Motion Control Snap-On Electrode System

For use with a Utah Arm or ProControl myoelectric prosthesis

Since the publication of Wayne Daly's JPO article (Winter, 2001, Vol.12, No.3) showing roll-on sockets used with the Utah Arm 2 and ProControl 2, our customers have requested that Motion Control make an electrode available to install into a roll-on type socket. The concept is a natural one for these Motion Control systems, since the electrode is separated from the preamplifier, allowing a variety of socket types, as well as easy repositioning of the electrode. This paper explains the process of installing electrodes in roll-on sockets.

The reported advantages of roll-on type sockets with myoelectric systems are:

* Improved electrode contact, even after moderate weight gain or loss by the wearer.
* Improved suspension, due to the suction maintained by a well-fitting roll-on liner.
* Improved wearer comfort, especially with problem skin, e.g, scar tissue, etc.

Parts:

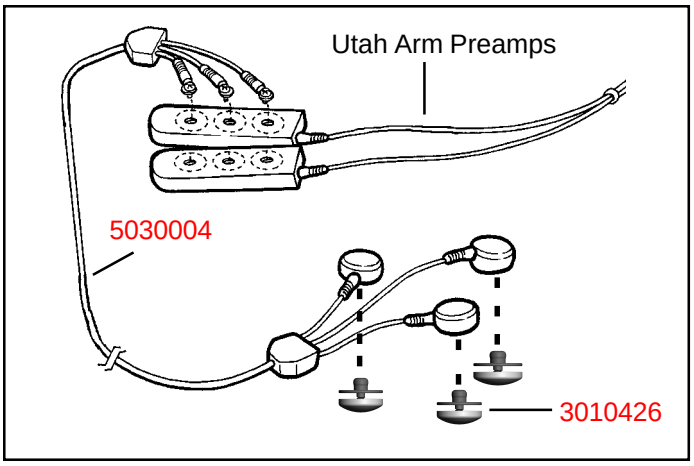
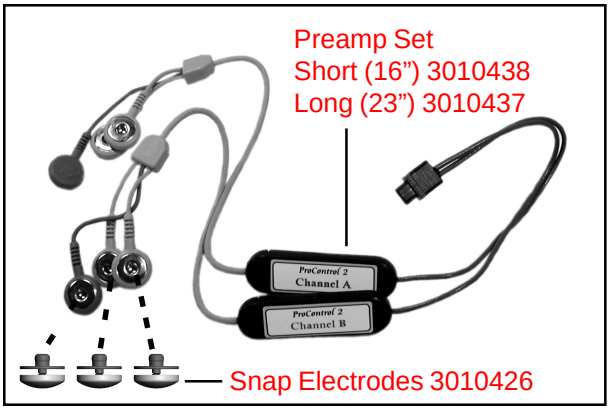


Figure 1. Utah Arm parts required for using snap-on electrodes.

(Order 2 ea.): Cable adaptor with snap connectors for preamplifier (p/n: 5030004)
(Order 2 sets): Snap type electrodes (p/n: 3010426) /set of 6

Figure 2. ProControl 2 parts required for using snap-on electrodes.

(Order 1 ea.):
ProControl 2 PreAmp set with snap connectors
Short - 16" (p/n: 3010438)
OR: Long - 23" (p/n: 3010437)
(Order 2 sets): Snap type electrodes
(p/n: 3010426) - set of 6



Fabrication Suggestions:

The choice of roll-on sleeve is up to the practitioner, however according to the JPO article, Wayne Daly strongly recommends the Alpha 3mm. liner, with the small size terminal end (specify when ordering), manufactured by Ohio Willow Wood.

Attachment of the liner to the socket frame is recommended by means of a either a shuttle lock, or a double lanyard system (Fig. 3), which is bonded directly to the fabric cover of the liner.* The lanyard has been fabricated from a double thickness of 1/2" Dacron webbing with Velcro loop on one side.

Figure 3. A double lanyard will help to prevent rotation of the liner inside the frame, providing secure suspension.

Electrode Site Selection

Electrode sites should be selected as usual, with a Myolab II EMG tester/trainer, or a ProTrainer, the new tester/trainer using the ProControl 2 user interface. The electrode sites are transferred to the liner - we recommend maintaining approximately the same distance between the sensing electrodes as on a preamplifier, i.e., 1 3/8 in.(3.5 cm.) center-to-center. However, one advantage of the roll-on liner system is the excellent contact possible between electrode and skin. Therefore, the practitioner has even more freedom to separate the electrodes (say, in cases of high perspiration levels) or to place them closer than usual (for very short remnant limbs, or scar tissue).

Figure 4. Picture of wearer lining up mark on skin with mark on the liner

Donning Technique

The wearer's donning technique for the liner must be carefully worked out. Land-marks on the skin should be identified and a mark placed [some have tattooed marks on the skin, if they do not exist already] on the liner and/or the skin so the wearer can don the gel liner in exactly the same position each time.

Care should be taken making the hole through the fabric of the liner, to prevent any excess damage to the fabric, which could "run" or spread the hole over time. A large sewing needle or small awl are recommended to start the hole with the tip, then spread the fabric side-to-side.

** Daly has used GOOP household adhesive to bond the lanyard. Put a thin layer on the dacron webbing and the surface of the liner and push them together. Put plastic over them and wrap with an Ace bandage overnight. Don't use too much glue, as it will dissolve the liner.*

After sufficient evaluation of the test socket and electrode sites (after a few days trial use by the wearer-- don't wait too long, the electrodes may loosen) the snap side of the electrodes may be bonded with cyanoacrylate (SuperGlue) to the fabric of the liner. This prevents the snap from loosening or the fabric spreading over time, as the snaps are tugged during donning and doffing.

The "hard" inner socket is formed by casting over the top of the liner, protecting the liner with a layer of plastic wrap. The socket designs we have recommended at Motion Control for transhumeral patients incorporate intimate-fitting AP stabilizers ("wings"), and a relatively narrow ML, to allow even weight bearing along the entire remnant humerus during abduction.

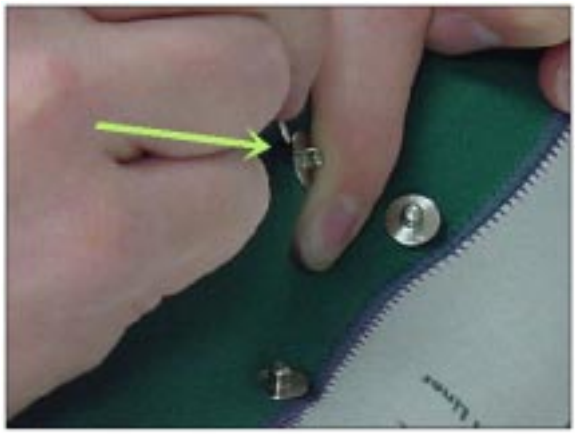


Figure 5. Glue the snap to the liner using SuperGlue

Using a thermoplastic inner socket fabricated over this cast, be sure to allow enough relief for the electrodes and snaps, which will increase the thickness of the liner over the electrodes, of course. [Wayne Daly recommends simply heating the thermoplastic and pushing out to form this relief.] Test the check socket on the patient for maximum range of motion, rotational control, and comfort.

The outer frame is fabricated as usual, allowing for space to mount the preamplifiers, for either the Utah Arm or the ProControl type. We recommend simply fixing the preamps in place with adhesive-backed Velcro, after forming space for the preamps in the frame socket using the dummies supplied with either system. Alternatively, a "pocket" can be formed from acrylic (with some microballoon filler) on the inner socket of the frame, and taping the preamp into this recess with duct tape.

Figure 6. Allow enough relief to slip the snaps into the socket as it is donned.

Figure 7. In one method, snaps are installed just as the electrodes slip into the relief in the frame socket.

Donning techniques using the snap-on wire sets are still open to experimentation. Wayne Daly has simply left the wire set long, extending from the top of the frame socket, and instructs the wearer to install the snap during the donning of the frame over the liner.

Donning Process for the Patient:

1. Wearer dons the liner, paying attention to the skin landmarks which have been previously located and lining them up with the exact location of the electrodes.

2. Wearer dons frame socket "half way", just until snaps are at the trim line of the socket. The ends of the lanyards are threaded through the holes in the bottom of the frame (Figure 8a & b).

3. Wearer snaps wire ends onto electrode snaps (Fig.7).
4. The snaps and wires are carefully tucked into the frame, into the relief that has been formed in the liner. Wearer finishes donning frame.

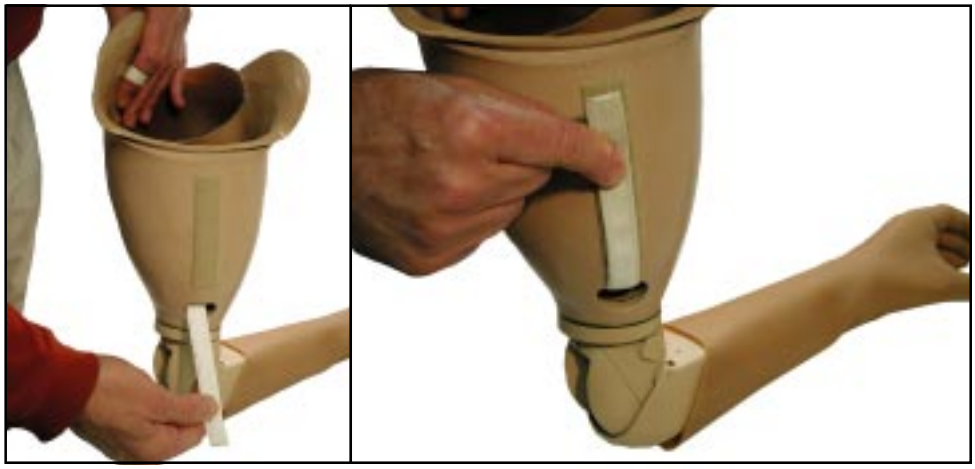


Figure 8a & b. The ends of the lanyard are threaded through the frame.

Alternatively, donning could be simplified if a "window" in the outer frame is fabricated to expose the snap ends of the wire (Figure 9a).

1. Wearer dons the liner (as above). Wearer dons the frame completely. Fasten the shuttle lock if used. The ends of the lanyards are threaded through the holes in the bottom of the frame.
2. Through "windows" in the outer frame, the wearer can reach the ends of the snaps, and installs the wire set to the electrodes. An opening such as this could be covered by a more cosmetic elastic sleeve, pulled over the top of the frame, covering the "windows" (Fig. 9b).

Note:

Whatever method is used to accomplish the connection of the snaps, a few principles should be followed:

1. The snap ends should be protected as much as possible.
2. **Tugging and flexing of the wires as the socket is donned should be avoided.**
3. Once installed, the snaps should be held in place as securely as possible (this will prevent disturbance of the EMG).
4. Avoid any motion of the snap connection as the socket is moved during use of the prosthesis.

Figure 9a. A window in the frame allows the electrodes to be snapped on after socket has been donned.

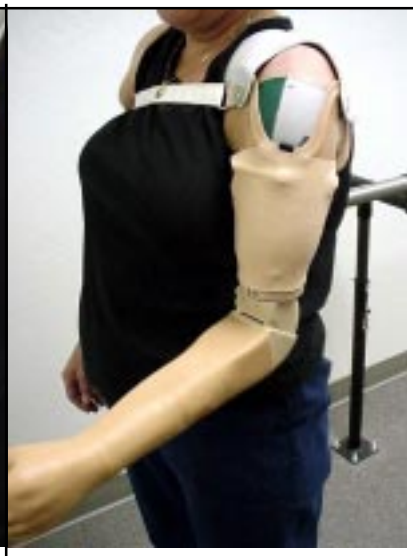


Fig. 9b. Sleeve has been rolled over window to protect wires and for better cosmesis.