

THE CURRENT STATUS AND FUTURE NEEDS IN LOWER-LIMB PROSTHETICS

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The current status of lower-limb prosthetics deserves high praise as a result of years of hard work by dedicated individuals in the areas of research, development, and education. In 1946, when I first became involved in prosthetics, there were no formal education program available. Training on the job was the only way to become involved. It was about this time that the American Orthotic and Prosthetic Association began to develop into a more professional organization, and thus began to coordinate more effectively the efforts of individual prosthetists and orthotists.

In 1947 and 1948 the Veterans Administration and the American Orthotic and Prosthetic Association sponsored a series of above-knee suction socket "schools," that were held at selected locations throughout the country.

AOPA recommended the establishment of the American Board for Certification in Orthotics and Prosthetics in 1949 to ensure that prosthetists, orthotists, and facilities specializing in prosthetics and orthotics meet certain standards of excellence.

In 1953, the first of the formal university-level short term courses began at the University of California in Los Angeles. In 1955, the pilot course in above-knee prosthetics fitting and alignment was held at the University of California, Berkeley. This was followed by a series of courses at the University of California at Los Angeles and New York

University, and later at Northwestern University.

The studies in locomotion and biomechanics made at Berkeley gave a new and understandable meaning to lower-limb prosthetics, especially in fitting and alignment, which led to the above-knee quadrilateral socket, the patella-tendon-bearing below-knee prosthesis, and the use of the adjustable leg and transfer equipment. These techniques and devices are still in use today.

The continuing education type of course offered by the universities enabled the practicing prosthetist to improve his ability to communicate with others in the medical field. The team approach to management of amputees was introduced and accepted. Good pre-prosthetic care and correct fitting of the socket, correct alignment of the components, along with proper training of the amputee resulted in more functional prostheses. Very little stress was put on special knee joints and exotic materials. Friction-type knee control for above-knee prostheses and a well aligned foot and ankle provided the basic necessities.

Prosthetists gained more confidence in fitting, and I could fit most amputees except those with very poor stumps, those in poor physical condition, or those that were psychologically mal-adjusted. However, as we all know, no prosthesis is good enough. It can always be better; a challenge that intrigues not only the prosthetist but the physi-

cian, therapist, and engineer as well. Over the past years many new components and materials have been developed through programs sponsored by the Veterans Administration, the Rehabilitation Services Administration, the National Institute of Health, the Children's Bureau, the Departments of the Army and the Navy, and by individual prosthetists and private manufacturers. Until recently the overall program was coordinated by the Committee on Prosthetics Research and Development of the National Academy of Sciences. CPRD deserves much credit for the progress made by providing stimulation and guidance to the various research and development groups.

The prosthetist has available a wide selection of components and materials, and at times it is difficult to determine which to use. Even with help of CPRD we still have many items that have never proven to be quite satisfactory. Prosthetists who have tried the new items still have many of them on their shelves after field testing proved them not to be satisfactory. We also have many components already designed which could be more satisfactory if design changes to improve function and reliability were incorporated. Extensive evaluation of all new components for prostheses is essential.

Even with a satisfactory state-of-the-art we are still searching for improvements—as we should. During this meeting we are here to make decisions as to future needs in lower-limb prosthetics. This is not any easy task. I have been actively engaged in fitting prostheses for 30 years and still find it difficult to define accurately individual needs. To help in our discussion on lower-limb prosthetics, I mailed a questionnaire to 150 randomly selected prosthetists. I received 50 returns. Many of these respondents went to considerable effort to express their opinion as to the current needs.

Before we discuss the results of the returns, let us first consider the component which is common to all lower-limb prostheses—the foot. Everyday, all active prosthetists discuss shoes and prosthetic feet with new and old wearers. The problem of heel-height adjustment affects every amputee. This lack of adjustment together with questionable foot and ankle functions of the de-

vices available today leaves the door open for further research. As Charlie Dankmeyer so aptly stated, "The SACH foot is not the panacea for all the prosthetic foot problems."

During the past several years what developments have been the greatest aid towards your fitting of the lower-limb amputee in each of the following categories listed on a priority basis? (Some listings will show the percentage of comments related to the total.)

Fitting techniques and procedures:

- Casting techniques (2 and 3 piece BK)
- Adjustable legs and biomechanics
- PTB and PTS type prostheses
- Check sockets (transparent)
- Total-contact sockets
- Expandable liner for Symes' prosthesis
- Vacuum forming
- Ultralight BK prostheses

Components:

- Modular Systems
- Knee mechanisms (Safety, OHS, Multiplex, etc.)
- Feet (Greissinger and Bock molded single axis)

Materials:

- Thermoplastics (Pelite, polypropylene, etc.)
- Foams (Bock dupliating)
- Acrylic resins
- Ultra-Dip

If you were given the time and resources to do research on projects relating to lower-limb prostheses, what would be your choices?

- Casting techniques (AK and BK)
- Suspension in general, and specifically for the geriatric patient
- Cosmesis—Endoskeletal, soft tissue and skin
- AK knee joints
- Socket materials
- Ankle Joints

During your daily practice when do you find yourself saying, "There must be a better way"?

Casting AK
Suspension (geriatric AK)
Maintaining fit (volume changes)
Patient information and/or misinformation
Geriatric fitting
SACH foot

What developments in components do you think are most needed for:

Below-knee prostheses?

Foot lightweight, articulating
Socket and insert materials—smooth, resilient, and tough
Cosmetic covers
Suspension for obese patients and others
Modular components

Knee-disarticulation prostheses?

Knee mechanism
Outside joints with friction
Cosmetic covers
Strong modular components

Above-knee prostheses?

Lightweight components
Knee mechanisms
Hydraulic devices
Cosmetic covers
Hip joints
Knee mechanisms for children
Stronger modular designs

Hip-disarticulation prostheses?

Stronger hip joint
Better cosmetic cover for endoskeletal prostheses
Casting technique

Other?

Cosmetic covers
Symes' feet
Hydraulic ankle
Better tools for inside measurements

In what areas is there the most need for improvement in measuring and fitting techniques?

25% - Above-knee casting and measuring

5% - Above-knee volume measuring
Obese patient handling and tissue
Tissue evaluation

In your experience what is your opinion concerning the present general status of the following services as they affect lower-limb fitting?

Surgical

28% Good
34% Needs improvement
.06% Poor

Pre-prosthetic care

.08% Good
32% Needs improvement
26% Poor
.04% None

Post-prosthetic care

22% Good
26% Needs improvement
30% Poor

What changes or additions to our educational programs do you think could be made to improve patient handling of the lower-limb amputee?

14% - More courses on proper patient handling
12% - More courses for therapists and nurses
Medical terminology
Better internship programs for prosthetists
More information about the cause and effect of vascular problems and skin disorders as they relate specifically to amputees wearing prostheses.

SUMMARY

In summary, the future needs in lower-limb prosthetics is not too much different than it has been for years. There is a need for improvement of components, especially knee joints for above-knee limbs, better feet,

stronger but lighter modular components, better soft tissue and skin covering, etc. We hope that research will be continued and close communication among the people involved will be maintained. The evaluation program should be renewed.

The respondents to the questionnaire stressed the need for better methods to evaluate tissue as it reacts to the prosthesis during use. We need better methods for measuring and making impressions. This is an area that has not been stressed in research program during the past few years.

Many are concerned about the concentration on components and more expensive items when patient handling skills are more important. I would like to quote Greg Gruman, who added this comment to the questionnaire:

"I think we can do a much better job even with no improvements in techniques or components. People who receive prosthetic care who are properly fitted and trained will have good success. Those who get off to a bad start may never be able to recover. Emphasis on 'total care' is needed.

Too often a patient will blame poor

performance on the prosthesis, i.e., 'This socket never did fit right!' They seem to feel that if they had a different foot or belt or other changes, that they would walk normally, or feel that a different prosthetist or facility would make them walk better. This wishful thinking, or hoping for a miracle, only causes problems for everyone involved. Maybe we as fitters also have too great a faith that new components will solve our problems, something that only improved skills can accomplish."

Thoughts were also expressed that too much time and money can be spent developing expensive items. We don't want to build a six-million dollar prosthesis when funds are not available in a great many cases to pay for what can be fitted at the present time.

Perhaps some of the thoughts expressed are too conservative. However, the panels involved are well selected and we hope that they will develop ideas and projects that will lead to better prostheses and better patient care for a majority of lower-limb amputees.