Experience with Electric Prostheses for the Partial Hand Presentation

Chris Lake, CPO, FAAOP

Advanced Arm Dynamics of Texas
3501 North MacArthur Blvd
Building 650
Irving, Texas 75062

Limb deficiency distal to the wrist represents a common presentation, yet a difficult level to treat with a functional prosthesis. (1) Historically, prosthetic treatment has been limited due to the lack of acceptable electric prosthetic options. Poor results were attributed to challenges including functional limitations of prosthetic technology, patient discomfort, cosmetics and absence of tactile sensation. (2) Until the late 1990s, the lack of acceptable electric prosthetic options as well as concise treatment parameters limited prosthetic treatment. John Michael, M Ed, CPO, FAAOP in the early 90s precisely described the challenge when stating, “The dilemma facing physicians and prosthetists is to determine when our admittedly limited prosthetic armamentarium will add a measure of function to diminish the substantial loss faced by the partial-hand amputee.” (3)

As the specialty of upper limb prosthetics realizes the attention of many different research endeavors, advances in upper limb technology once only found in the research laboratory or in the minds of idealists are beginning to evolve toward commercial availability. These current and future additions to the prosthetic field create a challenge. With the renewed focus on the partial hand level, variables such as residual limb presentation, surgical results, and anatomical stability point to the need for concise treatment parameters.

The Surgical Question – Shifting the Paradigm

As the treatment of the partial hand level progresses, the prosthetist will play a vital role in physician education as to appropriate levels that will maximize the rehabilitation of the individual with upper limb deficiency and in the development of progressive socket designs. Up to this point, hand restoration has been focused on saving as much of the anatomical structure as possible. Truly a worthwhile endeavor, this effort may at times conclude in residual limbs with significant reduced function and problematic pain. While the incidence of pain is more common at the phalangeal level, pain may be realized in more proximal partial hand levels. Ouellette, et al, noted that pain at these other levels may be the “result of an injudicious attempt to save length at all
costs. Although maintenance of length is of concern, such residua seriously jeopardize function of the entire hand.” (5) With the ability to apply prosthetic technology effectively at this level comes the absolute necessity for surgical and prosthetic collaboration.

**Goals of Prosthetic Management**

Our emerging clinical experience point to several specific prosthetic management goals. *Protection* of the residual limb is the first goal. Given the common traumatic presentation of the partial hand level, the residual limb can be significantly compromised in any type of grasping pattern without consideration placed on protection of the residual limb. To address the goal of residual limb protection socket biomechanics must be considered allowing optimal stabilization of the prosthetic socket about the residual limb. One can accomplished this in several methods including custom silicone restoration utilizing a suction fit, non wrist encapsulating or articulated wrist designs which suspend over the residual anatomy, as well as suction type interfaces that extend proximal to and encapsulate the wrist. (4)

The second goal of *bimanual stability* enables the patient to effectively manipulate an object or task using both the sound and affected hand. This goal is directly related to the third goal – *restoration of prehension patterns*. (4) Studies performed both within the prosthetic field and in other clinical areas direct the practitioner’s attention to the incidence of contra lateral overuse syndrome. (6) Contra lateral overuse syndrome leads to decrease hand and arm function often associated with pain and discomfort. In some cases contra lateral overuse syndrome can necessitate surgical treatment if conditions that exasperate this condition are not effectively addressed. There are many concurrent modalities that help reduce the prominence of this presentation. Along with medical and therapeutic management, the restoration of prehension patterns and bimanual stability can help promote less reliance on the sound side.

The last prosthetic goal is to provide acceptable cosmesis and durability given the location of the amputation. This goal has proven to be very difficult given multiple and varied joint motion that requires the cosmesis to accept both tensile and compression forces.

**Unique Opportunity**

Individuals with partial hand amputation represent a patient population that has been previously underserved. The significance of this level can be found in an analysis of the epidemiology of amputation itself. In 2002, Dillingham et al published an article looking at the epidemiology and recent trends in the United States regarding limb amputation and limb deficiency. In his study, he was able to determine that approximately 18,496 individuals yearly are either born without, lose an upper limb
secondary to cancer or experience some type of traumatic insult that results in upper limb amputation. When these numbers were further broken down, it was found that the vast majority was traumatic and, of significant interest, nearly 17,000 of these amputations were distal to the wrist. What this means from a clinical prosthetic standpoint is that professionals in our field are focusing their efforts on the needs of fewer than 2,000 individuals a year who are at a high level of upper limb deficiency, and this minority of amputees comprises the bulk of our typical clinical experience. Meanwhile, there is a huge pool of partial hand level amputees who would no doubt appreciate and benefit greatly from proper prosthetic options if these options were only available to them.

A unique opportunity exists at the partial hand level as our specialty enters a new prosthetic paradigm where evidence based rehabilitation and sound research practices are expected by both the medical community and reimbursement agencies. The opportunity is significant – we have the chance to formulate the research methods and clinical protocols from the ground up instead of retrospectively rationalizing clinical facts that lack the research base today’s rehabilitation community requires.

References


