

THE DIFFERENCE A TERMINAL DEVICE CAN MAKE

Patrick McGahey, CPO
Stephen Mandacina, CP, FAAOP
Hanger Prosthetics & Orthotics

Introduction

The manufacturers of electronic components have answered the requests of patients in recent years. Advancements were made with microprocessor-based controllers that allow for easy computerized adjustments, answering the need for increased control of the terminal device. Additionally, batteries have moved to Li-Ion, NiMH, and soon Li-Polymer, answering the request to provide a longer life to the charge, as well as the ability to top-off the charge. Another patient request was to increase the speed of the terminal device. In actuality, what patient wanted was a quicker response from the terminal device as they provided an input signal. An earlier response by the field was to increase the voltage to the terminal device. The higher voltage wasn't the perfect answer because it was also difficult to operate at slow speeds. The Sensor Hand Speed answered these requests to have a more responsive hand that operates quickly, but also is able to operate very slowly according to the user's input.

Field Trials

To date, our organization has fit over 160 of the Sensor Hand Speed in the past couple years. The evaluation of candidacy of this device is very simple because the versatility of the control options makes it suitable for almost every electric wearer needing a hand. This option has been favored by our patients who want the quick response of the hand closing from a full open position in 1/3 second, but also the control of slowly closing—all determined by the intensity of signal produced.



Oftentimes we have patients who have only one good EMG signal and still desire the speed and control offered by the hand. Through usage of coding plugs or a hand held programming device, different strategies of control are selected. (This hand held device can also slow the top speed of the hand down for initial training.) One of these strategies is a proportionally controlled single site that opens with an input signal and closes upon relaxation of that input. This single site usage can also be used on the weaker muscle site to provide strengthening, and then changed to a dual site once the weaker muscle is ready.

In occurrences where this weaker muscle doesn't strengthen to the intensity of the stronger site, we often do one of three things. One being leave at a single site; although not maximizing the capabilities of the hand, it is still a functional solution to the patient. The second option is making adjustments on a computer. The customizing process on the computer not only adjusts the hand, but adapts to other devices in the Otto Bock line as well. These adjustments are very practitioner friendly because the prosthesis can attach to the computer and we are able to see the input signals

graphically on the screen. Gain amplification, or "boost", can be done so the weaker muscle mirrors the intensity of the stronger muscle, all easily on the computer. Additionally, on and off thresholds can be adjusted to minimize unwanted signal from interfering with operation.

A third option for this user is to change to a VarioDual strategy with the yellow coding plug. This control gives the patient the same single site proportional control as the blue plug, but now will also provide gripping control with the second weaker signal. This strategy works very well with many users, even with excellent dual site control, because it mimics the natural opening & closing and gripping of a normal hand. This control strategy on this hand is the most physiologically normal way of grasping, gripping, and releasing onto an object than any other device available.

These strategies of control are not the only advantage our patients have enjoyed. Another feature is the autograsp feature it provides. First seen in the field by the original Sensor hand, the Sensor Hand Speed will increase the grip force on an object if the sensor picks up a change in weight distributed on the thumb, or, if the object is slipping or getting heavier. This puts the patient at ease that they will not drop the object they are holding. This is a true advantage for the single site user who does not have control of the grip force.

Other Options

The three strategies of control listed above (standard dual site proportional control, single site proportional control, and VarioDual control) are what we find our patient accepting most often. Although rarely needed or accepted in the field, the hand does have other control options. One option is a low input control that allows a much lower signal to control the opening and a very low pulse to close the hand. This is not used often because the adjustments on the computer can amplify the signals. Another strategy is the single site without proportional control. However, patients prefer adjustable speed so they can slowly grasp onto an object giving them a better sense of control. A final option is a plug that allows the patient to turn the sensor on or off. Of the patients who reported back to us, none desired to turn the autograsp on and off. There were some who didn't want the autograsp, in which case we provided a different hand. Although good options for this hand, the patient does not accept these controls as much as the first three discussed.

A problem is encountered when needing a second terminal device and using any of the options other than the standard dual site. No other terminal device (e.g. ETD, Greifer, Power Gripper) can mirror each of the control strategies as that of the Sensor Hand Speed. Due to varied vocation & avocations, many patients require the use of multiple terminal devices. The single site operation, a low signal to close and a high signal to open, is different in the Greifer than the "cookie crusher" of the hand. This change of control is confusing for patients and oftentimes they don't use the second device as much as they should. However, prototype Greifers are currently being tested to mimic these control strategies of the Sensor Hand Speed and we hope will be available soon.

Conclusion

There is a large acceptance of the Sensor Hand Speed for its functional benefits. Not only does the autograsp feature give the patient a security of grasp, but also the responsiveness through a high speed is well liked. Yet, patients also like the ability to control it very slowly if needed. The versatility of control mechanisms allows this hand to be used on many different patients who may not have been able to control myoelectrics in the past. Finally, the computerized adjustments are very easy for the prosthetist to fine tune the hand for optimum control.