ELECTRIC OPTIONS & SOCKET DESIGN FOR PARTIAL HAND PATIENTS
Stephen Mandacina, CP, FAAOP
Hanger Prosthetics & Orthotics

Introduction

Recent improvements in prosthetics has allowed for a marked increase in success and functional rehabilitation of the partial hand patient. Manufacturers are designing much smaller and lighter components such as electrodes, switches, batteries, and programmable microprocessors that allow a much smaller and simple prosthesis. In most partial hand cases, this allows the socket to not extend proximal to the wrist for full wrist ROM, simplified socket design, and lighter weight prostheses, all leading to greater acceptance.

Improvements are being made with two separate designs for partial hand patients that use an intact thumb to assist with prehension, or a smaller drive unit decreasing space necessary in the hand. Although both designs are progressing, the components are not readily available for most prosthetists fitting a Transmetacarpal/Transcarpal level amputation. The focus of the paper and presentation is to educate on options currently available and easily used by a majority of the prosthetic field.

History

In the past, partial hand levels incorporating electronic control raised a complication with two main issues: component space & placement, and limiting range of motion at the wrist. For an adequate suspension with laminate plastic, the socket needed to come proximal to the wrist joint. Coming proximal to the wrist warranted external batteries to be placed alongside the forearm for cosmetics. By locking the wrist with this design and extending the socket, wrist flexors and extensors were excellent placement for myoelectric control of the terminal device.

Advancements

Socket Design

Sockets have changed in years to a more aggressive fit allowed by flexible sockets permitting an increased range of motion and improved suspension without going beyond the wrist joint. Flexible plastics such as Northvane, Bioelastic, and Proflex allow the patient to easily don the device and maintain necessary suspension. Oftentimes, a lubricant such as silicone gel eases the donning of the device. For heavy-duty tasks or to increase the suspension, a small Velcro strap can be attached.
just proximal to the wrist. This is not necessary in most situations, but does allow for a stable skeletal lock of the prosthesis on the hand.

**Electronics**

Improvements in electronics have also increased functionality of partial hand electric systems. Internal batteries have allowed a much smaller frame built in the prosthesis, thus improving cosmetics. Some batteries can be placed inside the hand shell of the terminal device completely eliminating any bulge in the frame. Although not for an active adult user, Li-Polymer batteries by Liberating Technologies, Inc provide the smallest dimensions and lightest option readily available and are recommended for light to moderately active users.

Smaller size electrodes coupled with smaller preamplifiers have also allowed for a much smaller device at the residual hand. Because electrodes must maintain contact on the skin, there’s a greater acceptance of the remote preamp-electrode versus the standard electrode. Depending on the density of the soft tissue, the remote electrode is replaceable and easily maintains skin contact on the hand. However, if there’s a considerable amount of movement of the skin in the socket, as there is sometimes in Transcarpal levels depending on the weight of the object they are lifting, a switch or touch pad is recommended. All of these components are readily available to the prosthetist.

**Terminal Devices**

Electric hands for partial hand patients have also improved and are readily available for this clientele. The hands available for this level by Otto Bock and Motion Control are much shorter and lighter than their standard counterpart. These hands weigh in about 1/3 as much as the larger version and save approximately 1 ¾”. With hybridization of manufacturers, using the Animated Control System increases the speed of the hand up to 380mm/sec and the grip force up to 90-100N. Both of these are adjustable if this is too much for the patient.

The hands have the ability to be laminated directly to the frame of the prosthesis, or can be attached to a quick disconnect unit to interchange TDs if the patient needs other tools than just the hand.

**Conclusion**

All of these components allow the Transmetacarpal/Transcarpal patient to be successfully fit with electric systems without compromising the cosmetics of the device.
Improvements in socket design and socket material using these new components provide a comfortable device without limiting the necessary range of motion that patients find valuable.

References

Animated Prosthetics, Inc
Liberating Technologies, Inc
Motion Control, Inc
Otto Bock Health Care