

A Physiotherapist's View of the Modular System of Prosthesis

DONNA BJORE, Dip. P.T. (Manitoba),

Senior Therapist, Amputee Service, Manitoba Rehabilitation Hospital, May, 1968, to January, 1971.

HEATHER McLAREN, Dip. P. & O.T., B.P.T. (Manitoba), Certificate in Treatment of Lower Extremity Amputees, New York University. Senior therapist in charge of amputee programme, Toronto East General Hospital, October, 1966, to August, 1968. Enrolled in M.A. (Physiological Psychology) programme, University of Manitoba.

Advances in medicine since World War Two have resulted in an increase in the number of persons who must undergo amputation of the lower extremities as a preventive measure. Progress in prosthetic research has increased the number of amputees who can be considered candidates for artificial limbs. In this paper it is our aim to indicate the advantages to both the therapist and patient that a modular system of prosthetics provides in overcoming some of the problems encountered.

EARLY PROSTHETIC FITTING

The main advantages of the modular system are apparent in the early stages of rehabilitation. Since the early 1960s many centres have begun to use the technique of immediate post-surgical fitting developed initially in France, and publicised by Dr. Marian Weiss in Poland, and Dr. Ernest Burgess in the United States.³ This technique has proved useful for a wide variety of patients. Where this technique is not in use an amputee patient may have a two to three month period of treatment prior to receiving a prosthesis. Usually prosthetic appliances are not introduced until the sutures have been removed and the stump conditioned to receive a prosthesis. A programme of general strengthening exercises, balance training, religious stump bandaging, and ambulation with crutches or a walker is part of the normal post-operative regimen.⁶

With the modular system, prosthetic fitting and gait training can begin once the stitches have been removed. In the initial phase of gait training the above-knee (A/K) amputee is fitted with a prefabricated plastic laminate socket which is available in four sizes. A split down the lateral side and velcro straps allow adjustment to be made as the stump shrinks. The below-knee (B/K) amputee is also fitted with a prefabricated plastic laminate socket, available in 11 left and 11 right graduated sizes. As the stump shrinks the patient is fitted with a smaller prefabricated socket. One or more woollen stump socks are worn with the socket. Distal tissue support is obtained by filling the bottom of the socket with polyethylene tubing. The socket can then be quickly attached to the remaining component parts (see preceding article by Mr. J. Foort).

A result of early application of a limb is that complications as contractures and circulatory embarrassment due to prolonged bed rest are reduced. The early wearing of a prosthesis toughens the stump, maintains or improves muscle tone, strength and function. Stump shrinkage and shaping progress at a faster rate as total stump contact is provided.

Early prosthetic training consists of:

- (1) Transference of body weight from heel to toe and from side to side.
- (2) Correct placement of the artificial foot to assure an even step length.
- (3) Control of the artificial knee joint and transference of weight to the prosthesis using stump extension and anterior pelvic thrust. This applies only to the A/K amputee.

Alignment changes are usually made for two reasons:

- (1) To relieve pressure areas on the end of the stump.
- (2) To improve the heel-toe gait pattern.

The foot position is adjusted using the upper wedge disc alignment unit. All such alterations modify the position of the foot with respect to the knee joint centre, in either the anterior-posterior or medial-lateral directions. The foot angle is adjusted using the lower Wedge-Disc-Alignment Unit.

Alignment Adjustments

- (1) Foot Position (Upper Wedge-Disc-Alignment Unit)

Maximum Thickness	Foot Position
Anterior	Retarded
Posterior	Advanced
Medial	Outset
Lateral	Inset

- (2) Foot Angle (Lower Wedge-Disc-Alignment Unit)

Maximum Thickness	Foot Angle
Anterior	Plantarflexed
Posterior	Dorsiflexed
Medial	Everted
Lateral	Inverted

For any of these alterations the prosthesis is removed and realigned. Subsequently the patient's gait is re-assessed and further changes are made if necessary.

Once the patient has mastered the use of the prosthesis in the parallel bars he is progressed to elbow crutches or a walker, and then to canes, etc. It is important that the patient is placed on the Jobst Peripheral Compression Unit prior to applying the prosthesis to minimize daily fluctuations in stump circumference. The prosthesis should be worn as long as it can be comfortably tolerated, gradually increasing the time period to a full day.

When the modular prosthesis has been fitted and aligned so that the patient is comfortable and his gait is acceptable, he is provided with a removable covering which gives the limb a normal cosmetic appearance, yet allows alignment changes to be made easily. Despite the fact that maximum stump shrinkage has not occurred the patient is ready for discharge. He returns monthly to the amputee clinic for re-assessment and may return at any time should problems arise. At each visit his gait is checked as is the condition of the stump. Alignment changes can be carried out immediately. This is particularly advantageous to the geriatric patient in whom stump shrinkage tends to occur at a slower rate. The patient is functionally independent at home while waiting for his definitive limb.

THE DEFINITIVE LIMB

The procedure for prescribing the final or definitive limb for a patient varies between centres. This is usually delayed until it is certain that the stump has achieved maximum shrinkage, and that only minor adjustments may then be required once the limb has been made. To avoid costly major changes this decision may be delayed for months. When changes must be made the patient normally will leave his limb with the prosthetist for a period of a few hours to a week. This can create hardships for the patient and, if these delays occur frequently, he may become dissatisfied and reluctant to co-operate further.

Using the modular system the only new part for the definitive limb required is the custom fit socket and receptacle which is then used with the existing components of the prefabricated limb. Minor alignment changes are necessary at this time to compensate for the new receptacle. These changes are made by the prosthetist and the patient then possesses a comfortable, cosmetically acceptable, permanent

limb. Furthermore, if alignment or socket changes become necessary these can be made at minimum expense and with minimum loss of time.

PRE-PROSTHETIC EVALUATION OF THE BORDERLINE AMPUTEE

One of the most difficult duties of a physiotherapist working on an amputee team is that of assessing those patients who, for one reason or another, it is felt, may not become successful prosthetic users. These are commonly older patients with advanced peripheral vascular obstructive disease where the remaining limb is in jeopardy, and other medical problems. Despite many attempts, by both physicians and therapists, to develop a set of criteria to use in assessing these patients the therapist is still left to rely mainly on her own judgement. Many patients who have been refused a prosthesis on the ground that they were incapable of walking sufficient distances using crutches, or that they were unable to master the use of crutches at all, could quite possibly have used a prosthesis successfully.^{1,2,4,7} The inability to manage with crutches is not sufficient basis against which to judge their prosthetic ability. It is known that the energy expenditure during crutch walking exceeds that necessary to successfully walk on a prosthesis.⁵ The addition of another support point can certainly improve their standing balance. From a medical standpoint, the use of a limb helps to minimize the amount of strain to which the remaining leg is subjected and lightens the load on the cardiovascular system. Psychologically, the benefits of having a prosthesis are obvious. In the older patient it can mean the difference between independence and being a "plus-one" person at a time when he is struggling to maintain his independence.

The modular system allows the amputee team to evaluate these patients individually without putting the patient or social agency to great expense. Use of a prefabricated socket attached to the other components allows the patient to be given a two to three week trial period of prosthetic training. Should it prove that the patient is incapable of managing a prosthesis the team has obtained a decision based on more than subjective judgement. This decision is easier for the patient to accept as he has been given adequate opportunity to demonstrate his ability.

THE ADVANTAGES OF THE MODULAR PROSTHETIC SYSTEM TO THE THERAPIST

Although the main advantages are to be seen as they relate to the patient, there are also important advantages for the therapist. The therapist is provided with an objective means of assessing a potential prosthetic user without undue expense.

Therapists trained in the use of this system are capable of making the alignment changes in the department. In centres where the modular system is not in use the therapist must rely on the prosthetist to make alignment changes. Unless there is a prosthetist in the centre arrangements must be made for the prosthetist to attend the centre, or the patient to visit his shop. This may result in loss of treatment time for the patient and, when the therapist is required to accompany the patient, loss of the therapist's time in addition. In a centre with an active amputee population, this can seriously cut into the time available for productive treatment and will thus unavoidably prolong the average rehabilitation period.

Equipment

Provided there is a Prosthetic Department in the hospital to store the various sizes of prefabricated sockets, tubing and SACH feet, etc., very little space and equipment is needed in the Physiotherapy Department in order to make alignment changes. The equipment required is as follows: various lengths of aluminium tubing, screwdriver, allen wrench, aligning screws, polyethylene tubing and an open end wrench.

Therapist Training

The training necessary for therapists working with the modular system consists of a sound knowledge of the biomechanics of normal gait, the variations in biomechanics imposed by a prosthesis, familiarity with the Wedge-Disc-Alignment Units, and the principles upon which they operate. In this area, as in any specialized area of physiotherapy, training and practical experience will permit a therapist to carry out an efficient and successful treatment programme.

SUMMARY

The modular system of prosthetics as outlined by Mr. J. Foort has been discussed from a physiotherapist's point of view. The main advantages of this system as opposed to a conventional system are noted with respect to both the therapist and the patient. The effectiveness of early prosthetic fitting in the geriatric amputee is emphasised. This system provides the treatment team with an objective means of quickly assessing the patient's ability to become a successful prosthetic user. Therapists trained in the use of modular system can perform required alignment changes with ease, in the department.

BIBLIOGRAPHY

1. Anderson, A. D., Cummings, V., Levine, S. L., and Kraus, A. The Use of Lower Extremity Prosthetic Limbs by Elderly Patients. *Archives of Physical Medicine and Rehabilitation*, 1967, Vol. 48, No. 10, 533-538.
2. Burgess, E. Immediate Postsurgical Prosthetics in the Management of Lower Extremity Amputees. Veterans Administration, Washington, D.C., 1967.
3. Committee on Prosthetic-Orthotic Education. The Geriatric Amputee. National Academy of Sciences, Washington, D.C., 1971.
4. Davis, W. C., Blanchard, R. S., and Jackson, F. C. Rehabilitation of the Geriatric Amputee: A Plea for Moderation. *Archives of Physical Medicine and Rehabilitation*, 1967, Vol. 48, No. 1, 31-36.
5. Klopsteg, P. E., and Wilson, P. D. (eds.). Human Limbs and their Substitutes. McGraw-Hill Book Co. Inc., New York, N.Y., 1954.
6. Koerner, I. The Gait of the Amputee. *Journal of the Canadian Physiotherapy Association*, 1967, Vol. 19, No. 5, 321-329.
7. Kohn, K. H., and Gordon, E. E. Functional Rating Scales for Lower Extremity Amputees. *Archives of Physical Medicine and Rehabilitation*, 1965, Vol. 46, No. 6, 427-432.

EXPANDING HORIZONS OF PHYSICAL THERAPY

YOU ARE INVITED TO ATTEND THE SEVENTH INTERNATIONAL CONGRESS OF THE WORLD CONFEDERATION FOR PHYSICAL THERAPY, TO BE HELD IN MONTREAL, CANADA, JUNE 16-23, 1974.

WORLD CONFEDERATION FOR PHYSICAL THERAPY

P.O. Box # 6374, Station "A", Toronto 116, Ontario, Canada.