

Above Knee Prosthetic Socket Approaches

REPORT OF THE A/K STUDY COMMITTEE, UNIVERSITY COUNCIL ON ORTHOTIC AND PROSTHETIC EDUCATION

In May 1961, the university prosthetics and orthotics education programs formed an organization which has come to be known as "UCOPE," or University Council on Orthotic and Prosthetic Education. This group arose out of a recognition of a need for closer cooperation and coordination of courses between the three universities. With distances of at least a thousand miles between the schools, it is not surprising that the courses being taught at each center might diverge, at first in minor details, and as more time passed, in broader areas of instruction. Apparently, this is what has taken place in a few instances, particularly in the courses devoted to above-knee prosthetics which have now been in existence for six years.

As a first approach to resolving these divergences, UCOPE, at its meeting in Miami in October, 1961, compared and analyzed both the schedules and examinations for the A/K prosthetists' course. This analysis pointed toward several differences in teaching, which, it was felt, could be resolved only through discussions between the technical people who instruct in these courses. UCOPE thereupon appointed a committee consisting of the chief prosthetist instructors from each university, John Bray of UCLA, Ivan Dillee of New York University, and Blair Hanger of Northwestern University, and as chairman, Norman Berger of New York University, who would act as administrator and reporter. This Study Committee met for the first time in February, 1962, in Los Angeles for the specific purpose of exploring in detail the thinking and teaching at each of the three universities with regard to A/K fitting and alignment. This report is a summary of the findings and decisions of the Committee.

Early in the Committee's discussions, it became apparent that the primary differences in techniques and procedures being taught at the three centers were in the areas of socket planning, socket layout, and initial socket shaping. Accordingly, a considerable amount of time and thought was devoted to these matters.

I. *Socket Planning*

There are two different methods currently being taught of establishing a pattern for the socket at ischial level. The first method begins with sets of standard patterns which are modified and corrected on the basis of careful measurement and examination of the stump. We can call this the "pattern modification" approach. The second method consists of determining, again by careful stump measurement and examination, as many of the factors as possible which should be known if a proper pattern is to result. These factors are then incorporated into a pattern by systematic drawing of lines, angles, curves, etc., until the pattern is complete. We can call this the "pattern construction" approach.

In order to carefully explore the significance of these approaches, it was found necessary to work with an amputee subject who was measured and examined by each member of the Committee. Two patterns were then made; one in accord with the "modification approach" and one in accord with the

"construction approach." Detailed comparison of the patterns indicated the following differences:

- a) The medial lateral dimension is measurably larger with the "construction approach."
- b) The rectus femoris channel is significantly deeper and the apex of the channel's curve is more laterally placed with the "modification approach."
- c) Using the "modification approach," the angle formed by the posterior side and the medial side is a fairly constant 7° . With the "construction approach," this angle is varied between 6 and 10° .

In attempting to reconcile these differences, it was agreed that the "pattern construction" procedures should be altered so that the medial lateral dimension would be reduced by $3/16''$ and so that the depth of the rectus femoris channel would be increased by $1/8''$ increments. Thus, the resulting pattern differences were minimized.

Despite this, there remain some differences in the contours of the socket patterns. It is apparent, therefore, that while progress has been made, additional meetings will be required to effect a more complete reconciliation of the teaching procedures and techniques at the three centers. It seems obvious that future meetings could lead to one of the following alternatives:

- All teaching programs could adopt the pattern construction technique;
- All teaching programs could adopt the pattern modification technique, or
- Additional changes in the two approaches could be decided upon so that the resulting patterns would reveal only functionally insignificant differences.

II. *Socket Layout and Initial Shaping*

The second major area of concern relates to the underlying rationale and the specific techniques for socket layout and initial shaping. As in the socket planning discussions, the Committee once again found that two distinct approaches are currently being taught, which for convenience we can call the "measurement approach" and the "medial wall approach."

A. THE MEASUREMENT APPROACH

The measurement approach to layout and initial shaping rests on the fundamental assumptions that socket flexion and adduction angles can be predetermined through measurement on the amputee and that these measured values will represent the socket flexion and adduction angles in the finished prosthesis within 1° . Accepting this basic premise, layout and shaping proceed in a logical fashion. The measured flexion and adduction angles are cut into the socket block, thus establishing the posterior and lateral walls. These, since they will not vary, serve as a foundation for shaping the rest of the socket. The anterior wall is shaped according to the top pattern and a distal pattern, and the socket is brought up to size in accord with a tension analysis chart. This procedure produces a medial wall which maintains contact with the soft tissues throughout the length of the stump. The socket thus has relatively straight lateral and posterior walls with the medial and anterior walls contoured to follow the shape of the stump, and supporting as much stump tissue as possible.

B. THE MEDIAL WALL APPROACH

This approach begins with the cutting into the socket block of a straight medial wall, which then serves as the base or take-off point for stump perimeters as derived from the tension analysis chart. With the medial wall as a constant, the perimeters, in effect, determine the angulation of the lateral wall. The adduction angle, therefore, is not constant since it is dependent

upon the perimeter measurements built into the socket. This presupposes that there may well be a need for changes in the adduction angle of the socket during dynamic alignment. The ischial seat may then have to be modified (brought back to the horizontal) and the inside of the socket may also require modification after angular changes during dynamic alignment.

In summary, we can say that the second method (the medial wall approach) assumes the need for significant socket alignment changes during dynamic alignment, which implies that final fitting is completed during dynamic alignment. With the first method (the measurement approach) it is assumed that correct alignment angulations can be built into the socket from the start and that fitting refinements during dynamic alignment are rarely related to flexion or adduction changes.

In attempting to reconcile these divergent approaches to socket layout and initial shaping, the Study Committee members felt that there was little possibility of finding a compromise position. The proponents of each approach were of the opinion that it would take actual experience in the fitting of cases utilizing both approaches before one or the other method could be recommended. The Study Committee, therefore, plans a further meeting which will be a practical working session with amputees. In this way a final decision can be reached as to the comparative merits of each approach. A period of two weeks therefore has been set aside in July, 1962, for this purpose.

Summarizing their experiences the members of UCOPE were of the opinion that a significant start had been made towards the problem of resolving variations in teaching between the three university centers. For the first time, a clear and specific understanding has been achieved of the differences in techniques, and, more importantly, of the underlying rationale and meaning of the differences in terms of socket fit and alignment. The enthusiasm for this kind of interchange of ideas between the three universities was so marked that it is intended to continue with meetings devoted to below-knee procedures and upper extremity procedures, although the differences in teaching here seem much less significant. The importance of this work to the prosthetic industry as a whole and specifically to the American Board of Certification cannot be over-emphasized.

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