Capabilities

Communicating the Science of Prosthetics and Orthotics

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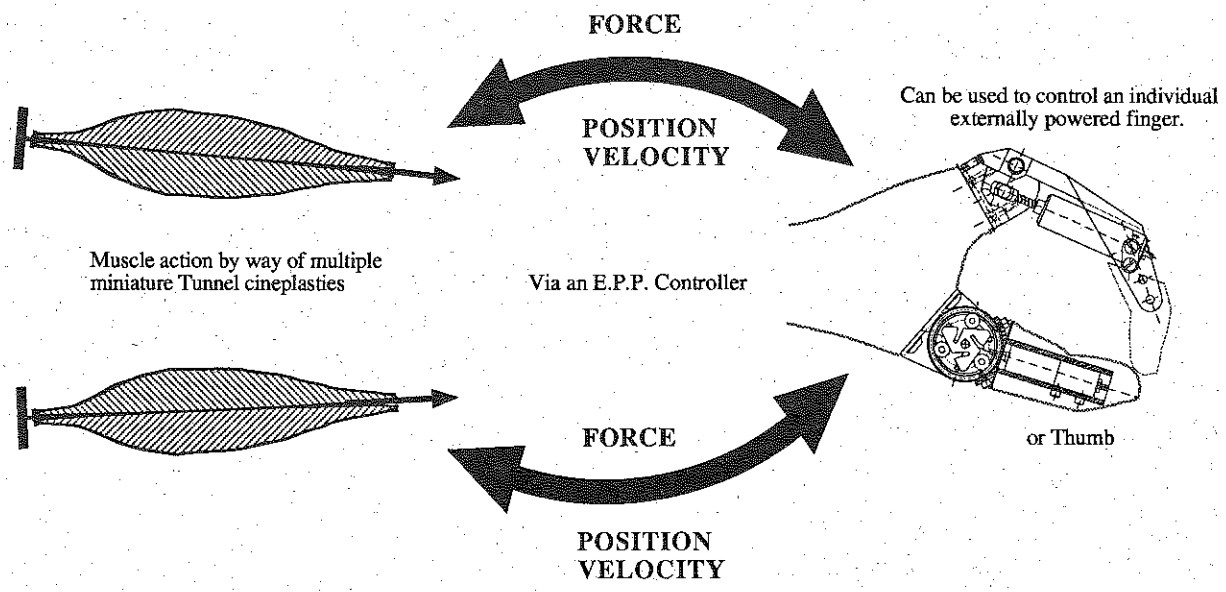

Prosthesis Control By Way of Direct Muscle Attachment

by Richard F. ff. Weir, M.S.

Our laboratory is exploring the use of direct mechanical interface between skeletal muscles and the control systems of powered prostheses. This work is related to the principles of *tunnel cineplasty*. It was stimulated by (1) the need for better control of arm/hand prostheses and better proprioception, (2) the advent of improved powered prostheses and controllers, (3) modern surgical methods, (4) renewal of interest in cineplasty in Germany, and (5) collaboration with Dr. Robert Beasley, a hand surgeon at New York University. Direct muscle attachment involves surgical intervention to make it possible to physically interconnect a muscle or tendon to a prosthetic limb for purposes of controlling that prosthetic device.

Tunnel cineplasty is the most common example of direct muscle attachment. Developed in a practical way by Sauerbruch in Germany in 1916, the procedure requires the surgical construction, by way of skin grafts, of a skin-lined tunnel through the distal third of a muscle that has been released from its insertion. Once healing is complete a pin can be inserted through the tunnel. Since the tunnel is skin-lined the pin does not break the skin's protective barrier with the outside world. Voluntary contraction of the muscle enables its force and excursion to be transmitted directly to a prosthesis.

To Tunnel Cineplasty, page 5

Figure above: Schematic drawing showing how multiple tunnel cineplasties, when used in conjunction with e.p.p. controllers, might provide subconscious independent multi-digit control for hand prostheses.

In This Issue

Consumer View

Usage of Golf Prostheses

by Wayne L. Vercellotti

As a means of an introduction to playing golf without an arm, I would like to mention that a majority of arm amputee golfers play the game without the aid of a prosthesis.

The first category of arm amputee golfers are above-elbow players. Due to the absence of an elbow, the function of an arm prosthesis is very limited, if not completely useless. I have observed only two golfers in my travels who actually used an above-elbow prosthesis as an aid in playing golf. All other players played with one hand without any additional device to assist them in their golf swing.

The second category of arm amputee golfers are below-elbow players. My own amputation falls within this category.

I have been using a golf arm that has straps that attach to my shoulders. This enables me to have the stability of the shoulder to provide a solid golf swing. The arm has no myoelectric capabilities. The disadvantage I have noticed with the shoulder harness is that it restricts my backswing to the extent that I cannot take the club back any further than a three-quarters back swing. This restriction has a major impact on the consistency of my arm and the overall distance of my shot. The problem is the same for right- or left-hand golfers. With a hand missing, the abbreviated swing results in an ineffective golf swing.

At the present time, I am developing a golf prosthesis that attaches to my left arm biceps and prevents any restriction to my backswing. The trade-off here is that you must, at least in part, power the golf swing with your left arm and shoulder. I have discovered that because of the atrophy in my left arm and the lack of strength in my left shoulder and back, I have lost a considerable amount of distance in my shots. I am working with a sports therapist, doing specific exercises to build up my left shoulder and arm. I hope to have this accomplished by Spring, 1992, and to take my new swing to the golf course for the ultimate test. If all is lost, I can still revert to my shoulder harness arm and play the same game that I have been doing for the past 28 years. I will give you an update in the fall of 1992 as to my success in this venture. Good golfing!◆

Wayne Vercellotti is a member of Northwestern University's Rehabilitation Engineering Program's Consumer Advisory Panel. He is the President of Friedrich Binding and Embossing in Joliet, IL. He is a member of the Wisconsin Amputee Golf Association.

Review

Coping With Being Physically Challenged
by Linda Lee Ratto, M.Ed., © 1991 LL Ratto
Order from Rosen Publishing Group, Inc., 29 East 21st St., New York NY 10010, Dept. N234. $12.95 plus $1.55 p/h.

In this upbeat and very readable book aimed at teens, Mrs. Ratto addresses the concerns of being *physically challenged* ("a more optimistic way of looking at the physical disabilities some of us have.") Mrs. Ratto is herself the mother of two children with disabilities.

The book is liberally sprinkled with the testimonies of challenged teenagers–from amputees to those with cystic fibrosis. These teens' stories act as a springboard for the wide variety of topics addressed in this book–from grieving, to being a partner with your medical team, to dating and family relationships–all from a teens' point of view.

The book's running theme is: feel good about yourself and develop your own unique potential to meet the challenge of being physically challenged. Mrs. Ratto encourages teens to become their own advocates and to teach others about the worth of those who are physically challenged. Since adolescence is a difficult time for communication with family, peers, and others, Mrs. Ratto especially stresses the need to talk about feelings and physical needs, and to begin taking personal responsibility for oneself.

The book is a nice addition to resources for teens, and contains common sense advice that could benefit adults as well. The book includes a glossary and resources list of helpful books and organizations in the back.◆
Review by Else M. Tennessen, M.S.

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ISPO Update

Come to the city "that works" and experience the beauty and diversity of Chicago–its fabulous skyline, with Sears Tower, the world's tallest building; outstanding architecture; world-renowned museums; its lively theater scene; and the incomparable Chicago Symphony Orchestra which will be performing at their summer home in a nearby suburb during the Congress. Enjoy the summer festivals and choose from hundreds of fine restaurants of all ethnic types and price ranges. You can swim, sail, or fish in beautiful Lake Michigan.

Chicago is the site of the VII World Congress of the International Society for Prosthetics and Orthotics (ISPO), to be held June 28 to July 3, 1992. At the Congress, discover "the New World Developing in Prosthetics and Orthotics Around the Globe"–the Congress theme. More than 60 hours of instructional courses and symposia will be offered–your chance to learn about innovations in the prosthetics/orthotics field, and to share knowledge with peers and fellow consumers.

A fine tour and social program is also planned, which includes visits to famous architectural sites on a delightful river cruise and visits to museums, galleries, sporting events (Chicago Cubs), and musical performances. Chicago's beautiful shops and multi-level malls offer all types of merchandise within walking distance of the Hyatt Regency Chicago Hotel, where the Congress will take place. A special hotel rate of $102 per night, single or double occupancy, is also available. The Congress is accessible to persons with disabilities.

To receive a Call for Papers, Exhibitor's information, or Registration information for the VII World Congress of ISPO, contact: Secretariat, VII World Congress of ISPO, c/o Moorevents, Inc., 676 North St. Clair St. Suite 1765, Chicago IL 60611 USA, Telephone (312) 951-9600, Fax (312) 951-9854.◆

Resource Unit

Manufacturers' Database Available

Beginning this month, a fledgling database of prosthetic-orthotic manufacturers is now available through the Resource Unit Help Line, (312) 908-6524. This database lists names, addresses, principal products, and other helpful information about P&O manufacturers. Approximately 100 manufacturers are currently represented. If you are a manufacturer who would like to be listed in this database, please contact Else Tennessen at the Resource Unit for more information.

To column 2...

"Communication About Disability"

For those interested in media issues, in NIDRR's RehabBrief, Vol. XIII, Issue 12, the discussion focuses on the communication of information about persons with disabilities. A new breed of communicator, the "disability communicator," has arisen to bring the concerns of persons with disabilities into sharper focus. These communicators are also working to modify language which describes persons with disabilities and disabling conditions.

Under grants from the NIDRR, studies have singled out specific problems in the media regarding persons with disabilities; for example

1) Too much emphasis on disabled people as human interest material–"the disabled person is often portrayed as being constantly good humored, patient, and courageous, or as being a sad victim."

2) Most media stories don't cover the real issues facing persons with disabilities.

3) The language describing persons with disabilities is often offensive.

The studies go on to differentiate between *traditional stories*, which show people with disabilities as malfunctioning in some way, to *progressive stories*, which show disabled people as contributing to society. The RehabBrief concludes with positive ways society and the media are improving in this area. The Brief is a helpful summary of this challenging problem; order additional copies from PSI International, P.O. Box 5168, Arlington VA 22205.

One way to improve communication is to dispense information, like the Resource Unit does, and to work for self-advocacy, where persons with disabilities act to educate those around them and to let others know how they feel, what their needs are, and how they want to be treated. The Resource Unit is proud to act in the area of advocacy through information.◆ *EMT*

1990 Annual Report and New PRL/REP Brochures Now Available

The Annual Report describing activities at Northwestern University's Prosthetics Research Laboratory and Rehabilitation Laboratory in 1990 is available FREE to interested parties. To order, send a written request plus $2.50 postage/handling for each report to: Bonnie Collard, NU REP-PRL, 345 East Superior St., Room 1441, Chicago IL 60611 USA. Allow 4-6 weeks for delivery. PRL/REP brochures are available free from the Resource Unit.

S.O.A.

On the Importance of Measuring Instruments to Prosthetics-Orthotics Advancement

by Dudley S. Childress, Ph.D.
Director, Northwestern University PRL-REP

As the field of prosthetics and orthotics advances, measurement instruments will likely become more important in the assessment of function and in the achievement of optimal clinical results. For example, gait analysis equipment is becoming more prevalent in hospital clinical facilities and in a few years may be used in private prosthetic/orthotic laboratories. Accurate data, obtained through appropriate and verified equipment, needs to be a primary goal. Poor or inaccurate data may actually be worse than no data at all. In the desire for quantitative data, we sometimes forget the need to make sure the numbers we obtain are accurate and meaningful. Hence, this short essay on the importance of quality instruments and accurate measurements.

Scientific advancement is undergirded by its instruments. For example, Kepler's laws, which revolutionized the understanding of planetary motion, and which contributed significantly to the development of Newtonian Mechanics, could not have been developed by Kepler without astronomical data of a certain degree of accuracy. The needed data, which Kepler ultimately obtained from Tycho Brahe, was available because Brahe had constructed observational instruments far superior to other instruments of his day and had used them to collect extensive planetary movement data. The scientific insights of Kepler could not have come about without the data having the required accuracy–accuracy that was dependent upon the design and construction of the measuring instruments.

Data related to biomechanical measurements (for example, human ambulation) is not likely to have the far reaching influence on science that Brahe's planetary motion did, but to a caregiver who provides people with prostheses or orthoses, such data may be of substantial importance. Nevertheless, fundamental understanding of human movement will be impeded by measurement systems that are either inadequate in design or whose results are improperly interpreted. There is need in biomechanics not only for improved measuring instruments but also for increased understanding of measurement principles. The overall effectiveness of these devices in prosthetics, orthotics, or general rehabilitation depends upon their reliability and accuracy, and upon their being used properly.

The intent of this essay is not to excessively eulogize the importance of accurate instrumentation in rehabilitation. Instruments, and the observations made with them, are of themselves useless without the integrating and hypothesizing minds of prosthetists, orthotists, physicians, engineers and others who use them and who ponder what their data mean. Nevertheless, there is a tendency sometimes in medicine, in prosthetics and orthotics, and in science and engineering generally, to depreciate the importance of carefully-constructed and well-characterized measurement instruments. After investigatory work is successfully completed, the results may be reported, remembered, and published in journals, but the instruments so important to the success of the work are often forgotten.

It is likely that sophisticated measurement instruments will play an increasingly important future role in the advancement of prosthetics, orthotics, and rehabilitation. It would be convenient if all of these instruments had ideal, perfect characteristics, and could measure everything that is desirable to be measured. Then we could concentrate purely on the questions that we want to answer through the use of these instruments. We wouldn't have to worry about developing new and improved instruments or about being led astray by bad measurements from the instruments being used. However, we know this is not the case. We also know that a lot of inaccurate results are reported because people sometimes make the assumption they can automatically believe the data collected by their instruments, without question. It turns out in real measuring systems that all data must be questioned as to its validity and as to the size and nature of the measurement errors. Users of this instrumentation equipment need to place considerable thought and effort upon measurements and measurement theory. Just as there is computer science, the science of computers, there also is measurement science, the science of making measurements. Good data is imperative for sound conclusions and judgements. Bad data that is thought to be good data can lead one astray. As Frank McKinney Hubbard has said, "Tain't what a man don't know that hurts him; it's what he knows that just ain't so."◆

Tunnel Cineplasty, from page 1

Tunnel cineplasty was introduced in the USA in 1939 by Kessler. The procedure was never very popular here and was mostly discontinued in the late 1950s. This was partly due to the failure of a significant number of tunnel cineplasties to provide sufficient force and excursion with which to power a prosthesis. But the superior control properties provided by those tunnel cineplasties that did work are well documented.

Availability of externally powered prostheses means that the muscle of a tunnel cineplasty is no longer required to provide the power for prostheses. Consequently, we believe that miniature tunnel cineplasties, used as control inputs to extended physiological proprioception (e.p.p.) controllers (unbeatable position servo mechanisms; see July 1991 *Capabilities*) can significantly improve the control of prosthetic devices for upper-limb amputees. The sensory feedback that is inherent in both the skin and muscle of the cineplasty provide a means for conveying information on the state of the prosthesis to its user in a somewhat subconscious and natural manner (proprioception).

The use of multiple miniature tunnel cineplasties, in conjunction with e.p.p. controllers, opens up many new control possibilities. Multiple forearm cineplasties, each with an e.p.p. controller, has the potential to provide independent multi-digit control for below-elbow amputees. Likewise, for high-level upper-limb amputees, multiple cineplasties could be used to augment or replace existing control sites to provide improved multi-functional control of arm prostheses.

Our laboratory is carrying out investigations to quantify how tunnel cineplasty compares with other prosthesis control methods used today. If tunnel cineplasty or other means of direct muscle attachment should prove to be superior to other forms of control, then the extra surgery required with this method could be justified. In order to measure the performance of one control method over another, we are having volunteer arm amputees, who already have tunnel cineplasties, perform pursuit tracking and blind positioning tasks through their direct muscle attachments and through other ways. By use of spectral analysis and information theory, an information transmission rate can be obtained from the results of these tasks. This quantity is a performance index that provides a measure of a subject's overall performance and that permits quantitative comparisons between control methods.◆

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