PROCEEDINGS OF THE 1966 ASSEMBLY OF THE AMERICAN ORTHOTIC AND PROSTHETIC ASSOCIATION

This issue of the Journal includes three papers delivered at the 1966 Assembly in Palm Springs, California:

1. Immediate Post-Surgical Prosthetics, by Ernest M. Burgess, M.D., and Joseph H. Zettl, C.P.
2. Upper Extremity Orthotics: A Project Report, by Thorkild J. Engen, C.O., and Louis F. Ottnat, C.O.
3. Plastisol Coatings and Application Techniques, by David H. Harden, and Richard D. Koch.

Immediate Post-Surgical Prosthetics

by ERNEST M. BURGESS, M.D.,
Principal Investigator
and
by JOSEPH H. ZETTL, C.P.
Associate Director

Presented at the 1966 AOPA Assembly, Palm Springs, California

GENERAL CONCEPTS

The fitting of lower extremity amputees with a temporary prosthesis immediately following surgery constitutes a dramatic departure from conventional amputation surgery and management. The closed wound of an amputation can be subjected to firm, even, controlled pressures by use of a rigid dressing, carefully applied with relief for bony prominences and by avoiding proximal restriction. With this immediate post-surgical dressing properly applied and contoured, it is feasible to incorporate into it a light, adjustable temporary prosthesis and foot. General condition permitting, the amputee can bear controlled weight the day following surgery and ambulate with minimal weight bearing a day or two thereafter. Continued increases in weight bearing in both stance and gait phase are feasible and desirable throughout the wound healing period to the fitting of the definitive prosthesis. Immediate post-surgical prosthetic management of the amputee provides a number of benefits not obtained by conventional amputation surgery and prosthetic management. The technic provides:

1. Accelerated wound healing and stump maturation.
2. Decrease of post-operative pain (often only mild opiates and sedatives required.)
3. Absence of post-operative edema.
4. Marked reduction in phantom pain.
5. Earlier weight bearing (first post-operative day, general condition of patient permitting.)
6. Earlier ambulation (second or third post-operative day, general condition of patient permitting.)

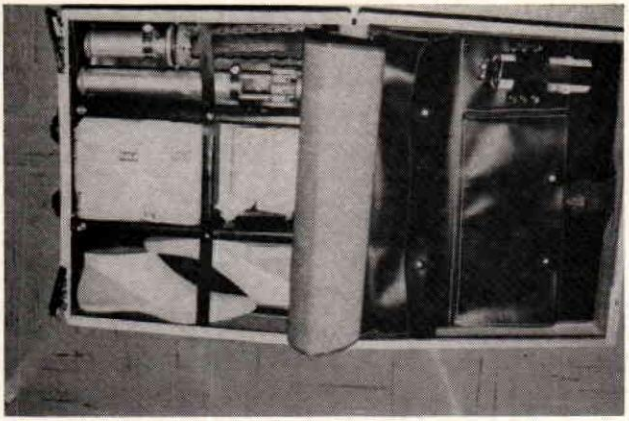

Figure 1—Prosthetic kit including AK & BK pylons, SACH feet, elastic plaster bandage, and AK suspension belt. On the right, adhesive spray, and compartments for felt strips, stump socks, and BK waist belt.

7. Shorter hospital confinement of the patient (average discharge between ten to twelve days.)
8. Earlier fitting with a definitive prosthesis (average 28 days post-operatively.)
9. A more stable stump (reduced changes due to muscle atrophy especially if tension myodesis was performed in surgery.)
10. An improved general physical condition of the patient due to reduced bed confinement.

Successful immediate post-surgical prosthetic fitting and ambulation also provides psychological and financial benefits and make the technic, whenever possible, the one of choice. The technic can be applied to any level of lower extremity amputation, and with proper attention to the details of the technic, extremely gratifying results can be obtained.

CASE SELECTION

The technic of immediate post-surgical fitting of lower extremity amputees is by no means restricted to selected cases of a particular category of disability or age group. Except for severe burns, the technic can be used successfully even if the patient is for some reason temporarily non-ambulatory. In this study to date, well over 100 cases have been treated in this manner and include the following amputation levels: Chopart, Syme, below knee, knee disarticulation, above knee, and hip disarticulation. No hemipelvectomy or upper extremity amputations have been carried out using this method. The patients' ages ranged from 3 to 86 years and covered practically the entire scope of standard lower extremity amputation surgery. The majority have been vascular amputees, many with gangrene and diabetic conditions.

SURGICAL AND PROSTHETIC EVALUATION

Whenever possible, it is standard procedure for the surgeon and prosthetist to evaluate the patient one day or more prior to surgery. At this time, a level selection is in order. In cases showing a poor circulatory status of the extremity, arteriography, oscillometry, plethysmography and

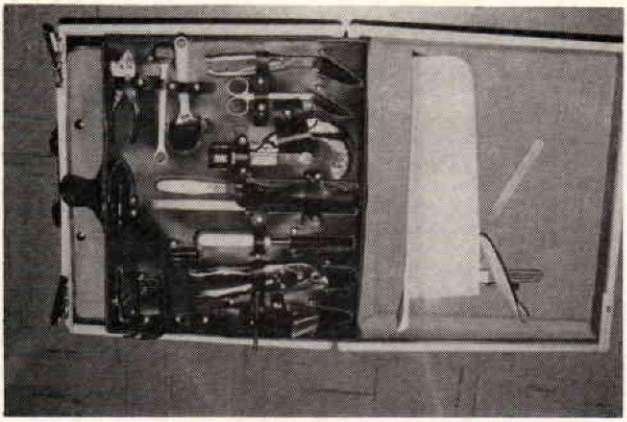

Figure 2—Prosthetic kit including required tools and PRS above knee casting fixture.

skin temperature readings will aid in level selection. However, it may be necessary to make the final decision at the time of surgery. Absence of a popliteal pulse is by no means a final indication for amputation at an above knee level. Satisfactory results have been obtained in below knee amputations without demonstrated blood flow through the popliteal artery, providing collateral blood supply was present to the skin flaps.

The procedure and the technics are fully explained to the patient to make him aware of his role and to insure his cooperation. It is good practice at this time for the prosthetist to secure a shoe from the patient, to note any contractures that may be present, and to take a waist measurement for the preparation of the suspension belt. This will insure the prosthetist to have the proper and fitting parts ready in surgery and to avoid any unnecessary confusion or delay. It is extremely valuable to have a complete assembled kit ready at all times, for just this purpose. (Fig. No. 1 & 2)

SURGICAL PROCEDURE

In surgery the departure from conventional amputation surgery whenever possible is in the form of the so-called tension myodesis. After the tibia is divided and beveled anteriorly, the periosteum is stripped back approximately 3/8″ and a series of small drill holes are placed through the distal end of the tibia. The major opposing muscle groups, i.e., the ankle dorsiflexors and plantar flexors in below knee amputations, and the flexor extensor and adductor muscle groups in above knee amputations, are sutured under tension to the bone near its terminal end. This retention of the musculature, in its functional position and being subject to voluntary control, avoids excessive stump shrinkage, and decreases stump and phantom pain. It also provides an improved circulatory status of the stump with a proprioceptive feedback sensation due to a more intimate prosthetic fit. Tension myodesis results in a cylindrically shaped stump capable of contracting powerfully during gait, resulting in a more stable relationship between prosthesis and amputee stump.

Contraindictions for tension myodesis are few, but it should be noted that in a severe vascular involvement, the additional trauma of the technic might jeopardize the success of the amputation. However, it is still advantageous to use the benefits of the immediate post-surgical prosthesis even if conventional surgical procedure is selected.

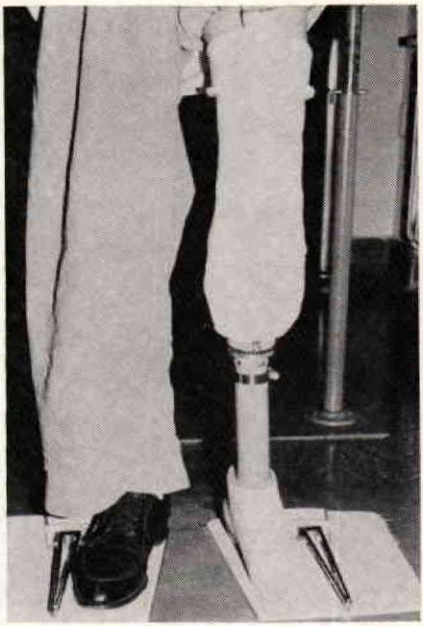

Figure 3—BK cast socket with adjustable wedge disk pylon and SACH foot.

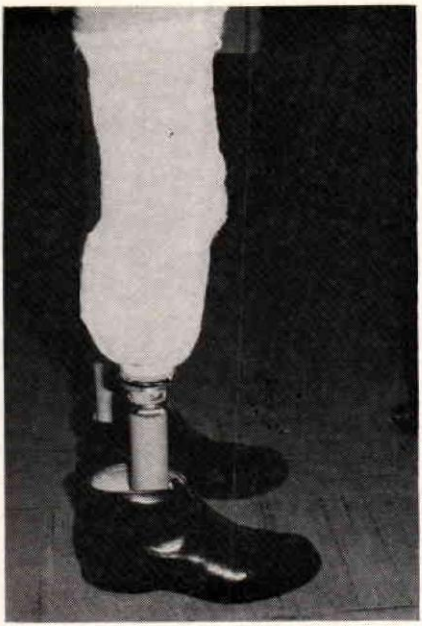

Figure 4—Lateral view of BK cast socket.

The wound is closed with interrupted sutures without excessive tension to the skin. A Penrose or suction drain is used in all cases to avoid the possibility of hematoma. The wound and sutures are then covered with a nonadherent Owens gauze dressing. Lambs wool or fully fluffed gauze is placed over the distal stump end and a special three ply Orlon/Lycra stump stocking of a corresponding size is gently rolled over the entire dressing and held in place with firm proximal pull to provide even, firm, but gentle pressure over the entire distal aspect of the stump and amputation site. The stump is now ready for the application of the cast-socket.

THE CAST-SOCKET

It is of utmost importance that the stump sock is suspended throughout the entire casting procedure to achieve adequate, continuous pressure relationships between the wound and the post-operative dressing. Felt strips 1½" wide, ⅜" thick, skived and beveled, are placed along both sides of the tibial crest and with the medial felt strip extending posteriorly to fit into the flare of the medial tibial condyle. An additional skived felt piece corresponding to the shape of the patella is fashioned, and all pieces glued in place with Dow Corning adhesive spray. The stump, held in 10° of flexion, is now wrapped beginning distally with firm controlled pressure and wrapping proximally to midthigh with decreasing tension to avoid proximal restriction. Elastic plaster of Paris is recommended because of its inherent quality to control desired tension, and its ability to conform to stump contours without tugging. Because of structural weakness, the elastic plaster must be reinforced with conventional plaster of Paris incorporating a 1½" safety buckle proximally to be used to suspend the cast-socket to the waist belt. Before the plaster wrap has hardened it is compressed slightly with

Figure 5—Syme cast socket with adjustable wedge disk pylon and SACH foot.

both hands proximal to the femoral condyles to provide additional cast suspension. A waist belt is applied to the patient and connected to the safety buckle on the cast. The prosthetic unit to be used is aligned in neutral position on the cast and attached with an additional roll of plaster of Paris. To allow for dynamic alignment changes, the unit selected should be adjustable in all planes. Next, the pylon is cut to the corresponding length of the sound extremity, the foot is attached, and the entire completed unit disconnected from the attachment plate. At this time the felt piece placed over the patella is cut out of the cast-socket and removed. This insures against possible abrasions and aids in determining if excessive piston action occurs during gait as a result of a loose cast.

In Syme and forefoot amputations, the knee joint is not included in the cast.

Due to the anatomical circumstances, of course, no felt reliefs are required in knee disarticulations and above knee casting procedures. However, after the initial wrap is completed, with the plaster of Paris still wet, the PRS developed casting fixture is applied to the stump to give the plaster socket a quadrilateral shape. Again, extreme care must be exercised to avoid proximal restriction. Since the previously used hip spica for cast suspension showed definite disadvantages, a suspension method was developed which allows the patient relative freedom of movement with increased comfort. The suspension consists of a 5″ wide webbing belt with a felt apron, and is attached to the socket by means of Bowden cables traveling through a housing incorporated into the cast. This arrangement suspends the cast-socket equally well regardless if the patient is supine or in a sitting position. The above knee unit for immediate post-surgical prostheses should incorporate the same features as the below knee and in addition include a manual knee locking mechanism with an adjustable friction device.

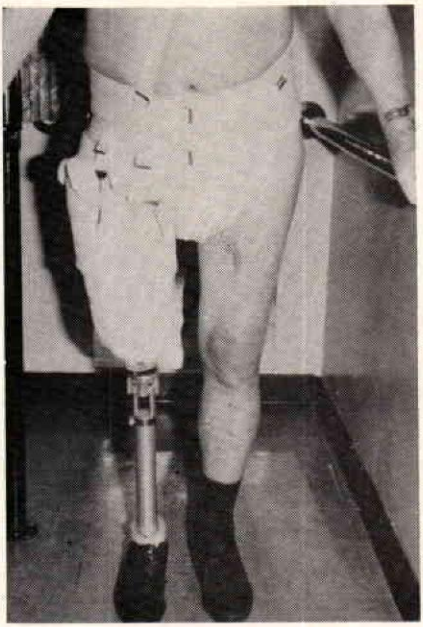

Figure 6—AK cast socket with adjustable wedge disk pylon, manual locking knee with adjustable friction. PRS Above Knee suspension system.

Figure 7—Same as Figure 6 as applied to knee disarticulation.

POST-SURGICAL AMBULATION AND MANAGEMENT

Circumstances and general physical condition permitting, it is standard practice to have the patient stand for a short period of time the day following surgery. At this time any necessary alignment changes will be corrected and attended to by the prosthetist. It is not unusual for the patient to experience relative freedom from pain, requiring little more than a mild medication for relief. The standing activity is attended and supervised by the physical therapist who will be in charge of the patient's post-operative course under the supervision of the attending surgeon. Progressively increasing weight bearing activities are continued twice daily for the next two or three days depending on the patient's motivation and general physical condition.

On the second post-operative day the drain is removed by cutting a window into the cast. The window is repacked with sterile fluff gauze and wrapped in place with a few layers of plaster of Paris.

Ambulation is initiated and increased progressively twice daily depending again on the patient's tolerance and motivation. However, actual weight applied at this time should not exceed 30 pounds. Because the technic and post-operative management usually provide a remarkable degree of post-surgical comfort, it is sometimes difficult to limit ambulation activities in patients, particularly in children. It is therefore extremely important that ambulation be supervised by a qualified physical therapist and practiced in accordance with pre-established instructions. The patient should ambulate between parallel bars with a gradual increase in duration and weight applied. Prosthetic alignment must be checked frequently and corrected if necessary in accordance with accepted biomechanical principles. Improper

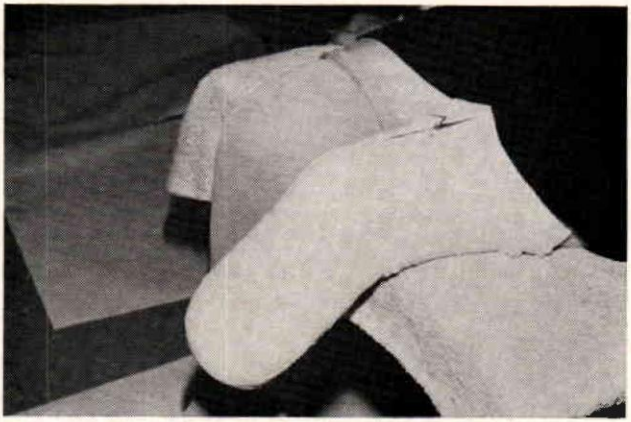

Figure 8—Rigid stump protector.

alignment will result in poor and painful gait and cause eventual damage to the tissues.

Unless clinical findings dictate otherwise, the initial cast change is usually between 10 to 14 days depending on the patient's age and general disability. In most instances, the sutures are removed at this time and the stump is recast in the same manner as previously. The day following the initial cast change, progressive ambulation activities are continued with the prosthetist present to reestablish dynamic alignment of the prosthesis. The patient can now proceed to crutch walking. However, at no time should the patient be allowed to ambulate without the prosthetic extension in place. The danger of the cast sliding distally will destroy the effectiveness of the entire concept of proper continuous pressure relationships, edema will develop, blistering can occur and with it, loss of the value of the entire technic.

The second cast-socket is generally left in place for an additional week to ten days. In most instances it is then possible to take the cast and measurements for the definitive prosthesis. The stump is rewrapped in a short removable plaster cast allowing knee motion and is to be worn whenever the definitive prosthesis is removed. This procedure will control possible stump changes until full stump maturation is achieved. It also guards against improper use of tensor bandages or stump shrinkers. (Fig. No. 8 Rigid stump protector)

It is absolutely necessary to fit and deliver the definitive prosthesis to the patient within a few days after the final cast change so as not to interrupt his ambulation, and to quickly complete his full rehabilitation cycle.

SUMMARY AND CONCLUSIONS

Immediate post-surgical prosthetic fitting of lower extremity amputees provides many definite improvements and benefits over conventional amputation surgery and management. With the ever increasing number of amputees, many can partake in the advantages the technic provides, with minimal disability time and financial hardship to the individual. The method can be adopted and used successfully at any modern medical center, providing meticulous attention is given to the details in the application of the technic. A thorough understanding of each team member, the surgeon,

prosthetist, and physical therapist, as to what is to be accomplished is of essence, but should provide final, gratifying results inherent in this method.

In closing, a word of caution: While the technic in its present stage as outlined above, is mature and sufficiently standardized to be used successfully by others, no attempt is made here to teach it or encourage its use. This is a report only on the current technic of immediate post-surgical prosthetic fitting and should be considered as such.

For clarification, the technic described here represents the current practices of the research team of the Prosthetics Research Study in Seattle, Washington, Ernest M. Burgess, M.D., Principal Investigator.

The work is conducted under Veterans Administration Contract No. V5261P-396.

Upper Extremity Orthotics: A Project Report †

by THORKILD J. ENGEN, C.O.*, LOUIS F. OTTNAT, C.O.**

Houston, Texas

The Department of Orthotics of the Texas Institute for Rehabilitation and Research (TIRR), in affiliation with the Baylor University College of Medicine, has conducted a clinical research program over the past four years to develop upper extremity orthotic systems that meet the complex requirements of simplicity, functional efficiency, and cosmetic acceptability. Existing components have been modified or redesigned and new components have been created in the process of developing individualized systems to meet a variety of patient needs. This paper will summarize improvements and innovations that have come about during the project period.

Engen Plastic Hand Orthosis

A promising achievement has been the development of a systematic method of hand splinting. A plastic hand orthosis, first described in 1959,[1] has been further developed and clinically evaluated during the project. It is

† Based upon a paper presented at the National Orthotic and Prosthetic Assembly, October 16-20, 1966, Palm Springs, California. The project was supported in part by Vocational Rehabilitation Administration Grant RD-1564. The facilities of the General Clinical Research Center for Chronic Illness were used in part for this project. The Center is supported by PHS Grant FROO-129 and Grant RT4 from V.R.A.

* Project Director; Director of Department of Orthotics, Texas Institute for Rehabilitation and Research; Assistant Professor, Department of Rehabilitation, Baylor University College of Medicine.

** Research Assistant and Orthotic Shop Supervisor, Texas Institute for Rehabilitation and Research.