COAPT GEN2

# PLANNING EMG ELECTRODE SITES FOR COAPT GEN2® PATTERN RECOGNITION

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# PLANNING PATTERN RECOGNITION ELECTRODE LOCATIONS

Successful pattern recognition use depends on good muscle signal (myoelectric) information. The more myoelectric information the pattern recognition algorithms get, the better the functional control potential.

**The goal of planning and placing electrode contacts for pattern recognition is to spread electrode contacts out as much as possible to capture all underlying muscle tissue that is providing information**. An analogy to this is planning the camera locations at a professional sports event – strategic locations are needed to capture all angles and information from the area of interest.

NOTE

Contact a Coapt representative with any questions about myotesting and/or electrode placement. Coapt is willing and able to assist with placement instruction and suggestion—these can often be accomplished by submitting socket and/or limb shape images to Coapt.

## Step 1: Discussing User Contractions

Having a user explore all of the possible muscle contractions they can imagine, feel, and produce – even if some contractions are faint and even contractions that might not be used for prosthesis control – is the important first step in determining where their underlying muscle information "areas of interest" are.

A thorough discussion will have them think about and try all possible residual limb contractions. Ask the user to first try contractions they would want to use for controlling their specific prosthesis functions. Focus on contractions that are distinct and repeatable.

TIPS

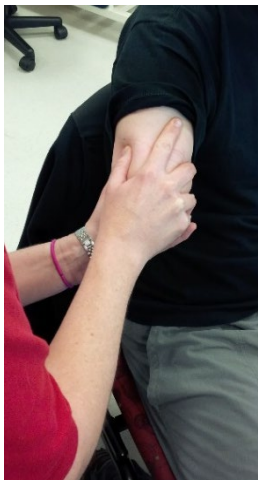
- Allow or encourage the user to mirror their perceived motions with their sound limb as needed.
- When users have difficulty making contractions exactly matching a function (such as not feeling all fingers well enough to mimic a certain grip, or not feeling their wrist turning), explore supplemental contraction variations (for example: adding a feeling of thumb extension to help with wrist supination, a feeling of pinky extension for wrist pronation, or a feeling of fingers spreading for hand open).
- Be patient, listen, and take considerable time with this process.
- Perform this discussion in a relaxed environment.
- Develop a common vocabulary for specific motions.

## Step 2: Palpating to find Underlying Muscle on the Residual Limb

To clinically determine where a user's muscle information "areas of interest" are, have the user repeat all the contractions from Step 1 while holding and feeling as much of their residual limb as possible. Ask the user to sustain each muscle contraction for 3-4 seconds at a medium strength. Take time with this process. Be sure to explore various contractions and repeat as necessary to feel all of the limb.

While feeling the limb, take note of all areas where underlying muscle activity is felt, even if it is subtle. This will guide where electrode contacts should be placed. Consider taking notes, capturing images, or making temporary markings on the user's skin.






TIPS

- Feel for the overall muscle activity – like what the pattern recognition algorithm does – by sensing the patterns of activity at multiple areas simultaneously.
- ***Remember:*** Pattern recognition myoelectric control does not rely on isolated muscle signals, and it does not always need strong muscle signals. Avoid tendencies to only feel with fingertips and to only feel for isolated "hotspots.
- Do not ignore areas of slight/subtle/weak underlying muscle contraction.
- Note any unique or unexpected areas of underlying muscle contraction – for transhumeral amputees, this may mean unique muscle activity distal on the residual limb.
- If the user contracts muscles quite hard for all motions, ask them to make contractions a little more softly.

## Step 3: Planning Electrode Locations

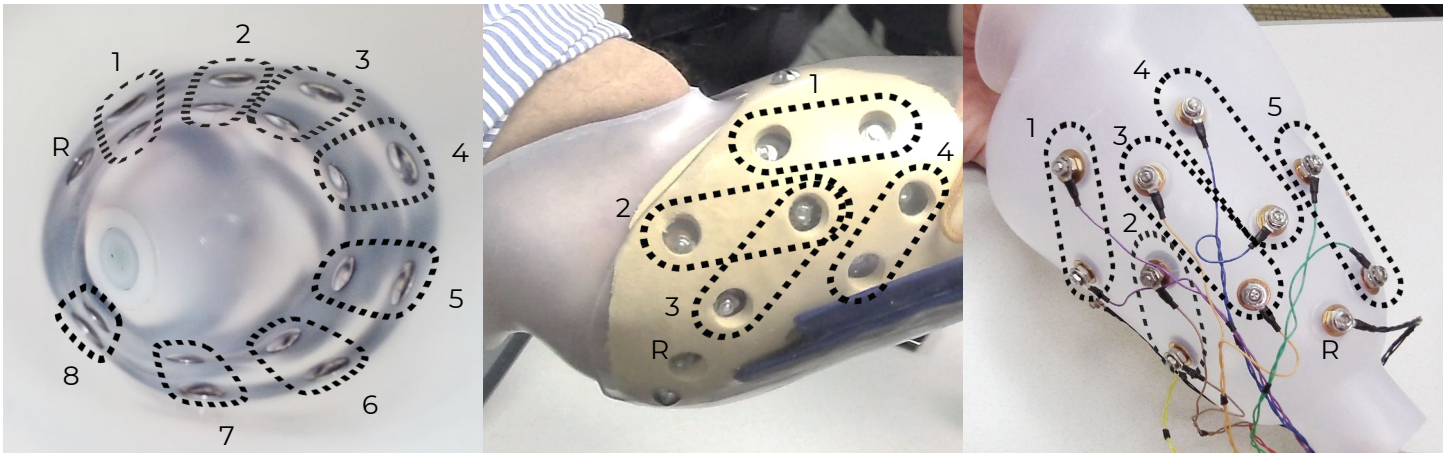
Use the areas of underlying muscle information discovered in Steps 1 and 2 to plan electrode contact locations.

The **Complete Control** System Gen2 has 17 electrode contacts to place, where 1 is an independent reference "ground" contact and the remaining 16 are paired to make 8 "signal channels". Each pair of signal electrode contacts work together to capture the bi-polar, differential measurement of the muscle contraction underlying their location. The two **contacts for a given channel are ideally placed 30-60mm apart** and detect a myoelectric signal from an oval area encompassing their general location. The farther apart the pair of electrode contacts, the larger (and deeper) the sensed area will be, and vice versa.

**General Placement** - Plan to place the 8 sets of 2 signal electrode contacts so their 8 myoelectric detection "oval areas" fully capture all underlying muscle information. The independent reference contact (the 17$^{th}$) should be positioned in a location that maintains excellent electrode-skin contact and should NOT be shared or paired with any of the signal contacts.

**Contact-Pair Orientation** – While it is generally a good idea to align a pair of signal contacts in the direction of underlying muscle fiber direction, it is ok with pattern recognition to place some of the electrode pairs "off-axis". This is helpful when fitting a residual limb with unique areas of muscle tissue, and for geometrically unique and congenital limb presentations.

**Contact Sharing** – For a limb that is too small to reliably fit all 17 electrode contacts, it is ok to have a few of the signal channels share an electrode contact. See the Coapt **ControlSeal™** product handbook for assembly detail when sharing. When connecting the signal conductor wires of the **Complete Control** System Gen2 to shared electrode contacts, do NOT place the two wires for the same channel (same color) on the same electrode contact – this will result in zero signal for that channel and not be helpful for pattern recognition performance. Also, do not leave any conductor wires unconnected. That is, always place electrode contacts for all 8 myoelectric signal channels.




TIPS

- Consider starting with sites that correspond to previous electrode locations when retrofitting existing myoelectric users.
- Do NOT limit electrode placement to "hotspot" areas.
- Identify locations to AVOID placing electrode contacts, such as
  - Areas that will lose electrode-to-skin contact during use.
  - Areas outside of socket boundaries or near valves.
  - Areas that have no underlying muscle (i.e., bone only).
  - Sensitive skin areas.
  - Areas over muscles that contract with arm loading positioning (example: deltoid or brachioradialis muscles).

# INSTALLING ELECTRODE CONTACTS

The electrode domes of the product must be placed through the wall of an inner socket interface. The domed side will contact the skin surface while the connection wire and hardware components are on the outside of the socket interface. When using Coapt **ControlSeal™** electrode domes, please follow the assembly and care instruction of the **ControlSeal™** product handbook.

The wires of the **Complete Control** System Gen2 EMG Connection Cable have 8 different colored pairs to help with connection to the electrode domes. The wire for the non-paired reference "ground" is the only black wire and must connect to its own electrode dome.

All 17 EMG Connection Cable wires must be connected to an electrode contact for proper operation.

NOTE

**Electrodes MUST MAINTAIN CONTACT WITH THE USER'S SKIN for proper operation**. Electrodes that do not stay in contact with the user's skin will lead to prosthesis control limitations. Take care in planning and be sure to fabricate a well-fitting socket interface.

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