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A Method of Early Prosthetics Training for Upper-Extremity Amputees[1]

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OVER the past ten years, there have been gradual changes in the treatment and training of patients who have had upper-limb amputations *(1,2,3).* This paper discusses early training techniques used over a two-year period at Valley Forge General Hospital on 67 (32 above-elbow and 35 below-elbow) amputees. Thirty-four of the amputees were treated from July 1968 to February 1969, and 33 from February 1969 to July 1970.

Prior to February 1969, there was no separate ward for amputees, and each patient was placed on a ward appropriate to his overall disability, rather than according to his amputation. The upper-extremity amputees were pretrained in the leather-laced practice prosthesis with plaster-shell insert. However, this type of practice prosthesis was not fitted to the patient's stump until all wounds had healed and drainage had ceased. Consequently, preprosthetic training was delayed, and unilateral patterns could develop in the interim. When the patient did receive his practice prosthesis, training was initiated, with limited practice periods in occupational therapy for one hour a day. At first, the amputee wore the practice prosthesis only in the clinic. After he had mastered its operation and could tolerate the socket for longer periods, he was allowed to wear it the entire day. The patient was instructed to remove the prosthesis at night and to use the standard stump-wrapping procedure to control edema. A major problem during the training period was the constant separation of the plaster socket from the leather-laced cuff. Also, the functional alignment and the appearance were anything but desirable (fig. 1). The therapist noted that the patients did not voluntarily wear their practice prostheses outside the supervised clinic environment. It was apparent that a more functional and streamlined type of practice prosthesis was urgently needed.

In February 1969, the chief of orthopedics organized a separate amputee service, and a new training plan was initiated. The successful treatment of lower-extremity amputees by a technique in which a rigid dressing and plaster pylons were applied immediately after surgery lead to the hypothesis that a similar procedure might be beneficial for upper-extremity amputees. A practice prosthesis that consisted of a plaster socket with the terminal device

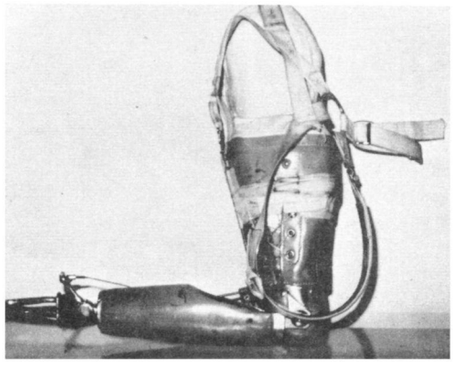

Fig. 1. A leather-laced practice prosthesis with plaster-shell insert.

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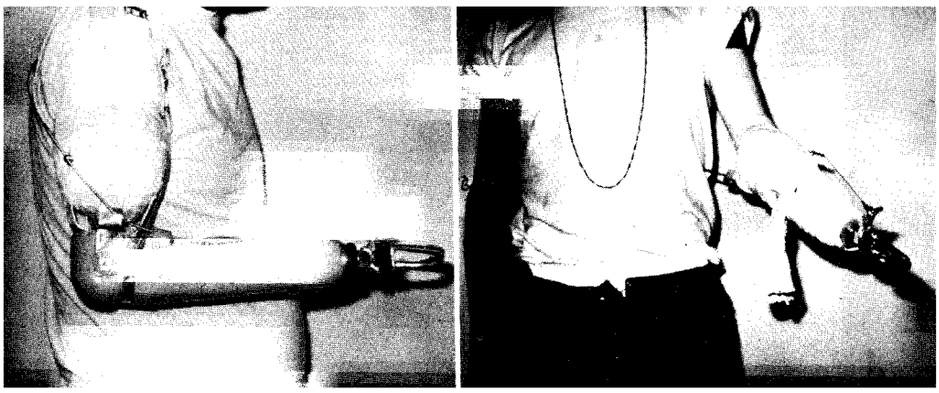

Fig. 2. Adapted above- and below-elbow practice prostheses.

and cable attachments embedded within the outer shell was fabricated (fig. 2). From February 1969 to July 1970, 30 patients were fitted with the device (three amputees could not be fitted, because of transfer, infection, etc.). Their ages were between 19 and 39; the average age was 22 years.

The key to a successful practice prosthesis is a firm, nonconstrictive, well-made socket. Both the above- and below-elbow sockets must be formed firmly and evenly to control swelling and to forestall blisters from developing by movement of the stump within a poorly fitting socket. Fabrication of the plaster-of-paris socket and prosthesis is relatively easy, and the procedure is basically the same for both above- and below-elbow prostheses.

Fig. 3. The first layer of stockinet applied to a below-elbow stump.

For the below-elbow socket, a layer of stockinet is pulled over the stump (fig. 3) and extended two or three inches above the elbow, which allows for a fold and a trim on the proximal end. The distal end of the stockinet is cut and folded smoothly over the stump. Double thicknesses of three-inch plaster roll are thoroughly soaked and placed lengthwise on the stump. An area is left open ventrally to allow room for maximum flexion of the forearm. Circular, non-

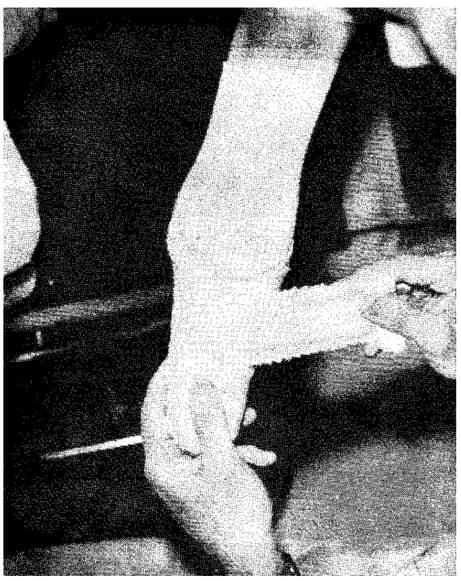

Fig. 4. Application of plaster to the below-elbow stump.

constricting, single-thickness wraps are then applied (fig. 4).

For an above-elbow socket, the stump is completely covered with stockinet. The distal end of the stockinet is cut and folded smoothly over the stump. Double thicknesses of three-inch plaster roll are thoroughly soaked and placed lengthwise on the stump (fig. 5). Each strip is ended three or four inches distal to the axilla to facilitate removal of the piaster socket. Circular, nonconstricting, single-thickness wraps are then applied. The lateral proximal apex is reinforced in order to provide a firm base for attachment of the lateral harness buckle.

Aluminum struts are attached to the prosthetic appliance and plastered into the socket (fig. 6). When the socket is finished, a figure-eight harness with a Northwestern ring is fitted to the patient, and a terminal device is attached to the practice prosthesis. All of the cable, base-plate, and harness connections are adjusted for each patient. Once the connections are attached and in proper alignment, the patient is trained to operate the practice prosthesis (fig. 7). Additional sockets are fabricated if stump shrinkage exceeds the thickness of two single-ply stump socks. This basic prosthesis is used by the patient until he receives his final prosthesis.

Because these prostheses have proved so acceptable to the amputees, a plaster socket is fitted immediately upon the patient's admission. A below-elbow amputee can be fitted and can start to use his prosthesis all in the same day. An above-elbow amputee, if not ready for a practice prosthesis, is

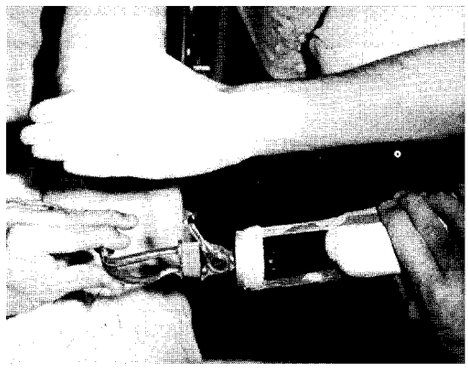

Fig. 6. Affixing aluminum struts and a terminal device to the plaster socket.

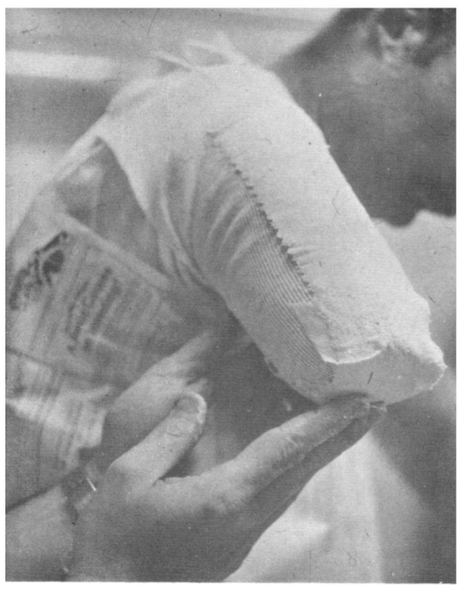

Fig. 5. Plaster being applied over the stockinet.

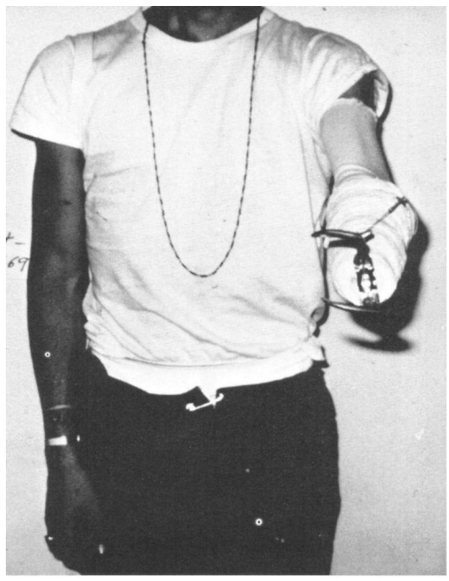

Fig. 7. A below-elbow amputee learns to operate the terminal device on a practice prosthesis.

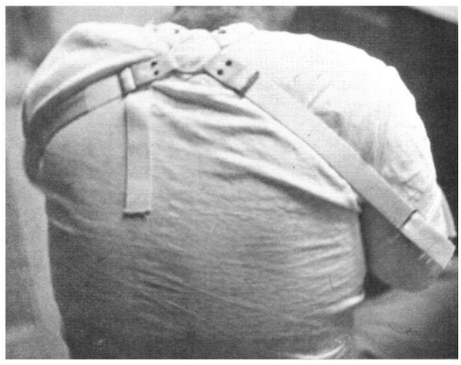

Fig. 8. An above-elbow amputee fitted with a plaster shell with figure-eight harness and Northwestern ring.

fitted with a plaster-shell socket and figure-eight harness (fig. 8). Anterior and posterior elastic straps are attached to the plaster shell to provide an even upward pressure.

The plaster shell replaces the standard elastic wrap and provides an exercise modality for the patient. The protection provided by the hard plaster shell and the nonconstricting but firm pressure against the patient's stump are superior to that provided by an elastic-bandage wrap. An elastic bandage, when wrapped properly, is firm distally and becomes less and less firm proximally. The wrap is thus very unstable, and it readily falls off. The plaster shell provides a more constant pressure, and the elastic straps can be adjusted easily.

Once the patient masters his practice prosthesis, he is assigned to a work-therapy job, which usually is related to his future vocational interest. The ability to use his prosthesis on the job convinces the patient that he can function normally, which is another step in preparing the man for his permanent prosthesis and eventual discharge. If the patient cannot perform a certain function with his prosthesis, a therapist shows him how to solve the problem. The ability to hold grain sacks, handle meat knives, and lift pails are just a few of the everyday tasks that can be taught in work-therapy assignments.

At this point in his rehabilitation, the patient receives a thirty-day leave. It is during this period that the amputee can really give his prosthesis a workout, by wearing it around the house and using it while doing repair work or mechanical tasks. Completely relying on his prosthesis is the best way for him to work out any problems in its operation. He learns what works best for him, and this knowledge is of great value when he is sent to the prosthetist for the fitting of the permanent prosthesis. After the patient receives his permanent prosthesis, he needs no further training; he can operate it with maximum efficiency, and all that is needed is a final check-out. After minor pressure points and alignment problems are adjusted, the patient is ready for discharge.

If necessary, amputees can be fitted while their stumps were still open and in traction. The importance of skin traction cannot be overemphasized; 75 percent of the amputees received for treatment needed some type of skin traction before being fitted.

The skin-traction weight is removed, and the traction ties are folded back over the stump end. Another stockinet is then pulled over the skin traction, and a plaster socket is fabricated over both.

Although at first only the less open stumps were fitted in this manner, the method was so successful that we used it on grossly open stumps, and the fittings were accomplished without difficulty (fig. 9).

Fig. 9. Stump ready for fitting with practice prosthesis and traction still maintained.

Training sessions in occupational therapy with the practice prosthesis are a tremendous boost to the patient's well-being. After the training session, he removes the prosthesis, reties the traction, and attaches the traction weights. As skin coverage and healing improve, skin-traction time becomes less, and practice-prosthesis-wearing time increases.

DISCUSSION

Acceptance of the permanent prosthesis by the 30 patients fitted after February 1969, and their functional use of it, was evaluated. The degree of acceptance and functional use decreased as the level of amputation increased, with positive acceptance of the long below-elbow prosthesis and a gradual rejection of the shoulder-disarticulation prosthesis. Every patient was given and trained with an APRL (Army Prosthetic Research Laboratory) hand. Two of the 30 patients preferred the APRL hand to the hook; both of these had shoulder disarticulations.

The post-February 1969 patients were fitted three to four weeks earlier than the pre-February 1969 patients. Duration of hospitalization remained about the same, but the post-February 1969 patients were on work therapy and were productive three to four weeks earlier.

Ease of fabrication and patients' acceptance of the streamlined practice prosthesis were noted. The patients' stumps tolerated the hard-shell sockets without difficulty.

Early fitting over open stumps and over skin traction is possible. Edema is reduced and the stump is desensitized while the patient uses his prosthesis.

Rehabilitating the upper-extremity amputee to normal activities as soon as possible requires a total team approach. Close coordination among the physicians, nurses, physical therapists, occupational therapists, and prosthetists is necessary. If everyone on the team understands the problems of the upper-extremity amputee, then all can work together in directing and guiding his treatment.

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