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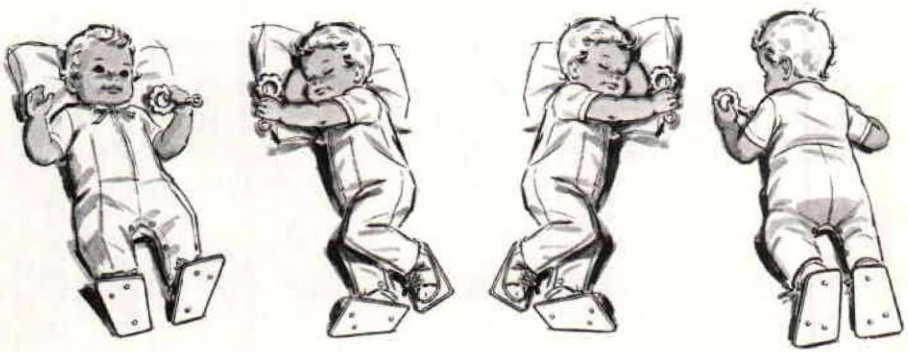

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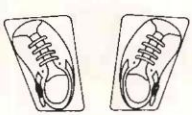

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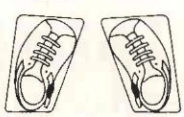

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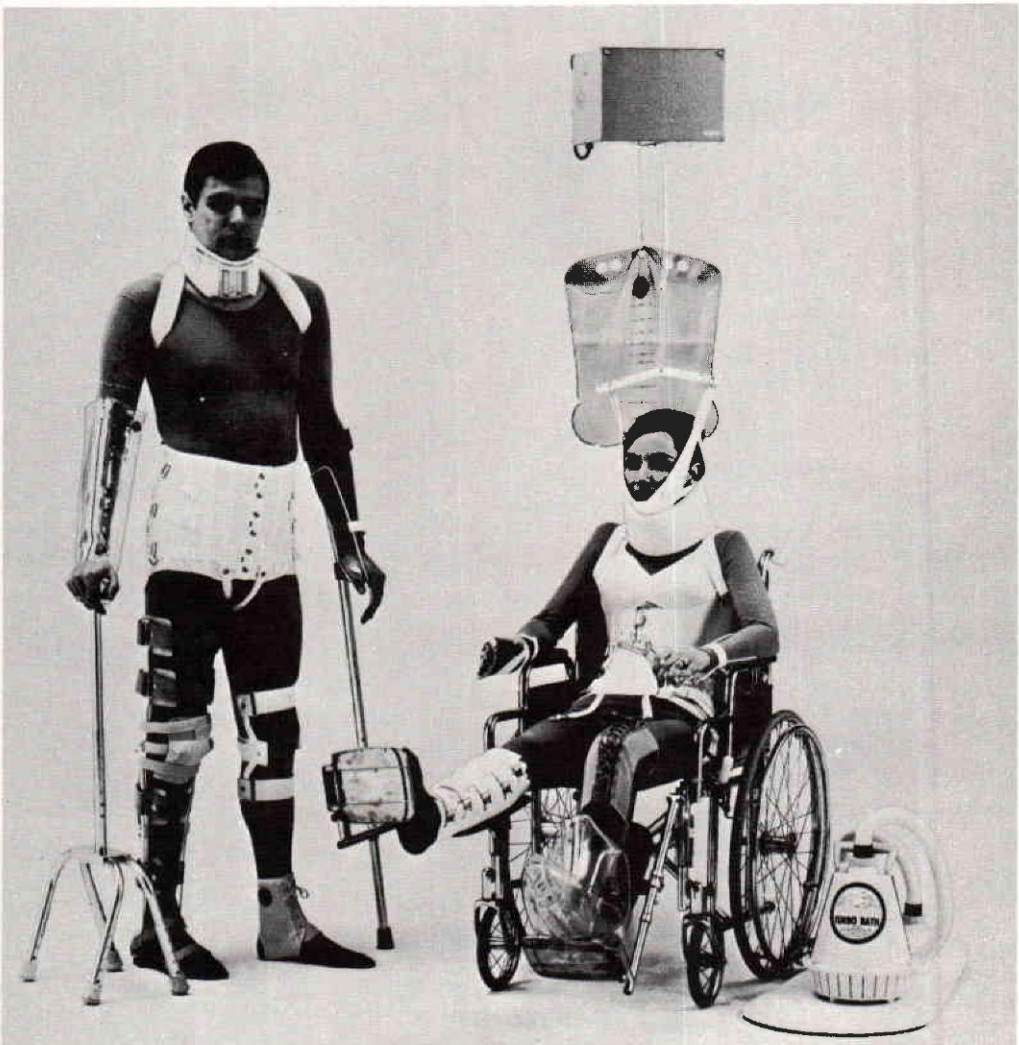

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Pronator Assist[1]

by Edward C. Grahn

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Introduction

The quadriplegic patient frequently has active supination due to retained control of the biceps brachii, the supinator, and sometimes the brachioradialis muscles. The biceps and the brachioradialis exert their supinator effect along with an elbow flexion component (Fig. 1).

Since table-top work surface activities require placement of the pronated hand away from the body, this unopposed supination and elbow flexion restricts hand use. Degrees of contracture easily occur in the flexed and supinated position.

In the sitting position gravity

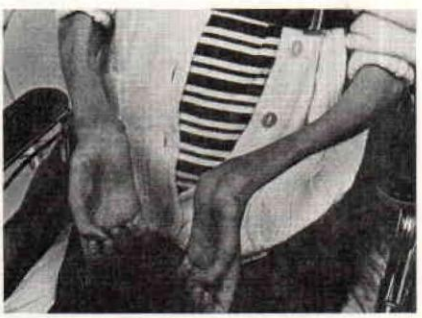

FIGURE 1—The quadriplegic patient showing the unopposed supination and elbow flexion which restricts hand use.

[1] Based on work performed under V.A. contract V101 (134) P-5.

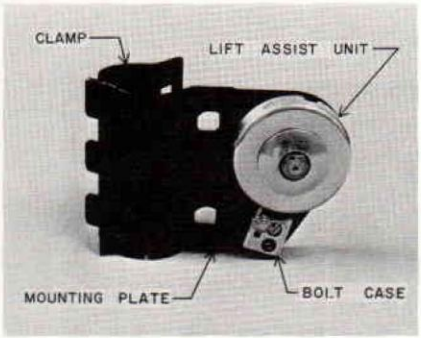

FIGURE 2—Partially assembled Pronator Assist showing the clamp, mounting plate, Lift Assist Unit, and bolt case.

may be a sufficient elbow extensor. Gravity will not pronate the hand, although a pronating effect can be produced by shoulder abduction.

The Pronator Assist presented permits orthotic pronation to be supplied without encumbering the hand with a significant weight increase, additional harnessing, or interference with elbow extension. One end of a cable can be attached to a wrist cuff or the forearm component of a grasp-release orthosis, while the other end of the cable can be attached to the wheelchair. The entire device is easily understood and appreciated by the patient and his attendants. It is applied as easily as the hand splint. Its torsion adjustment are simple: the hand knob is simply turned until the forearm pronates.

Enough rotary force can be exerted to correct mild supination contractures, and the continuous torsion will gradually release more severe contractures. It may be necessary to modify the cuff or forearm component of the device to provide a broad surface on the dorsum of the radius and a broad surface on the volar aspect of the forearm to permit the application of the force couple exerted by the torsionally loaded cable.

Patients can be fitted bilaterally. This device is sufficiently simple and well tolerated so that it does not threaten the patient's "gadget tolerance." It does not interfere with clothing, since it leaves the arm and elbow entirely free of encumbrance.

Design

The device is designed to keep the fabrication of parts to a minimum. Most of the parts are available from either a supplier of prosthetic components or a hardware store.

The torque required to pronate the wrist is supplied by the energy stored in both the Forearm Lift Assist Unit* (Fig. 2) and the steel

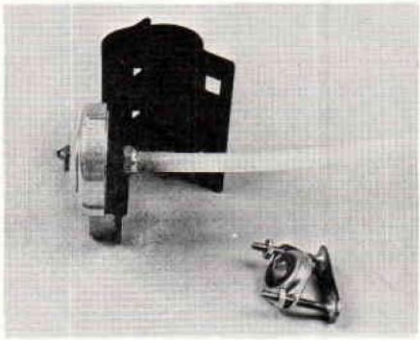

FIGURE 3—Completed Pronator Assist showing the addition of the polyethylene tubing and music wire. In the foreground is the base plate and its mounting plate for the distal attachment of the tubing and music wire as shown in Fig. 5.

music wire inside the polyethylene tubing (Fig. 3). This torque is easily adjusted to meet the individual patient's needs. The unit is

* A. J. Hosmer Corporation, Campbell, California.

attached to the wheelchair frame with a simple clamp (Fig. 2). The plate to which the Forearm Lift Assist Unit is attached can be either brazed to this clamp (as shown in Fig. 2) or held there with the screws used to clamp the unit to the wheelchair. The mounting plate is shown in detail in Fig. 4. The material can be 3/64-inch to 1/16-inch thick steel or 3/32-inch to 1/8-inch thick aluminum alloy.

The Forearm Lift Assist Unit is not modified in any way. A left Lift Assist Unit is used on the right side and a right Lift Assist Unit is used on the left side. This unit is attached to the mounting plate with a #10 hexagon-head screw at least 1¼-inch long. The screw is drilled in two places with a #55 (.052-inch) drill to accept the proximal end of the music wire. One hole is drilled through the center of the screw and the other just through the head as shown in Fig. 2. The music-wire size can vary from 15 gage (.035-inch diameter) up to 23 gage (.051-inch diameter), depending upon the requirements of the patient. The small diameters allow the greatest flexibility for hand placement; the

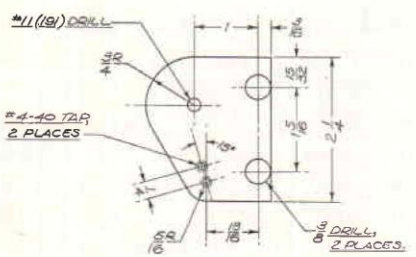

FIGURE 4—Drawing of the mounting plate for the Lift Assist Unit and bolt case. It can be used for either the left or right side.

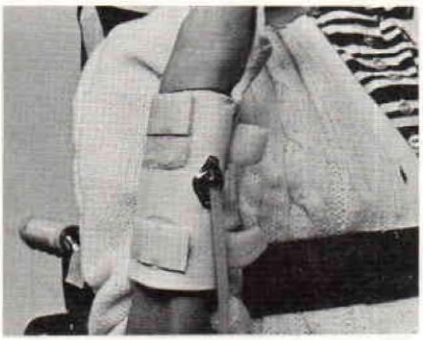

FIGURE 5—Distal attachment of the polyethylene tubing and music wire.

large diameters are less flexible, but allow a greater torque to be applied to the wrist. The plastic tubing is high-density polyethylene, ¼-inch outside diameter by .062-inch wall thickness, tapped on one end for the #10 screw. This plastic tubing adds additional stiffness to prevent the music wire from "coiling," however it does not contribute nor interfere with the torsional load. The distal end of the music wire is attached to the hand orthosis or wrist cuff, using a standard prosthetic housing retainer and base plate. To attach the base plate, braze two #4-40 flat-head screws to a thin strip of steel (Fig. 3) and insert through the wrist cuff and base plate. The most distal screw is used to anchor the music wire as shown in Fig. 5.

Assembly

Determine the length of polyethylene tubing required by having the patient extend his arm actively as far forward and to the contralateral side as possible. Measure the distance between the wrist and the wheelchair frame where the unit will be attached. Do not

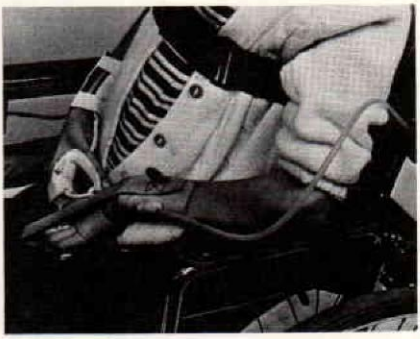

FIGURE 6—The finished device installed on the wheelchair and orthosis, and adjusted to obtain maximum pronation.

measure in a straight line, but rather measure the curved path that the tubing would follow and cut the tubing to length. Cut the music wire approximately five inches longer. Insert the music wire through the center hole in the screw, bend back one inch from the end, insert into the other hole in the screw head, wrap the wire one turn counterclockwise (viewed from head end) around the screw body, and cut off the excess. Fig. 3 shows how the music wire looks after it is fastened to the screw. Insert the music wire and screw through the Forearm Lift Assist Unit and secure firmly with a nut. Insert this in turn through the plate and secure it **loosely** with a lock nut; it must be free to rotate. Slip the polyethylene tubing over the wire and thread onto the screw. Push a one-inch length of Standard Cable Housing* halfway into the other end of the tubing. Attach the bolt case of the Forearm Lift Assist Unit to the plate (Fig. 2). Attach the base plate to the wrist cuff or forearm component of the orthosis and cut off the proximal screw flush with the nut. Thread the housing retainer on the housing and insert into the base plate. Wrap the music wire around the distal screw clockwise two turns, cut off excess, and secure with a nut (Fig. 5). Cut off the excess screw and cover the wrist attachment with leather or some other appropriate material as shown in Fig. 6.

* A. J. Hosmer Corporation, Campbell, California.

Clinical Evaluation

Miss G. is a sixteen-year-old female with an incomplete cervical 5-6 quadriplegia as a result of a diving accident in September 1969. The patient spent eight months in two hospitals for acute care and progressive rehabilitation before being admitted to the Rehabilitation Institute of Chicago in May 1970.

At the time of admission Miss G. displayed poor hand placement abilities bilaterally due to muscle weakness, tightness, and contractures. Bilaterally, the patient had tight and weak (grade three-plus) scapulo-humeral musculature, grade four elbow flexors which were also tight, and forearm supination contractures. The left upper extremity had grade three-plus radial wrist extensors. The right upper extremity, which was previously the patient's dominant extremity, had grade three radial wrist extensors. She had no active finger or thumb motion bilaterally and was unable to perform any prehension activities. Prior to admission to the Rehabilitation Institute of Chicago, Miss G. had been taught to brush her teeth and sign her name using

a utensil holder. This device had to be put on her right upper extremity which was maintained in supination due to muscle contracture.

The patient was referred to Occupational Therapy where she was placed on a program of graded activities to improve joint range-of-motion, muscle strength and endurance, hand placement, and self-care abilities. Prehension activities with any orthoses were impossible for Miss G. due to supination contractures and lack of prehension musculature.

In cooperation with the Northwestern University Prosthetic Research and Evaluation Center, Miss G. was fitted bilaterally with Pronator Assists to position both forearms in pronation. The left Pronator Assist was attached to the wrist cuff of a temporary Rehabilitation Institute of Chicago tenodesis orthosis of Orthoplast,* which had been fabricated by the occupational therapist. This orthosis provided a three-point prehension for grasp and release activities. Following training in the use of the temporary orthosis with attached Pronator Assist, the patient was able to pick up utensils and a glass to feed herself, pick up a telephone receiver, and perform prehension activities such as table games. As Miss G. became more proficient in performing these activities, the temporary tenodesis orthosis was discarded and the Pronator Assist was attached to the wrist cuff of a laminated plastic Rehabilitation Institute of Chicago tenodesis orthosis (Fig. 6) (1).

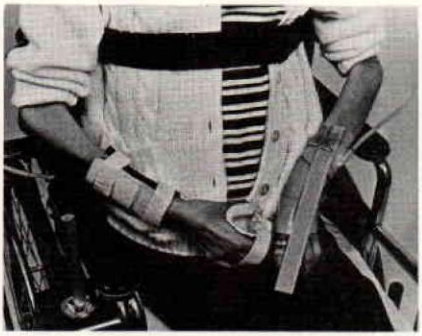

FIGURE 7—Anterior view of the patient in Fig. 6.

A temporary right volar Orthoplast static orthosis was also fabricated by the occupational therapist. This orthosis maintained the patient's hand in a functional position. It also supported the patient's wrist in 30° extension, maintained a satisfactory thumb-web space, provided an attachment for utensils, and incorporated a wrist cuff to which the Pronator Assist was attached (Fig. 7). Miss G. used this orthosis to write, to dial a telephone, and to operate her electric wheelchair. The patient could also type on an electric typewriter using both upper extremities with wooden dowels and operate a cassette tape recorder that was modified with extension levers (2). The only activities for which Miss G. did not need the Pronator Assists and orthoses were washing her face and hands and brushing her teeth. For the latter activity the patient used a toothbrush inserted into a leather utensil cuff which she could put on herself.

The Pronator Assist allowed the patient's forearms to move through

* Registered Trademark of Johnson and Johnson, New Brunswick, New Jersey.

maximum passive joint range-of-motion at the elbow and maintained the increased passive joint range-of-tion that was gained through passive stretching by the physical therapist. Following are the passive joint range-of-motion measurements taken at the time of admission to and discharge from the Rehabilitation Institute of Chicago:

	5-22-1970	10-13-1970
Passive Forearm Pronation	Right 0-55° Left 0-52°	Right 0-60° Left 0-70°
Passive Elbow Flexion	Right 30°-163° Left 26°-168°	Right 18°-168° Left 15°-165°

Some additional pronation was gained when Miss G. performed humeral abduction. While wearing the bilateral orthoses and attached Pronator Assists, the patient was able to actively supinate when it was necessary.

During the course of therapy Miss G. improved in muscle strength, endurance, and passive joint range-of-motion. After training with the orthoses with bilateral Pronator Assists, the patient displayed adequate hand placement to perform many activities. At the time of discharge from the Rehabilitation Institute of Chicago Miss G. was able to feed herself with standard eating utensils and a glass, pick up a telephone receiver and dial the phone, operate an electric typewriter and adapted tape recorder with dowels, operate an electric wheelchair which had adapted controls, write with fair legibility, and participate in table games. Miss G. wore the right orthosis and Pronator Assist throughout the day. The left orthosis and Pronator Assist were worn during meals and table-top activities. As the patient herself was unable to put on the orthoses with cables attached, family members were instructed in applying the orthoses to the patient and setting the two springs of the Pronator Assists to attain maximum forearm pronation.

In summary, the Pronator Assist:

1. Maintained optimal joint range-of-motion that had been gained through therapy.
2. Improved hand placement.
3. Permitted the use of a Rehabilitation Institute of Chicago tenodesis orthosis, which enabled the patient to perform prehension activities with the left upper extremity.
4. Allowed use of a static orthosis for the right upper extremity, which enabled the patient to write and operate adapted equipment.

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2. Grahn, E. C.: Tape Recorder Modifications for Use by Quadriplegics. *The American Journal of Occupational Therapy*, XXXIV: 360-361, July-August, 1970.

Method of Control of Electric Wheelchair for Paralyzed Patients And a Myoelectric Control For Upper Extremity Orthoses

by Edwin M. Prentke, B.Sc.E.E.

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Department of Physical Medicine and Rehabilitation
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An electronic system has been designed and built that enables quadriplegic patients and other severely handicapped persons to operate an electric wheelchair. Both speed and direction of motion are provided. The system also includes a myoelectric control for a flexor hinge hand splint, a powered elbow flexion device, and an acceleration limiter. All of the components are contained in a metal cabinet attached behind the wheelchair. Power is supplied by the wheelchair batteries and by an auxiliary nickel cadmium rechargeable battery. Without hand, wrist, or arm function, these patients can now avail themselves of an electric wheelchair.

The system provides these functions:

1. Pre-selection of speeds: slow, medium, fast, and off.
2. Control for eight directions: straight ahead, straight back, clockwise turn ahead, counterclockwise turn ahead, sharp right, sharp left, right turn backwards, and left turn backwards.
3. Provision for operating appliances other than the wheelchair.
4. Opening and closing a hand splint.
5. Powered elbow assist device

for those who cannot bring their hands close enough to their mouths for eating.

6. Acceleration limiter to provide smooth, gradual starts to prevent the jerking of the head and trunk that occurs without this device.

Both speed and direction of the wheelchair are controlled by sensitive touch switches located on a panel on the lapboard. To set the speed, the user repeatedly touches a disk (a) in Figure 1 until the desired lamp, marked "Slow," "Medium," or "Fast," lights. To drive away, he touches the rim of the large disk (b) in Figure 1 at a location corresponding to the desired direction of travel. If, for example, he presses the disk in front, the chair goes straight ahead. As soon as he removes his thumb from the touch disk, the chair comes to a stop.

Another touch disk can be used to turn various appliances, such as TV, radio, tape recorder, on and off. This requires an auxiliary control unit such as the Ampersand Paratrol.

Some of the features of the control device include a meter for checking the battery, a built-in test signal for checking the operation of the myoelectric control system, a mercury switch for operating the powered elbow motor, a knob for adjusting the rate of acceleration, a switch to disconnect the acceleration limiter if desired, and a special electronic circuit that cuts off current to the elbow and splint motors after the cables have reached the end of their travel. The relays that operate the wheelchair motors are driven by transistors which are turned on by the lapboard switches. This prevents arcing and corrosion of the switch contacts, and prolongs their life.

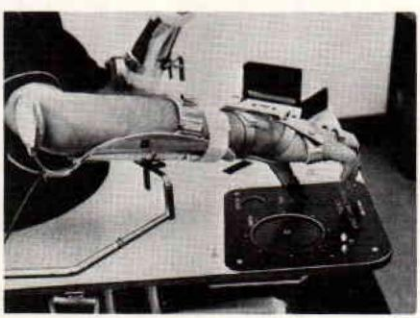

Figure 1

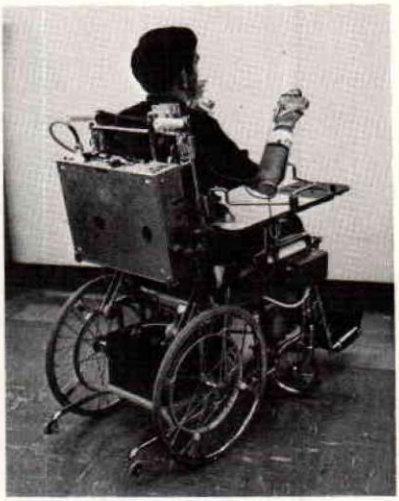

Figure 2

Both the lapboard and the electronic unit can easily be detached from the wheelchair by unplugging the cable connectors. The entire system is shown in Figure 2.

Several of these systems have been built and are now in use. Great care was used in the design, selection of components, and in the fabrication, to achieve high reliability. The system has proved to be relatively trouble free.

Construction of a Short Above Knee Pylon in a Patient with Amputations of Three Extremities

Gerald J. Herbison, M.D.[1]

Dexter Friesen[2]

This study was supported in part by Research and Training Grant RT-8 Vocational Rehabilitation Administration.

L. S. is a 25-year-old male who fell in front of a moving subway train on November 17, 1968. He was admitted, unconscious, to Temple University Hospital on the day of the accident. The systolic blood pressure was 70, with a pulse rate of 130. The physical examination on admission disclosed traumatic amputations of the right leg approximately five inches below the greater trochanter, the right upper extremity approximately four inches distal to the head of the humerus, the left leg at the ankle. The patient was transfused and taken to surgery. The following procedures were done: a left below-knee amputation four inches distal to the tibial tubercle; the fibula was removed two inches higher; a right above-knee amputation done two inches below the greater trochanter; a right above-elbow amputation done three inches distal to the head of the humerus.

Subsequent to surgery, the right lower-extremity stump oozed seropurulent material. December 9, 1968, there was a revision of the right stump. The revision was done

1. Assistant Professor, Department of Physical Medicine and Rehabilitation, Temple University School of Medicine.

2. Physical Therapy Assistant, Prosthetics Technician, Department of Physical Medicine and Rehabilitation Temple University Health Sciences Center.

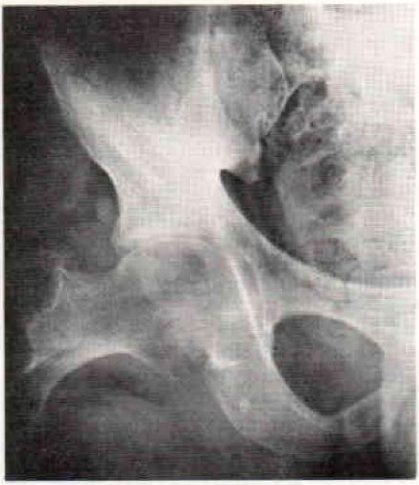

Figure 1

through the greater and lesser trochanter. (Fig. 1)

Description of Pylon: The pylon was fabricated using a positive mold. The mold was then sanded into a quadrilateral-type socket. The femoral triangle was hollowed out. About this mold a final socket was fabricated in forty-five degrees of hip flexion. A two-by-two was used for the "thigh" of the pylon. Initially the thigh section consisted of a tapered block with a hinge. This was used in conjunction with a hip Spica the patient wore for about two weeks while developing ambulatory skills. Its purpose was to allow removal of the pylon at the hinge by removing the peg connecting the two halves (Figure 2). This was attached to an above-knee prosthetic unit* (Figure 3-6). The socket fit so well that with the patient at forty-five degrees of hip flexion, it was impossible to pull the socket from the stump. A

* United States Mfg. Co., 623 South Central Ave., P.O. Box 110, Glendale, California 91209.

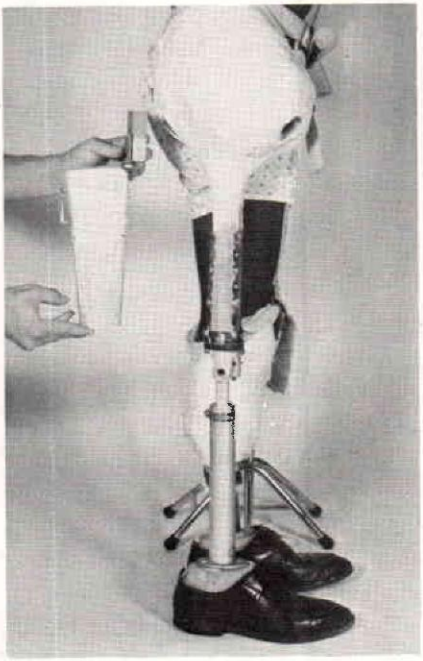

Figure 2

shoulder strap was used as additional suspension.

A method of fabricating a satis-

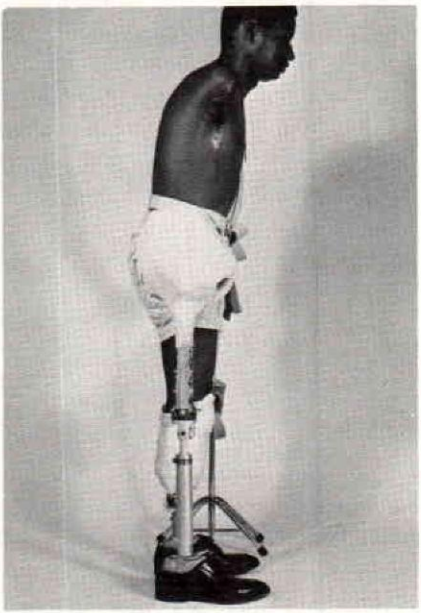

Figure 3

Figure 4

Figure 5

Figure 6

factory short above-knee pylon has been described.

The patient was discharged on May 2, 1969, capable of ambulating one thousand feet. He is completely independent in activities of daily living including the ability to go up and down stairs.

We are aware of the fact that the patient will depend on a wheelchair for most of his locomotion. However, because he could not leave his house or be independent in toilet care without the limbs, we feel that the energy expended on the patient was justified. Final prosthetic devices have now been fabricated.

A Total Contact Color Pad

by Alfred Schnell, C.P.O.*
and
Herman G. Pollack, DPM**

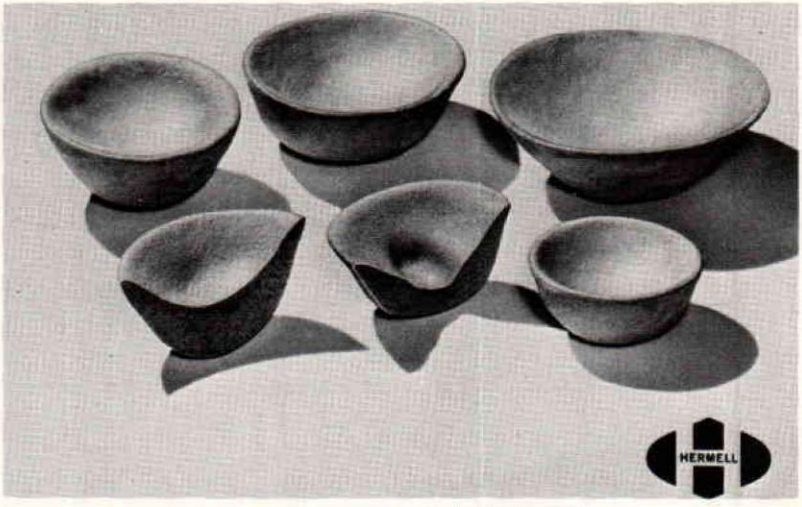

Fig. 1. Total Contact Pads in Various Sizes.

Introduction

There has been a need for some method of determining whether pressures caused by bony prominences are present on BK and AK amputees fitted with total contact sockets. It is also necessary to insure that total contact is made. After experimenting with several types of materials, a distal pad has been developed that has proved to be most effective and easy to apply.

* Hartford Orthopedic Appliance Co.
589 Prospect Avenue
West Hartford, Conn. 06110.

**Hermell Products
111 Pearl Street
Hartford, Conn.

Suggested Application Procedure

Place the desired size pad in the total contact socket. Have the patient, wearing a stump sock, walk with his prosthesis. A cushioning effect is felt as the pad conforms to the distal end of the stump and socket. The prosthesis is then removed and by observing the pad, the indentations made by pressure points can be observed. Discoloration will also appear according to the amount of pressure on the pad. The thickness variations in the compressed pad will also indicate whether or not total distal contact is maintained between the stump and socket.

Technical Information

Total Contact Pads, shown in Fig. 1, are made of a non-toxic latex foam, specially treated to retain its identification of the compressed areas. A colored flock has been added for strength as well as for color identification of the compressed areas.

American Academy of Orthotists and Prosthetists, Inc.

(The following is a brief description of the newly-formed organization of Board-Certified Orthotists and Prosthetists. Anyone desiring additional information should contact Mr. Daniel G. Rowe, C.P.O., 2032 Marshall Ave., St. Paul, Minn. 55104)

Until the formation of the American Academy of Orthotists and Prosthetists, no vehicle existed that gave the *individual* Certified Practitioner a vote in the affairs that most directly concerned his profession. Because of an awareness of these problems, AAOP has been formed, with the endorsement of the Board of Directors of the Association and the American Board for Certification to formulate and establish a group which will represent the interests and affairs of the individual certifees. As a result, an organizational meeting was held in St. Louis on December 12 and 13. Eighty-three Certified Practitioners were present at this meeting and endorsed the by-laws and the Charter of this group; elected officers and directors; and established application fees and annual dues.

The purposes of the corporation, as stated in the Certificate of Incorporation, and subject to amendment from time to time, as therein provided, are the following:

A. To conduct and carry on the activities of a non-profit corporation in order to promote attainment of the highest standards of technical competency and ethical conduct by practitioners;

B. To provide, through membership in the Academy, recognition of practitioners who practice according to technical and ethical standards that the Academy may adopt;

C. To conduct investigations and examinations and do any other act necessary to ascertain whether practitioners who apply for or who have been admitted to membership in the Academy achieve and maintain these standards.

D. To collaborate with recognized educational, research and other organizations to develop technical and ethical standards for the profession of orthotics and prosthetics.

It is recognized by the Board of AAOP that there are now in

existence several active societies at the regional or local level, and that other groups are in the process of forming. It is hoped by the Board that these groups will align themselves with, and become members of AAOP, and subscribe to the articles of incorporation, and become chapters of the National AAOP organization. Much of what the Academy hopes to accomplish in the areas of educational advancement, public relations, recruitment, and other efforts will have to be done at the local level. This will require the support and the effort of all practitioners, nationwide.

The board is formulating active working committees. They will be comprised of practitioners in all parts of the country to make the Academy a functional and energetic working body to stimulate, encourage, and promote attainment of the highest standards of technical competency and ethical conduct by practitioners of the profession of orthotics and prosthetics.

In the final analysis, the success or failure of the infant Academy rests solely with the Certified Practitioners. If they support these efforts, not only by joining the Academy and paying dues, but by offering their services and working for the Academy, then it cannot help but be a successful effort.

Membership requirements are as follows:

1. Membership is limited to orthotic and prosthetic practitioners who are certified by the American Board for Certification in Orthotics and Prosthetics, Inc.

2. Such practitioners who apply and pay the application fee and dues during the first year of the Academy's existence will be charter members.

The Officers and Directors who were elected at the December 12-13 meeting in St. Louis are:

President: Ralph R. (Ronney) Snell, C.P.
President-Elect: William Brady, C.P.
Vice-President: Hugh Panton, C.P.
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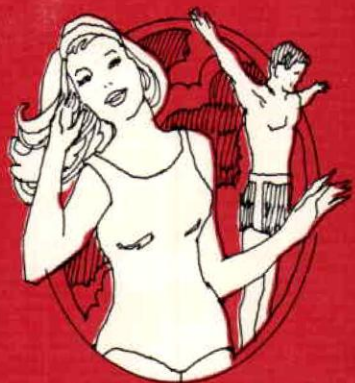

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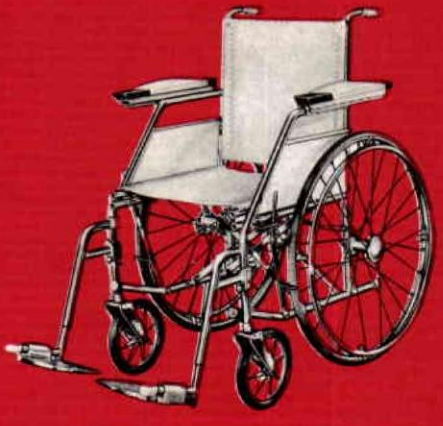

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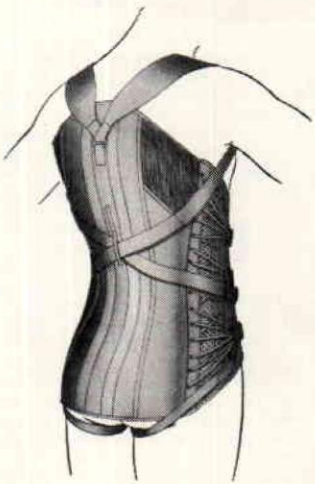

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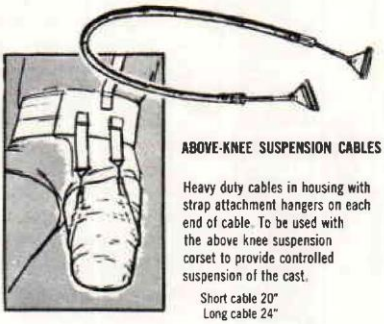

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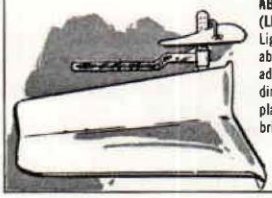

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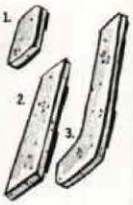

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