GUEST EDITORIAL

We Can Do Better

My first real involvement in the care of amputees occurred in World War II. I had just finished a classical orthopedic residency where the few amputees we encountered were children with congenital limb deficits and adolescents with limb malignancies. Amputations for ischemia and related medical pathology were performed by general or vascular surgeons as were amputations for civilian trauma. Exposure to prosthetic rehabilitation was, at the least, informal and scanty. Team management had not been generally introduced.

There are no accurate statistics as to the number of persons worldwide sustaining amputations in that war. Professor Marion Weiss, M.D., orthopaedic surgeon, of Warsaw, Poland, told me some years ago that at the end of World War II, there were at least 50,000 major limb amputees in Warsaw alone. Certainly millions of people, worldwide, experienced limb loss. This great number of casualties, incurred over a short period of time and largely to young people, severely tested the existing facilities for rehabilitation. A period of great activity followed shortly, resulting in a new day for amputees.

Most of us are familiar with the improved quality of life that now exists, resulting from improvements in all areas of amputee care over these past 45 years. However, there have been so many spectacular advances in medicine and surgery during this same half-century, that what has happened to amputees is often not well-known by people generally; even by some in the medical profession. However, progress in amputee rehabilitation has been remarkable and continues. Negative attitudes associated with the destructive nature of the surgery are being replaced by a recognition on the part of the surgeon that the surgery is truly constructive. The residual limb, even up to proximal disarticulation, continues to be the body's contact with the environment. The prosthesis extends that interface, even as a shoe or a glove interposes environmental contact in the intact limb. This factual attitude toward amputation surgery places it in the same class as nonablative hand and foot surgery in the intact limb. It upgrades the level of interest and improvement in surgical technique. There is still a great deal of room for surgical advances, including the use of knowledge now available, but not utilized by many who perform amputations.

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As surgical management has improved, and the profile of people coming to amputation in the

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industrialized countries changes, two areas of needed clinical research stand out. These both relate to levels of amputation. Assuming the surgeon now understands the plastic and reconstructive nature of his task, then the level of amputation becomes an overriding consideration. With certain *well-known exceptions*, the lower the level of amputation, the less functional substitution is required by a prosthesis. Standardized level selection has long since been replaced by the knowledge that modem prosthetics allow successful restoration of function at most levels. The surgeon can then, by the amputation technique, reconstruct the residual limb, fulfilling the necessary criteria to produce a terminal-end organ that successfully interfaces with the artificial device.

Selection of an amputation level now specifically relates to *wound healing*. As a result of considerable study over the last two decades, amputation levels for medical causes (i.e., peripheral vascular disease and diabetes) have been successfully lowered, to the great functional benefit of the patient. This pre-surgical level determination needs continuing clinical research, with transfer of that research to the operating table. Peripheral vascular disease and diabetes account for at least 75 percent of all major amputations performed in the United States and Western Europe today. Appropriate level selection, together , with a more clear cut understanding of the role of vascular reconstruction in "gray area" cases, will continue to decrease morbidity and preserve a greater degree of independent function in these individuals. These data can be collected in an objective, unbiased manner with the cooperation of the vascular surgeon, the orthopedic surgeon, the research investigator and the prosthetic profession. As guidelines increasingly clarify, these people (usually elderly) will experience decreasing morbidity, and an improving quality of life; the benefits will also be reflected in cost of care.

When, in the presence of massive limb trauma, does the surgeon elect to reconstruct or to amputate the threatened limb? The last two decades have also seen unprecedented advances in reconstructive surgery as it applies to severely damaged limbs. Many types of composite tissue grafts with microvascular artery and vein suture, as well as nerve suture and structural stability, are available. The majority of these severely injured limbs occur in young people. Limb salvage using current, often spectacular, techniques is not only surgically inviting, but often successful. The measure of success, however, is not just limb salvage, it is restoration of function. The finality of amputation can cloud our initial or early decision-making. Primary amputation may be by far the most function-restoring and desirable approach. The surgeon faces a heavy responsibility. Each circumstance must by its nature be individualized. Statistically valid outcomes research is needed to best serve the patient. The not infrequent path taken, based on "We can always amputate later," may be a severe disservice. The physical, psychological, and economic effects of prolonged hospitalizations, multiple surgeries, and eventual amputation can be a much more devastating experience than early, successful prosthetic rehabilitation. The surgeon needs to have solid outcomes data at his or her disposal. Continuing research to aid and support this decision-making is a high priority. This judgment challenge confronts trauma and reconstructive surgeons regularly, not only in the large trauma centers, but at hospitals in less populous areas. Air evacuation to Center Care is not always available or feasible.

A major focus of amputee rehabilitation research continues to be functional limb substitutes. The biological response, beginning with the circumstances resulting in limb loss, is also equally important. One is asked why, if solid organ transplantation has advanced so far, cannot allograft limb transfer become a reality? Certainly, limb replantation has achieved some degree of success and techniques continue to improve. The answer is highly complex. Immunosuppression, not surgical technique, is probably the critical hurdle. It is now possible to transplant limbs, including skin, in experimental animals (rats hind legs) successfully with reasonably long-term survival and with significant functional return[1]. The degree of immune modification is so profound, however, as to be completely inappropriate for humans at this time.

The expanding knowledge about clinically useful biologically derived growth factors also offers exciting relevant research. Genetics add to this arena. The research pathways ahead are, to say the least, challenging.

The amputees among us, young and old, can be better served through research and education. The teams of health professionals serving them are, of course, the key to that hope. *We can do better.*

Ernest M. Burgess, M.D.

[1] **Effect of FK506 and Donor-specific Blood Transfusion on Rat Composite Tissue Limb Allograft and Mechanism of Long-term Graft Survival**, by H. Kuroki, M.A. Bean, Y. Ikuta, M. Akiyama, and E.M. Burgess, M.D., in: *Transplantation Proceedings* 25(1): 658–661, February 1993. Supported by the Department of Veterans Affairs, Rehabilitation Research and Development Service Project #A868-RA.