Whither Prosthetics and Orthotics?

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The publicity concerning scientific and technical advances keeps us constantly aware of man's increasing competence to master his environment. The technologies available make possible a wide variety of mechanisms that expand man's sphere of activity and make possible comfortable living in environments previously considered undesirable. Some of the modern techniques, when applied in the biological fields, have eliminated some diseases, controlled others, and have made possible medical and surgical procedures that extend the life expectancy of persons of all ages. Continuing research undoubtedly is going to demonstrate eventually the etiological factors in other disease entities and thus permit the development of a nonsymptomatic approach to therapy.

Many of the current scientific advances have been the result of interdisciplinary effort, where two or more separate disciplines have worked together, hopefully synergistically. This interdisciplinary effort in prosthetics and orthotics has produced what is often described as a bioengineering effort. In the past twenty years increasing emphasis has been placed on the engineering aspects of this specific problem. These years have witnessed a rapid advance in the development of new industrial materials and hardware that have been readily applicable to artificial limbs and braces. Many improvements in previous fabrication techniques and components were facilitated by using these newly available industrial developments, and thus some advances were made in upgrading the quality of prosthetic and orthotic devices.

There have been varying degrees of concurrent fundamental research in the biological aspects of this interdisciplinary approach.

It seems at times, though, that the glamour of technology has overshadowed the purely biological problems. Research activities involving these glamour areas have been more attractive to many, and funds for such research have been more available in these sometimes esoteric areas.

At times it would seem that many involved in prosthetics and orthotics

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research and development have failed to see the entire problem. Basically, it is the problem of achieving the optimum man-machine interface. The ultimate resolution of the problem is the production of designs that result in comfort, maximum function, and reasonable cosmetic restoration.

There is little question that much has been accomplished. Certainly we have available currently biological and engineering techniques that are capable, in a high percentage of cases, of producing improved function and cosmesis. Continuing intelligent modification of techniques and components produces more and more improvement in all of these areas. It is fair to assume that amputees and others with orthopaedic impairments are now better served than ever before.

Unfortunately, many in the field of prosthetics and orthotics research and development seem to have a tendency to relegate the patient to a secondary position. They appear to be bent on the perfection of the machine without due consideration to the education or alteration, or both, of the man to perfect the interface.

It seems timely to give consideration to some of the areas in which continuing, accelerated investigation is desirable.

Research in amputation surgery to provide more functional stumps and consequently more comfort to the patient has been significantly lacking. There is a multiplicity of amputation techniques. Myoplastic and osteoplastic techniques either alone or in combination have been recommended to promote comfort and improved function. In this country there has been no well-organized clinical evaluation of these claims made primarily from abroad. It seems logical that such procedures be investigated and evaluated thoroughly. There are good theoretical reasons to justify consideration of these procedures so that they not be simply rejected because of dissimilar training and experience.

Cineplastic procedures were critically investigated, and well-established criteria have been developed for their use. A similar review should be made of some of the other surgical problems.

The immediate postsurgical fitting of sockets with or without early weight-bearing currently is being investigated. Undoubtedly, the results of this well-organized investigation will develop proper indications and techniques for this procedure. Hopefully, such techniques will be of positive value in influencing the man aspect of the man-machine interface.

There are in addition many areas of basic biological research that need further investigation. The problem of biological signal sources for control of external power comes to mind immediately. Other, perhaps less exotic, problems, such as analysis of joint motions to permit more satisfactory alignment and construction of braces, or the metabolic problems incident to amputation and use of prostheses as well as analogous problems in the orthotics field, need further investigation. These are but a few of the many fundamental problems that need clarification.

In the truly engineering area, there is a large volume of continuing research and development of systems, components, and techniques to produce better artificial limbs and better braces. Much of this work is in the newer areas of technology and has increasing emphasis on the problems related to the use of external power in prostheses and orthotic devices.

There may be a need to review some of our accepted designs in the light of our recent progress and perhaps an effort should be made to determine whether previously acceptable items are really the best that can be developed in relation to some of our improvements in materials and techniques. It may be the time to review terminal-device design. It is possible that we now need (particularly in the light of external power) to redefine the functional requirements of a terminal device and arrive at some design criteria that will permit more efficient utilization of our technical improvements in power sources and transmission.

With an increasing emphasis on prosthetic restoration in congenitally limb-deficient children, it may develop that there must be a redefinition of goals, in the case of the upper-extremity patient, as related to age, rather than as related to the needs of an adult. Possibly a careful analysis of the functional needs of pre-school and primary and secondary school children would permit us to develop components for a system that would be more effective than simply using scaled-down adult components and systems.

An overall review of research and development in prosthetics and orthotics over the past twenty years cannot help but emphasize that people requiring prostheses and orthotic devices are being increasingly better served. There seems little question but that the efforts of our schools of prosthetics and orthotics education have produced a marked upgrading of the skills in prescribing and fitting these devices as well as greater competency in the training of the patient in the use of such devices.

As a clinician, I am very pleased with the improvement of patient care in these areas. As an interested participant in research and development endeavors, I am increasingly aware that there is much more that remains to be done. There exist the technical facilities to do both better research and better development. What is needed is the wisdom to direct our efforts in such a way that we adequately explore all areas of this man-machine problem and so correlate our activities that the result—the functioning man-machine combine—is a continually improving biomechanical unit.