

ANNUAL REPORT

PROSTHETICS RESEARCH STUDY^a

July 1, 1965–June 30, 1966

Ernest M. Burgess, M.D., Principal Investigator

1102 Columbia, Room 409
Seattle, Washington 98104

Because of widespread interest in the application of an "Immediate Postsurgical Prosthesis," and the work performed by the Prosthetics Research Study group in developing, demonstrating, and training others in this technique, the following report is presented.^{*}

The Editors

ACTIVITIES

Immediate Postsurgical Protheses

Throughout the period covered by this report, the activities of the Prosthetics Research Study in Immediate Postsurgical Protheses have been restricted primarily to the training of physician-prosthetist teams from various centers throughout the United States, demonstration of our technique in Seattle to various interested professional personnel throughout the world, and the preparation of educational materials (a manual and a motion picture) for use in any general educational program which might be undertaken. In order to accomplish the above and to increase our own experience with the technique developed, an additional forty-one cases of lower-extremity amputations have been treated in this center using the method outlined in our report of May 1, 1964 through September 30, 1965.^b

The training program for physician-prosthetist teams was established as part of a field study to determine as quickly as possible whether or not the technique of Immediate Postsurgical Protheses as developed in this center, would in fact be used successfully in other widely separated centers. The preliminary results of this field study have proven to be extremely gratify-

^{*}Based on work performed under VA Contract V5261P-374.

^bPublished in BPR 10-4 Fall 1965, pp. 42-51.

ing when the technique is used exactly as taught. To date, approximately 100 cases of lower-extremity amputations have been completed and informally reported to us by three other centers.

In every instance, any difficulty encountered with the use of Immediate Postsurgical Fitting program was determined to be technical in nature; i.e., usually in cases where the wound has failed to heal, it has been stated that the level selected for amputation was too distal and the circulatory status of the tissues involved was inadequate to support healing. No problems of wound infection or skin maceration have been reported. Occasional minor problems over areas of bony prominences have been attributed to improper pressures exerted in these areas by the cast socket; these have been determined to be a result of improper felt pad placement and not excessive wrapping pressure. The areas over the patella in below-knee amputations and the iliac crests in above-knee amputations have given the most difficulty. In one instance, it was reported that a chemical reaction to the surgical preparatory material (iodine) was encountered. The resulting severe blistering of the skin at the 10th postsurgical day when the initial cast socket was removed, required that the rigid dressing be withheld.

Increasing interest in our technique throughout the world, but especially in the United States, has prompted us to prepare a thirty-four minute, 16-mm. color-sound motion picture titled, "Immediate Postsurgical Prostheses." The movie demonstrates dramatically the results obtained on some of our cases with a description of the technique of Immediate Postsurgical Prostheses program as we have developed it. However, this is not a how-to-do-it film as time would not permit inclusion of the necessary technical detail both surgically and prosthetically.

Because of the interest generated through presentations at professional meetings, professional and general publications, etc., the University Council on Orthotics and Prosthetics Education (UCOPE) asked that a teaching manual be prepared for possible use in the Prosthetics/Orthotics schools during the school year 1966-67. Accordingly, with the assistance of Mr. A. Bennett Wilson, Jr., Executive Director of the Committee on Prosthetics Research and Development, National Academy of Sciences—National Research Council, a preliminary draft of this document has been duplicated and distributed for trial among the schools and other cooperating centers. A special meeting of UCOPE and the representatives of other cooperating centers in the United States has been scheduled for mid July, 1966^c to review the manual and decide on a course of action for including Immediate Postsurgical Prostheses in the curriculums for this coming year.

^cDr. Burgess and other expected participants were unable to attend the meeting because of an airlines strike. As a result, several unresolved matters were postponed for a future meeting.

RELATED ACTIVITIES

Pylons

Work has continued on the development of improved commercially acceptable adjustable pylons for both above- and below-knee prostheses to be used either as temporary or permanent units. We have concentrated our efforts toward improvement on the commercially available below-knee adjustable pylon device now offered by the United States Manufacturing Company of Glendale, California. This is because, in our opinion, the U.S. Manufacturing Co. pylon offers the following advantages over competing units: light weight, good strength, universal adjustability at the distal socket, clean efficient disconnect at socket, easy length adjustment (can be used with less space between socket and foot than any other unit now available), adaptable for cosmesis with suitable cosmetic covering, and comparatively low cost.

As a result of working closely with the inventor of the adjustable mechanism (wedge-disks), Mr. A. Bennett Wilson, Jr. and the manufacturer, some of the difficulties with the unit that were originally encountered in the use of this device have been lessened or eliminated. Resistance to horizontal rotational torque has been increased with the addition of leather shims between the disks. Soft aluminum socket attachment straps have been replaced with lightweight expanded stainless steel, to reduce breakage. One quarter in. projections have been included on each disk to provide for easier tilt adjustment. A larger oval-shaped foot attachment plug welded to the pylon tube distally has been added to distribute the load more evenly over the top of the SACH foot and reduce loosening of the foot and breakage of the bolt. Future planned refinements include redesign of the base plug to allow loosening and tightening of the center bolt efficiently while the patient is standing, and reduction in the outside diameter of the pylon tube to 1¼ in. to allow for easier, more acceptable cosmetic covering and reduced weight.

We have also been working with the U.S. Manufacturing Co. in the development of an above-knee adjustable pylon. Although this unit is still in its prototype state, results in limited use (three applications) have been very encouraging. The alignment and disconnect systems used in the above-knee pylon are identical to those used in the below-knee pylon. The knee mechanism incorporates a simple constant friction device with a manually operated knee lock.

Air Cushion Sockets

For the past ten months, our laboratory has been participating with other centers in the country in the evaluation of the below-knee P.T.B. Air Cushion Socket as developed at the Biomechanics Laboratory of the University of California in San Francisco.

During this time, we have fitted 18 of these prostheses. Although all the patients fitted were very comfortable initially, eventually shrinkage of soft tissue in 14 of the cases resulted in poor fit and discomfort. Because of the nature of the materials and construction of the Air Cushion Socket, it is impossible to accommodate the change in stump volume, and all 14 sockets had to be discarded. Eight of these 14 were refitted with new Air Cushion Sockets. Additional shrinkage in six of these patients made the third socket necessary within two months following the second fitting. In all, six patients are still wearing Air Cushion Sockets comfortably, four with original sockets and two with second sockets.

We are continuing in the evaluation of this type of prosthesis, but in our opinion now, further work needs to be done on the construction in order to allow the prosthetist an opportunity to accommodate for any change in stump volume. Because the cost to the prosthetist in fabrication of the Air Cushion Socket considering both time and money may be multiplied by three, it must produce consistently better results over a longer period of time to be of value in general use.

Orlon Spandex Stump Stockings

Early in our study of Immediate Postsurgical Prostheses it became apparent that the conventional 5-ply-wool stump stocking commonly used with prostheses and recommended by some for use as a stump covering before casting, left a lot to be desired. First of all, with some sterilization techniques, the wool fibers would shrink dramatically. Secondly, it was necessary to have three or four sterile stump stockings of various sizes available in the operating room, because it was impossible to determine the actual size necessary prior to surgery. This, of course, was very expensive and often wasteful. Third, even when a sock was of the correct size the stretch characteristics were such that uneven pressures were directed to the distal tissues. There was a great deal more pressure directed to the corners of the stump than to the center of the stump end. This inequality of pressure resulted in a prolonged healing time in the central wound area (14 to 18 days) while the wound ends healed quite rapidly (8 to 10 days). As a result of these observations, it was decided that a stump sock with better stretch and contouring capabilities was needed.

Accordingly, we contacted The Knit-Rite Company of Kansas City, Missouri and asked if such a stump stocking could be made. They thought it could and proceeded to investigate the matter using an Orlon/Lycra fiber. The result was a 3-ply-weight stump stocking of 95.24 percent Orlon Acrylic and 4.75 percent Lycra Spandex which had all the desired characteristics. Stretch and contouring were excellent without elastic constriction. For the past 10 months, we have been using these Orlon/Lycra stump stockings in two sizes, which simplifies storage and dramatically reduces

the necessary inventory. The sizes used are above-knee 18-in. long, 8-in. top, 6-in. modified box toe; and below-knee 18-in. long, 6-in. top, 5-in. modified box toe. These socks are gas sterilized for six hours at 300 deg. and individually packaged for use when needed. We have yet to find a patient we could not use these socks on and this includes all levels of amputation from Chopart and Syme to short above-knee in small 35-lb. children and 225-lb. adults. Since routinely using these stump socks, all wounds are healing uniformly and without delay.

Instrumented Below Knee Pylon

Throughout our experience in Immediate Postsurgical Prostheses, we had attempted to determine the increments of weight bearing on the immediate prostheses by having the patient stand between parallel bars or a stationary walker on a double set of bathroom scales with one foot on each scale. The patient was asked to apply only as much weight on the prosthesis as was comfortable and the reading on each scale was recorded. This recording of weight applied to the prosthesis was, of course, static and there was no way to determine weight applied dynamically (while ambulating). Also, following necessary alignment changes and a repeat weight measurement, we found that more weight could be applied to the prosthesis comfortably than before the change. This, of course, we realized related directly to the kind and magnitude of multiple forces directed through the prosthesis to the stump.

The problem of measuring forces directed to the stump through the prosthesis in a dynamic situation was presented to the Bioengineering Research Division of the VA Prosthetics Center in New York City. Under the direction of Mr. Anthony Staros and Dr. Edward Peizer of the VA Prosthetics Center, an instrumented pylon device was developed to measure five forces directed through the prosthesis to the stump, including vertical load, medial-lateral shear, knee-flexion moment, knee-extension moment, and anterior-posterior shear.

During the week of May 2, 1966, Dr. Peizer and Mr. Carl Mason of his staff, came to Seattle to assist us with the use of this device in the collection of data. A below-knee amputation was performed for post-trauma complications on a 30-year-old adult male, otherwise healthy. The instrumented pylon (adapted for use with the U.S. Manufacturing Co. below-knee unit) was attached the next day and recordings were made during each session for the remainder of the week. Recordings were taken both statically and dynamically and after each alignment change at every session. The data were taken back to the VA Prosthetics Center. Although a full analysis has not been completed as yet, the preliminary findings are very encouraging. This work will continue.