which held a conference on "The Geriatric Amputee" at the National Academy of Science. Many of the top surgeons and scientists of the country were assembled to exchange views and research data in prosthetics research, especially in regard to more vigorous rehabilitation of the older amputee. This problem has increased as medical science has pushed the average span of life beyond the Biblical three score and ten. With an ever increasing number of senior citizens, many of whom become susceptible to the vascular problems of the aged, there is a progressive increase in the number of amputees who require expert attention for fitting with artificial limbs and rehabilitation, an ambulatory parent certainly poses much less of a problem to his family than a bedridden cripple. Don't be surprised to hear of wider prescription of artificial appliances for individuals previously relegated to the "scrap heap" as not suitable for rehabilitation. Many surgeons who previously were strongly opposed to the prescription of artificial limbs after amputations for vascular disorders are now changing their views, after observing increasing success with the use of modern prosthetic components.

The Patellar Tendon Bearing below-knee prosthesis appears to be losing some of its initial spectacular popularity. We still have two bilateral amputees who have continued to wear their new prostheses with considerable success but some of the unilateral amputees have returned to their conventional appliances. It appears that future candidates will require more careful screening before the Patellar Tendon Bearing prosthesis is prescribed.

A recent experience with one severe problem encountered in private practice may illustrate what persistence and positive encouragement may accomplish. A 52 year old female with a below-knee amputation of 34 years duration fractured the femur on the amputated side in 1957, followed by gangrene after open reduction. An above knee amputation was performed as a life saving measure, followed by fitting with a conventional "plug fit" prosthesis. She gained 100 lbs in the next 2 years, weighing 210 lbs, 63" tall, when initially seen. She had not used her limb in the past 2 years, confining activities to a wheelchair.

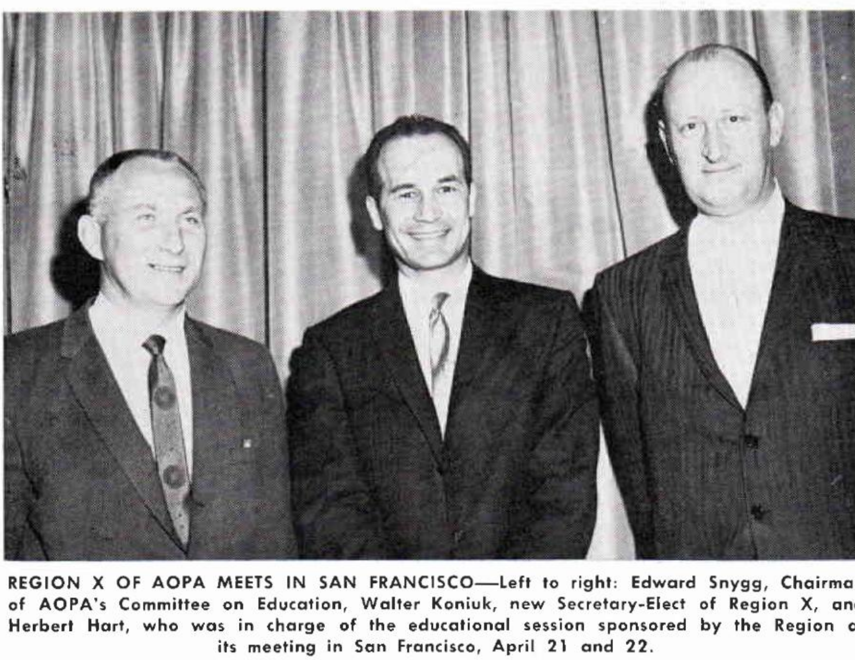
Examination revealed a mid thigh amputation with a large, redundant, exquisitely tender, soft tissue mass in the terminal scar. The patient was unable to full insert the large stump into her prosthetic socket. She was encouraged to lose weight with the help of her family physician, and made moderate progress in this direction. Surgical revision of the stump was postponed because of a history of pulmonary thrombus, and her poor general condition. However, after a loss of 50 lbs. in body weight, the stump was revised; a large neuroma and redundant soft tissue mass were removed. Several exostoses noted by pre-operative x-ray were also resected, and the bone ends smoothed. The patient made an uneventful recovery from surgery and continued her weight loss at home. A new prosthesis with an ischial seat has now been ordered, but the measurements are being deferred until her weight loss is complete.

The point of this story is well illustrated by the patient's unsolicited letter: "When Doctor W. found me sitting in a wheel chair, I had completely lost all faith in all doctors, and had become resigned to sit for the rest of my life, rather than take another chance in torture at the hands of a brutal physician. It still is a mystery to me and my family as to just who made up my mind for me, since I had sworn NEVER to have another amputation. Therefore, all that I can say is thank you very much for these services, which had brought me back on the road to living. I am losing weight slowly but surely, and I shall be calling for another appointment soon." Isn't a letter like this sufficient reward for persistent effort to help such individuals?

The author recently published an article in the Journal of International College of Surgeons, entitled "Do Above Elbow Amputees Use their Prosthesis?" representing a clinical survey of the above elbow amputees attending the Washington area Veteran's Benefits Office. Reprints are available upon application to this journal. Reprints of previous articles on "The Orthopaedic and Prosthetic Appliance Team" and "The Clinical Use of the Sach Foot" are also available. You may be surprised to learn that many more upper extremity amputees are now using prostheses, reflecting the improved performance of newer appliances as a result of research and development sponsored by the Veteran's Administration and the National Academy of Sciences.

Readers are reminded that their comments are welcome and we would very much appreciate communications to this department. We will be more than happy to publish any new ideas or critical comments on new appliances. Please pass them along, no matter how trivial they may appear to you—they may be important to someone else.

AOPA RECEPTION FOR CPRD—Dr. Roy M. Hoover, and M. P. Cestaro visit with Miss Cecile Hillyer and Dr. Gilbert Barnhart of the Office of Vocational Rehabilitation at the reception given by the Association in honor of the Committee on Prosthetics Research and Development of the National Academy of Sciences and the Conference on the Geriatric Amputee. The reception was held on April 13 in the Washington Room of the Army and Navy Town Club in Washington, D. C. More than 250 AOPA members and guests attended.



REGION X OF AOPA MEETS IN SAN FRANCISCO—Left to right: Edward Snygg, Chairman of AOPA's Committee on Education, Walter Koniuk, new Secretary-Elect of Region X, and Herbert Hart, who was in charge of the educational session sponsored by the Region at its meeting in San Francisco, April 21 and 22.

To The Ladies:
FROM AOPA'S AUXILIARY

Mrs. Pearl Leavy
President

Mrs. Margaret Brownfield
Vice President

Mrs. Lorraine Scheck
Secretary-Treasurer

Mrs. Margaret Peters
Past President

Dear Members:

Once again we say hello to you through our *Journal*, and at the same time look ahead a few months to the good time we will have in October.

The plans for our social activities are gradually shaping up. The management of the Eden Roc has been most helpful.

In the next month we hope to send a program to each of you. Many interesting tours have been suggested. Two of these are : The Parrot Paradise, with tropical gardens and an outstanding trained bird show, and Vizcaya, which some of you visited in 1958. Vizcaya is a thirty acre estate perfecting an Italian palace, complete with formal gardens. How about a deep sea fishing trip? Interested?

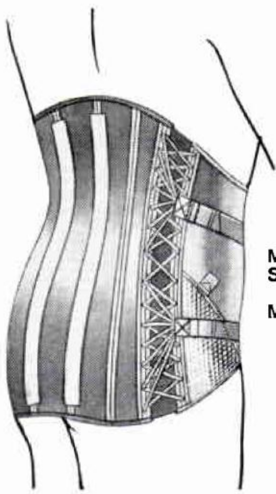
We are planning our usual fashion shows and luncheons, which we are sure will interest most of you.

These are still only tentative plans, so any comment will be greatly appreciated. Let's try to make this our largest and most successful Convention yet.

Ever since Spring began, many of your husbands have been busy gathering at the Regional Meetings throughout the United States, and we are quite sure Miami Beach will look very good to them in October also.

Hoping to see all of you there, until next time,

Best wishes
Pearl Leavy
President



Model 422 Sacro-Lumbar Support for Men.

Model 423 for Women.

Matchless QUALITY
Generous MARKUP

STOCK ORDERS SHIPPED IN 48 HOURS

Look closely at all comfort features, quality, and low dealer prices of Freeman surgical supports. Notice that contact between the body and the support is cushioned with cool, soft Velveteen lining and stay covers to relieve irritation. Exterior is of the finest Pima Cotton and Dacron fabric. Skilled needlework.

Medically correct Freeman supports have been developed in 70 years of close association with the medical profession and offer full therapeutic values.

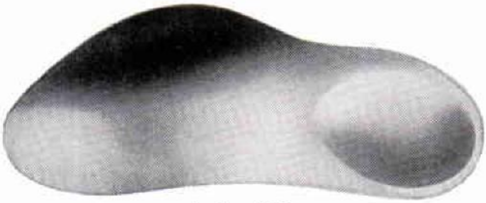
You can depend on the fast handling of *your* order—and on special request we will ship the same day your order is received.

Freeman

SELL FREEMAN WITH CONFIDENCE

WRITE FOR FREE CATALOG — FREEMAN MFG. CO., Dept. 806, STURGIS, MICHIGAN

ESTABLISHED over 3 DECADES



Style 4005

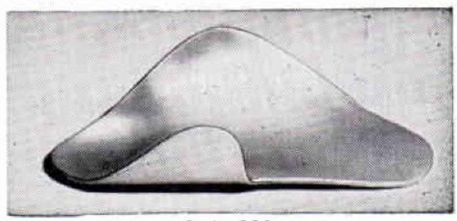
Flexible Type Support, Combination Longitudinal and Metatarsal with Concealed Metal Spring, Made in Women's, Men's and Children's Sizes.

Style 903 (Leather Whitman)

A Combination Support with Both Inner and Outer Flange, Made with One or More Springs, Women's, Men's and Children's Sizes.

Style 803

Stainless Steel Support with Moderate Inner Flange, Women's, Men's and Children's Sizes. The Above Style also available in Specially Treated Dural.



Style 900

Most Popular Metal Whitman, Made of High Grade Stainless Steel. Women's, Men's and Children's Sizes.

All Arch Supports Are Made Either from Cast or in Stock Sizes

MOULDED LEATHER SHELLS STYLE A
FOR WOMEN, MEN AND CHILDREN

MOULDED LEATHER SHELLS STYLE B WITH MET
FOR WOMEN AND MEN

MOULDED LEATHER SHELLS STYLE D (WHITMAN)
FOR WOMEN, MEN AND CHILDREN

All Leather Shells Can Be Had with One or More Attached Steel Springs

RUBBER SHELLS
WOMEN'S, MEN'S AND CHILDREN'S SIZES

PEDIC SPONGE RUBBER
In Thicknesses of 1/16" to 1/2" Medium and Firm Density

ORTHOP. AIR-FOAM
1/8" TO 1" MEDIUM, AND FIRM DENSITY

FOAM ON COTTON
1/8" 3/16" 1/4"

RUBBER CORK
1/16" TO 1/2"

ORTHO CORK
1/16" TO 1/2"

CORK BLOCKS FOR ELEVATIONS
12x4" 1/8 TO 4"

RUBBER-SCAPHOIDS
SMALL, MEDIUM, LARGE AND EXTRA LARGE

RUBBER METATARSAL PADS

CELASTIC MOULDING FABRIC
No. 45 No. 75 No. 115 No. 125

VINYL LEATHERETTE
IN WHITE AND NATURAL COLORS

CATALOG AND PRICE LIST ON REQUEST

HERSCO Arch Products Corp.
MANUFACTURERS
137 East 25th St., New York 10, N. Y.

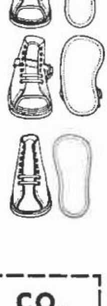
"Chesbrough Pre-Walkers mean NEW business for you"

"Here are orthopedic shoes parents can afford. Orthopedic surgeons in 45 states and many foreign countries are now prescribing them. Spectacular sales figures prove it. This important referral business can be yours.

"When a child in my own family needed a corrective shoe, I discovered what a strain it can mean to a family budget, because 1) corrective footwear is expensive and 2) frequent purchase of new corrective shoes is required. Then and there I decided there was a real need for a moderately priced corrective shoe—a shoe parents could afford. That's why and when Chesbrough Orthopedic Pre-Walkers were born.

"Our 60 years of shoe-making experience resulted in corrective Pre-Walkers of scientific design, expert workmanship, fine leathers combined with orthopedically correct lasts to provide necessary correction at an economical price."

All shoes in unlined white elk, sizes 000 to 4, narrow and wide. Available in full pairs, split pairs or single shoes (no extra charge for half pairs).



No. 1400 OPEN TOE. Straight-line symmetrical last, firm heel, no back seam. Adaptable to Denis Browne Splints.

No. 1700 CLUBFOOT, OPEN TOE. Special outflare last, sturdy instep strap to stabilize heel.

No. 1300 CLOSED TOE. Lace-to-toe design permits snug, gentle fit. Perfectly smooth inside.

MAIL COUPON FOR SAMPLES

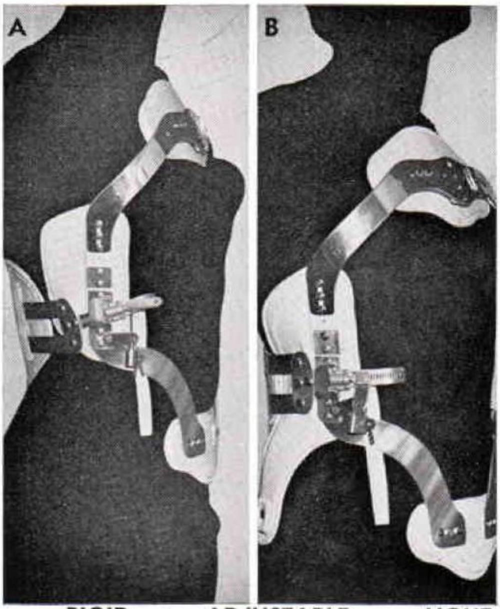
G. W. CHESBROUGH CO.

797 Smith Street, Rochester 6, N. Y.

NAME ....

ADDRESS ....

CITY ....



THE JEWETT HYPEREXTENSION BACK BRACE*

FOR

1. Uncomplicated Compression Fractures and/or Kummell's Disease
2. Osteoporosis, with or without compression fractures
3. Marie Strumpell's Arthritis of the spine.
4. Adolescent Epiphysitis (Scheurmann's Disease)

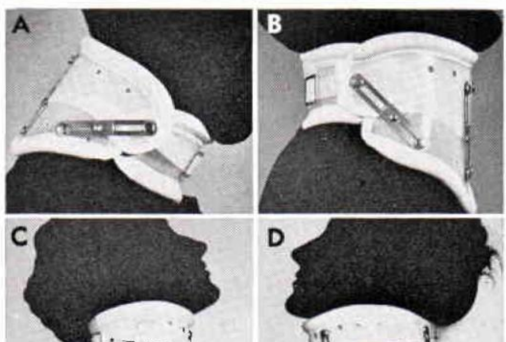
A. Standard Hyperextension Model

B. The Post Lumbo-Sacral Fusion Model

Catalogs, Reprints and Measuring Charts Upon Request.

RIGID • ADJUSTABLE • LIGHT WEIGHT • WASHABLE

CERVICAL COLLARS FOR EXTENSION-FLEXION OR STABILIZATION



LIGHT WEIGHT

WASHABLE

ADJUSTABLE

A & B THE EXTENSION-FLEXION COLLAR—A universal cervical collar, extremely versatile and adaptable for extension, flexion, or stabilization.

C—The MYO-VENT—A one-piece extension collar with ventilated adjustability.

D—The CER-VENT Extension Model. A one-piece collar with ventilated adjustability. Easy to put on, complete support.

E—The CER-VENT Flexion Model. A one-piece collar with ventilated adjustability. Easy to put on, complete support.

F—The MYO-CERVICAL. A one-piece extension collar with overlapping adjustment. Catalog and Order Blanks upon request.

*FLORIDA BRACE CORPORATION

601 Webster Avenue, Post Office Box 1366
Winter Park 5, Florida, Telephone MIdway 4-2650

NEW PROFIT ITEM!

added to Bell-Horn's famous line of elastic stockings

61* NO-RUN

*Trade Mark

THE FIRST NO-RUN ELASTIC STOCKING

Bell-Horn, America's leading maker of elastic hosiery for more than 100 years, brings you amazing new 61 No-Run, the first elastic stocking that locks out runs forever. End customer complaints about runs once and for all! 61 No-Run simply will not run. And you get these additional sales features:

- **Full-fashioned for contour fit.**
- **Sheerness for fashion appeal.**
- **Full foot with specially reinforced sole and heel.**
- **Sufficient support for the most aggravated cases.**
- **Support that only rubber can give.**
- **Attractively packaged, ideal for point-of-sale displays.**

Bell-Horn also manufactures the famous "TROPICAL WEIGHT" brand in both service and sheer weights—contour fashioned, two-way stretch to support even the severest cases of varicose veins.

Send for Additional Information on New 61 No-Run Stockings

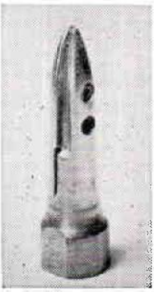
BELL-HORN

457 North 3rd Street, Philadelphia 23, Pa.

AMERICA'S LEADING MAKER OF ELASTIC HOSIERY FOR OVER 100 YEARS

New Helps for your

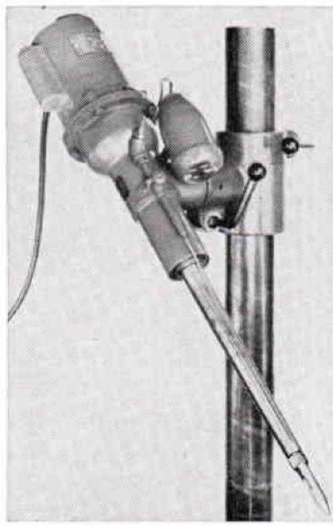
TRAUTMAN CARVER



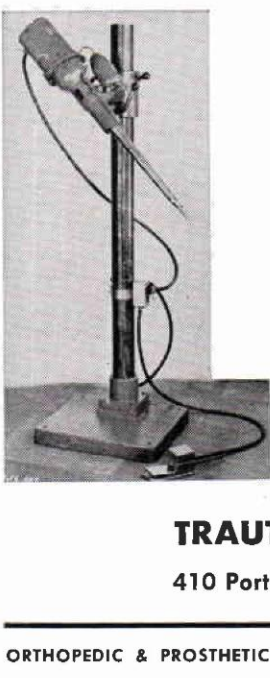
MIDGET CUTTER—No. 2100H

A new single blade cutter to help you pull small children's sockets—and to route out corners for all quadrilateral fittings. $25.00 including an extra blade.

Air Attachment for Trautman Carver No. 2100J



Another tool to help you get ultimate efficiency from your Trautman Carver. This is a blower attachment which gently blows sawdust and chips away from the cutting tool. This enables you to see at all times exactly where and how you're cutting. Comes complete with airhose fitting—can be plugged into any standard airline. Flow of air can be regulated. Attach in minutes with screwdriver only tool needed. Cost $10.50.



FOOT SWITCH (For the Trautman Carver 2100K)

We've had requests for a foot-operated switch, and this is the answer. It can be attached in a matter of minutes to any Trautman Carver. Designed so that if the operator wishes to use the hand switch instead of the foot pedal, all he has to do is remove the motor plug from the receptacle on the column of the Carver and then plug it directly into the power supply. Does not affect the Carver's normal operation. Cost $22.65.

TRAUTMAN SPECIALTIES, INC.

410 Portland Avenue, Minneapolis, Minnesota

THE AMERICAN ORTHOTICS AND PROSTHETICS ASSOCIATION (AOPA)

(Formerly the Orthopedic Appliance and Limb Mfrs. Assn.)

919 18th Street, Washington 6, D. C.

EXecutive 3-0385

OFFICERS AND STAFF

Ralph Storrs, President, Kankakee. Illinois

Fred Quisenberry, President-Elect, Los Angeles, California

Carlton E. Fillauer, Vice President, Chattanooga, Tenn|

Paul E. Leimkuehler, Past President, Cleveland, Ohio

M. P. Cestaro, Secretary-Treasurer **Washington, D. C.**

Lester A. Smith, Executive Director Washington, D. C.

Stockton V. Banks, Editorial and Public Relations Assistant

LeRoy Wm. Nattress, Secretary, AOPA Committee on Education

Bertram D. Litt, Associate Project Director

HEADQUARTERS STAFF

Thomas W. Bevis, Bookkeeper; **Janice Lowe, Victoria Bowen,** Secretarial Staff.

REGIONAL DIRECTORS

Region I—**Joseph Martino** Boston, Mass.

Region II—Mary S. **Dorsch,** New York City

Region III—**Basil Peters,** Philadelphia

Region IV—**Bert Titus,** Durham, N. C.

Region V—**Durward R. Coon,** Detroit, Mich.

Region VI—**Richard G. Bidwell** Milwaukee, Wisc.

Region VII—**Robert Gruman** Minneapolis, Minn.

Region VIII—**David C. McGraw** Shreveport, La.

Region IX—**Harvey Lanham** Long Beach, Calif.

Region X—**Herbert J. Hart** Oakland, Calif.

Region XI—**August W. Pruhsmeier,** Portland, Oregon

AMERICAN BOARD FOR CERTIFICATION IN ORTHOTICS AND PROSTHETICS, INC.

Howard Thranhardt, C.P., President Atlanta, Ga.

George Aitken, M.D., Vice-President Grand Rapids, Mich.

Eugene Record, M.D., Boston, Mass.

Herbert J. Hart, C.P. & O., Oakland, Calif.

Alvin Muilenburg, C.P. & O. Houston, Texas

Roy Michael Hoover, M.D. Roanoke, Va.

Richard Bidwell, C.P. & O. Milwaukee, Wis.

M. P. Cestaro, Secretary-Treasurer Washington, D. C.

Chester C. Haddan, P. & O., Consultant, Denver, Colo.

STAFF

Leroy Wm. Nattress, Jr., Executive Director, Washington, D. C.

Judy Thomson, Secretary