Medical/Technical Collaboration in Prosthetics Research and Development

The recent successes of Professor Per-Ingvar Brånemark and his team in Göteborg, Sweden with human direct skeletal attachments for arm and leg prostheses may herald a new era in the field of limb prosthetics. Direct skeletal attachment has long been a hope of practitioners in the limb prosthetics field. It is too early at this point to know what the long-range impact of the preliminary Swedish work in this area may be. Nevertheless, the group in Sweden is well-advanced with this potentially valuable technique and their previous successes with dental implants in the jaw to support artificial teeth and with attachments to the skull for support of maxillofacial prostheses indicates that the approach is well-founded. One thing is apparent, direct skeletal attachment of limb prostheses exemplifies the possibilities that can come about through interdisciplinary research and development activities.

Interdisciplinary research and interdisciplinary clinical care have long been hallmarks of the limb prosthetics field and of the rehabilitation field in general. However, over the last 10 to 15 years, a gap seems to have developed between people in limb prosthetics and those in the biomedical/surgical community. The probable causes of this gap are multifactorial and are not addressed here. The result of this gap has been that the field of prosthetics has been technology-driven for more than a decade. While an obsession with technology can be beneficial, the focus of the field should not be so narrow that it reduces input by surgeons or that it reduces input from the general biomedical community. In the long run, diminished interaction between the technical side of prosthetics and the biomedical/surgical side is likely to be detrimental to the advancement of the limb prosthetics field. It is time for investigators from various disciplines to build new relationships, or to rebuild old ones; to develop new approaches to problems of body prosthesis integration.

Historically, physicians/surgeons have been heavily involved in the prosthetics field not only in amputation but also with other function-enhancing procedures. The work of Sauerbruch, Lebsche, Kessler, and others on tunnel cineplasty comes quickly to mind. Also, we are aware of the effectiveness of the Krukenberg procedure when it is needed. Marquardt’s development of the angle osteotomy is an example of more recent vintage. The work of Burgess in the USA, and many other orthopaedic surgeons here and abroad, in the appropriate surgical management of amputations is well-known. Nonetheless, it seems that the most recent surgical advances of vascular surgery, plastic surgery, neurosurgery, hand surgery, and general
orthopaedic surgery have not, in recent years, influenced limb prosthetics to the extent that might be expected. There have been few systematic team efforts to integrate available prosthetics technology with new surgical possibilities. Furthermore, few new technologies are being developed to complement new surgical capabilities.

It is interesting to speculate about the possibilities of direct muscular attachment being used in combination with direct bone attachment. The first skeletally attached below-elbow prosthesis, fitted in Sweden, used myoelectric control, but improved control might be possible though more direct means. Robert Beasley, MD, a hand surgeon associated with New York University, has demonstrated the feasibility of exteriorized tendons, which, like tunnel cineplasties, make it possible to bring muscle forces directly outside the body. This kind of control has the potential of considerably enhanced proprioception through direct muscle connections. The intimate integration of bone and muscle with prosthesis structure and control has considerable potential to move human/prosthesis function to a new level of performance, but the development of such systems requires collaborative efforts.

Many persons with hand loss inquire about the future possibilities of control of individual artificial fingers in meaningful, coordinated ways. Intimate connections with muscles in such a way as to take advantage of their natural proprioception is one way such control may be brought about. These ideas may also be of considerable benefit for persons with high-level arm loss, particularly bilateral high-level loss.

This editorial is a call for new—or for renewed—collaboration between people in the limb prosthetics field and people in biomedical/surgical fields. Many possibilities exist beyond the examples already cited. It is hoped that increased collaboration of the kind proposed will result in deft prostheses that have natural proprioception. The objective of this kind of collaborative work should be limb prostheses that permit persons to make meaningful, multifunctional, coordinated movements with little mental effort and with minimal visual supervision.

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