

Electrodes

Electrodes are used to transmit the electrical current to the body and can be referred to as electrical conductors. The electrodes are the point of contact where the current that is produced by the electrical stimulation unit reaches the body. Depending on the modality used, electrodes can stimulate the surface of the skin or can be used to stimulate the deep muscle, tendon and ligament tissues.

The electrodes should be durable so that they can be utilized repeatedly over a long period of time. In addition, they must be flexible so that contact with the uneven skin surface is maintained even when the skin flexes during contractions. Due to the possibility of sensitivity to latex, the electrodes should be latex free.

The connection of the cable to the electrode must allow a consistent electrical pulse through each electrode. Therefore, the dispersion of the electrical signal can be uniform over the entire contact surface of the electrode. This characteristic is extremely important when the higher intensities used by electrical stimulation units for muscle contractions are applied. The below illustrations (Courtesy of Pepin Manufacturing, Inc) illustrate the differences between a poor dispersal of the signal and an excellent dispersal of the signal.

Electrode Connection Options

There are two different types of electrode contacts with the body that are used to carry the current to the treatment site.

The first and most common contact is to place the electrodes directly on the surface of the skin. This type of electrode is called transcutaneous, which simply means of the surface of the skin. The other type of electrode contact is made by inserting small wires into the muscle or around the nerve that is to be stimulated, and is called a subcutaneous electrode. This type of electrode that is positioned under the surface of the skin, is mainly used for severe injury or research. A good contact between the skin and the electrode is made by:

- Wetting the skin and contact surface of the electrodes
- Using a non-conductive lubricating jelly between the skin and electrode
- Hair can be removed from under the electrode, through clipping not shaving

Electrode Placement

The electrode placement can be determined through surface palpation of tissue and through diagnostic imaging. Training in the application of electrical stimulation and an understanding of the anatomy and physiology of the horse is essential in determining the correct placement of the electrodes.

When treating the spinal area, the electrodes are placed on each side of the spinal column so that the signal passes through the spine as it travels between 2 electrodes.

Some general guidelines for electrode placement include:

- Directly on painful area felt during surface palpation
- Directly on area identified through diagnostic imaging
- Around the painful area felt during surface palpation
 - This position is used when the treatment site is too painful for direct placement of an electrode
- Over acupuncture or trigger points

Size of Electrodes

Small electrodes are used for TENS units because the signal is typically used in a small and specific area of the body. The electrodes used for TENS, are generally about 1.75" x 1.75" (4.5 to 4.5 cm) squared.

Large electrodes are typically used with electrical muscle stimulation units because they increase the comfort level at the intensities needed for contractions. (Alon G et al, 1994). The size of the electrodes for muscle stimulation tend to be from 1.75" x 3.75" (4.5 x 9.5 cm) up to 4.25" x 7" (11 cm x 18 cm) or larger.

Types of Electrodes

Electrode design continues to evolve and improvements are constantly being made to produce electrodes that are easy to use while providing accurate signals. Some research has been performed to determine the best electrodes to use for the different types of applications. Four different types of electrodes (carbon rubber, single layer pre-gelled, felt and silver foil tape) were compared (Nelson HE et al, 1980) and in general the following guidelines are used to determine the appropriate electrodes to use.

The list is not to be viewed as a comprehensive listing of all of the types of electrodes available, but only as a general reference of the electrodes currently being utilized for electrical stimulation. Of course, new electrodes and improved techniques are constantly being developed. The manufacturers should be contacted to obtain relevant research results of specific electrodes.

1. Carbonized conductive silicone rubber.

These do not typically contain conductive silver.

In comparison with other commonly used electrodes, carbonized conductive silicone rubber electrodes in general produced:

- Slightly higher impedances
- Slightly less torque
- Best for prolonged use
- Minor skin reactions

2. Pre-gelled.

The best quality of pre-gelled electrodes has 4 layers including; topical material, conductive silver, conductive carbo film and gel. In comparison with other commonly used electrodes, pre-gelled electrodes in general produced:

- Lower torque
- Higher electrical impedance
- Produced the most skin reactions
- Easiest to apply

3. Carbon impregnated hard plastic.

These electrodes do not conform to the shape of uneven skin surfaces but have increased durability.

4. Felt or foam covered metal plates.

Can be used for single use, but are difficult to adhere to the skin surface due to the need to soak in water before use. In addition, these electrodes can dry out and currently are not widely used in therapy. Soaking the electrodes in tap water or physiologic saline solution did not produce any significant difference in torque production.

In comparison with other commonly used electrodes, felt covered metal plate electrodes produced:

- Highest torque
- Low electrical impedance
- Good for single use for short periods of time
- Not practical to use

5. Silver impregnated foil tape.

- Variable and unpredictable torque and impedance
- Not recommended