Developmental Research in a Private Facility

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Editor's Note: The following article is presented as an example of how research may be carried out and its findings reported by a private facility. Mr. Traub's article provides enough data for other prosthetists to study the case for development of their own hypotheses, as well as using its principles in the management of similar problems.

CASE REPORT—LEFT ABOVE KNEE AMPUTEE—POST POLIO

35 year old white male, married and the father of seven children ranging in age from 2 through 16 years. Family living on welfare as a result of the inability of the father to work following the amputation of his left leg above the knee.

This patient was born in Texas, and states that he was completely normal at birth. At the age of five he was stricken with infantile paralysis and confined to a respirator for the period of one month during the acute phase of the disease. Following this he was gradually able to regain the use of the greater part of his body, residual paralysis affecting only his left leg and hand.

The involvement in his lower extremity was so marked as to require an ischial-bearing long leg brace with pelvic band for any ambulation. The patient was fitted with a brace of this type and was able to use it successfully. In later years, with additional growth of the rest of his body, the affected extremity had a 2 inch shortening, 45 degrees equinus of the foot with a marked varus. Special shoes were fabricated to accommodate these deformities which naturally made the brace much more cumbersome and difficult to use.

During the summer of 1955, the patient moved his family to California, where he was employed as a service station attendant. With increased age and activity it gradually became more difficult to be comfortable and perform adequately with the brace. On the advice of his physician, feeling that he could perform more adequately on a prosthesis, a supracondylar amputation of the left leg was performed, leaving a 12½ inch stump with excellent surgical characteristics. (See Figure Ia & Ib)

The patient referred himself to a private certified prosthetist for prosthetic help after two years of repeated disappointments. After careful evaluation of his prosthetic problems, and consultation with Charles O. Bechtol, M.D., of the U.C.L.A. Division of Orthopedic Surgery, it was decided to prescribe a completely new prosthesis, incorporating certain principles of fitting and selected component parts to offset the physical difficulties encountered. The physical difficulties, the fitting, and the prescription of component parts will be discussed in detail later in this report.

Since the fitting of any prosthesis to this patient was a calculated risk at best, and the condition of his finances as previously mentioned was not good, it was decided to fabricate and fit this prosthesis as a private facility research project.

Initial Evaluation

When first evaluated, the patient showed the following: *Complete absence of any active hip or stump musculature, with the exception of what could be classified as a fair-plus Psoas Major.* Severe atrophy of all the hip and stump musculature and sub-cutaneous tissue, and a marked differential between the sound and amputated side in growth of ilium and femurs.

Again, it must be stressed that this patient could exhibit no active range

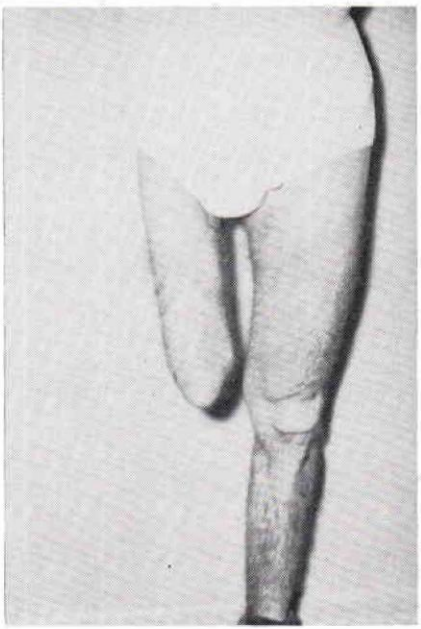

Figure Ia

Figure Ib

of motion in abduction, adduction, or extension, and had only a fair-plus hip flexion grading. In addition, the absence of any extension power in conjunction with the fair-plus Psoas Major, had produced a flexion contracture of approximately 15 degrees. (See Figure II.)

The vital statistics of this amputation stump were as follows:

1) A.P. Dimension at ischial level 2½ inches
2) Circumference measurements
   0″ — 12½″
   2″ — 11½″
   4″ — 10⅞″
   6″ — 10½″
   8″ — 10″
   10″ — 8″
   12″ — 7¼″
3) Stump length—12½ inches.
4) Hip extension—15 degrees anterior to midline.
5) Hip adduction—3 degrees.
6) Ischium, extremely pressure-sensitive.
7) Very little, if any, subcutaneous tissue.
8) Rectus Femoris-Adductor Longus relationship—Flat.
9) Greater Trochanter position—Posterior.
10) Almost non-existent Gluteous Maximus bulk.

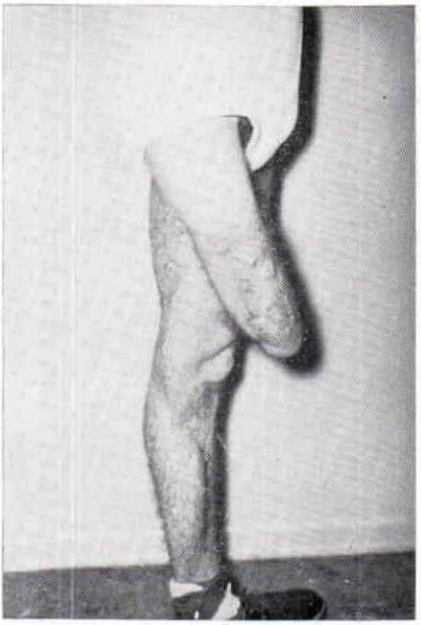

Figure II

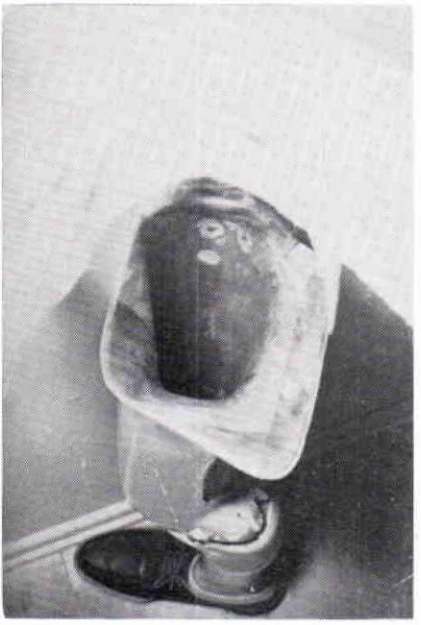

Figure III

With the above statistics at hand, the prosthetic prescription was as follows:

"Left above knee prosthesis for long supracondylar amputation of paralytic hip and thigh stump. Combination suction socket and single axis pelvic joint suspension. Quadrilateral socket, with extreme caution advised in fitting M-L, friction lock knee with knee extension control regulator. Single axis ankle joint, wood foot with toe joint."

Socket Plan

a) Top circumference of pattern	11½ inches
b) Bottom circumference of pattern	6½ inches
c) A-P of top pattern	2 inches
d) M-L of top pattern	3¾ inches
e) Initial flexion of socket (Planned reduction to assist flexion of hip at toe-off)	8 degrees
f) Adduction of lateral wall	3 degrees

Initial Fitting — Inside Perimeters of Socket

Perimeter Stump	Initial Shaping	Final Shaping	Socket Tension
0″ — 12½″	11½″	11¾″	¾ inch under
2″ — 11½″	11″	11″	½ inch under
4″ — 10⅞″	10¼″	10⅝″	¼ inch under
6″ — 10½″	10″	10¼″	¼ inch under
8″ — 10″	9½″	9¾″	¼ inch under
10″ — 8″	7½″	7¾″	¼ inch under
12″ — 7¼″	6¾″	7″	¼ inch under

During this initial fitting it was found that in order to give support to the ischial tuberosity, an inch and one-half shelf would have to be added to the posterior-medial corner of the socket. This was as a result of the absence of any adductor or hamstring bulk to position the ischial prominence on the seat lateral to the medial wall where it normally would be located. It was also necessary to undercut the lateral wall, at ischial level, ¾ of an inch to maintain contact in the area of the greater trochanter. Without muscle bulk posteriorly, it was necessary to channel a relief for the upper third of the femoral shaft to evenly distribute posterior wall pressure. A gentle flattening of the lateral bulge in the area of Scarpa's Triangle served to eliminate femoral artery and nerve pressure.

Dynamic Alignment

Dynamic alignment was completed using the actual knee-foot setup instead of the adjustable leg, as the stability of the knee was of paramount importance and, because of the missing extensor power, was attainable only through the use of a friction lock knee. Because of the posterior location of the greater trochanter, the mechanical hip joint was located approximately 1½ inches anterior and ½ inch superior to the palpable anatomical center. A metal iliac band (very rigid) was *closely fitted* just inferior to the iliac crest, extending from one inch medial to the anterior-superior iliac spine to one and one-half inches medial to the posterior iliac spine. A pelvic belt, 3 inches wide, of ten-ounce strap leather with a joining ring over the area of the lumbar vertabrae, was then attached to the pelvic band and joint. This belt was laced anteriorly to prevent forcing socket rotation when tightened. It was determined that placing the trochanter-knee-ankle axis in its ususal relationship required great effort to "break" the knee at toe-off because of the nature of the knee friction lock. The solution used, was to locate the knee center one inch anterior to the normal trochanter-knee-ankle

axis and allow the friction lock coupled with the dorsi-flexion bumper in the foot to supply all the knee stability. (See Figure IV) This knee center location, together with the reduction of the initial socket flexion from 15 to 8 degrees, produced excellent hip flexion at toe-off. A major problem was to reduce as completely as possible all piston action between the ischial seat and the unpadded, extremely pressure-sensitive ischial tuberosity. Close fit-

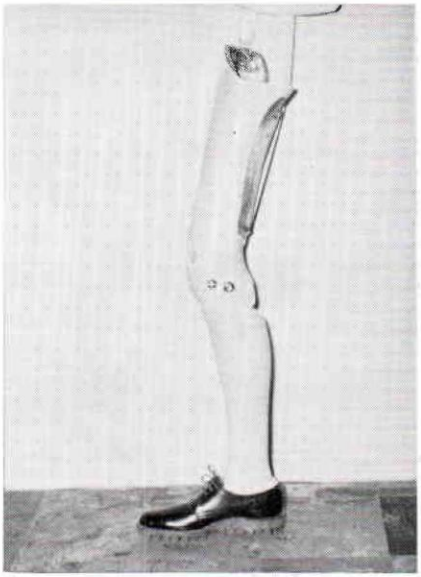

Figure IV

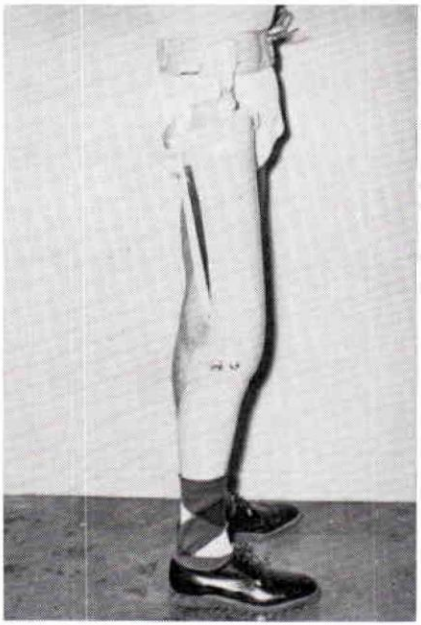

Figure Va

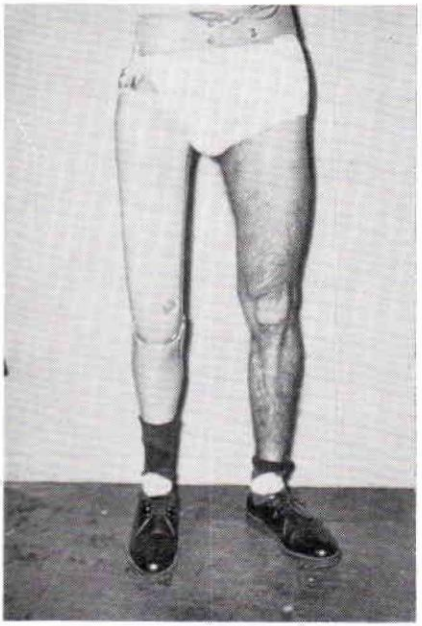

Figure Vb

ting of the pelvic band, the proper positioning of the hip joint, and the use of the suction socket produced most of the desired result, but the addition of an elastic gluteal strap finally helped to accomplish the goal. This addition also supplied a certain amount of involuntary extension power to the hip. At this point the patient was ambulating well, but had a decided Psoas-Major "sinking" upon full weight bearing. It was decided that the addition of a 178-degree extension stop to the hip joint might help. This completely eliminated the problem. The completed prosthesis is shown in Figure V.

It must be mentioned in conclusion that any success achieved on this most difficult case must be ascribed to the coordinated team approach. Repeated consultations between the orthopedic surgeon and the prosthetist were the birth place of all the ideas which eventually bore fruit in the completed prosthesis. Prescription and check-out were only the beginning and the end, and although they are essential, the crux of the problems encountered and solved were found during the actual fabrication and fitting of this prosthesis.

Institute on Prosthetics and Orthotics For State Rehabilitation Personnel

The School of Medicine, Department of Orthopedic Surgery of the University of Virginia, and the Woodrow Wilson Rehabilitation Center, presented an Institute on Prosthetics and Orthotics for state Rehabilitation personnel in cooperation with the Office of Vocational Rehabilitation Department of Health, Education, and Welfare, Region III. This was held at the Woodrow Wilson Rehabilitation Center, Fishersville, Virginia, March 20 through 24, and a second Institute was held April 4 through 8, 1961.

The course included concise presentation of the anatomy and biomechanics of both the upper and lower extremities. Amputation sites were described with the resulting functional loss. Prosthetic components for both upper and lower extremity prostheses were demonstrated and their functional implications discussed. The fabrication of both upper and lower extremity prostheses was discussed, and essential fabrication techniques demonstrated. Clinical demonstration of the fitting of prostheses and the training of the amputee in their use were given. Special emphasis was placed on pre-prosthetic care, gait training, and the vocational use of the prostheses. Vocational possibilities and limitations of the various amputee groups were explored with illustrative cases.

A general view of the field of bracing was given with demonstration of typical braces. The most frequent conditions requiring bracing, including poliomyelitis, spinal cord lesions, hemiplegia, and spinal syndromes were discussed and the appropriate braces demonstrated. The vocational possibilities and limitations of each group were emphasized. Representative cases in the groups were seen illustrating the various types and their functional possbilities and limitations.

There were twenty members in each class, including counselors, supervisors, and one State Director. Among visitors and observers were, Dr. Robert D. Wright, Assistant Director of Health and Medical Activities, Office of Vocational Rehabilitation, Department of Health, Education, and Welfare; Dr. Sidney Fishman, Director, Prosthetic Education, New York University; and Dr. Floyd Kefford, Rehabilitation Supervisor for Pennsylvania.