

Transcutaneous Electrical Nerve Stimulation (TENS)

Transcutaneous electrical nerve stimulation devices are most frequently referred to as TENS. TENS devices can be used to assist with short-term or long-term pain relief. These systems are used frequently for acute or post surgical pain.

TENS units all produce analgesia of pain and reduce responses of dorsal horn neurons to painful stimuli. The TENS systems activate the descending inhibitory pathway from the brain stem to the spinal cord. However, the means of reducing pain varies between the specific types of systems and includes activating spinal cord gating mechanisms, endogenous opiates, serotonin receptors, noradrenalin receptors and muscarinic receptors.

The initial development of TENS technology was based on the gate-control theory of pain developed by Melzack and Wall in 1965. The researchers found that pain transmission could be stopped when the "gate" closed, therefore the pain signal would not be felt by the patient. TENS units were developed to send an electrical impulse that confuses the pathways in sensory nerves "gating" or blocking the sensation of pain. However, continued research has shown that there are many different methods the body uses to modulate pain and therefore reducing pain requires a multifaceted approach. The understanding of how TENS devices work continues to evolve, and one current piece of research has found that the blocking of pain may occur at deep tissue afferents.

Many types of stimulators, that are not specifically called TENS devices, will produce a current similar to a device promoted as a TENS unit. With most TENS units, there is no significant increase in blood flow because there is no muscle movement. If muscle contractions are induced with TENS systems, the acceptance of the treatment can be a concern, especially with animals.

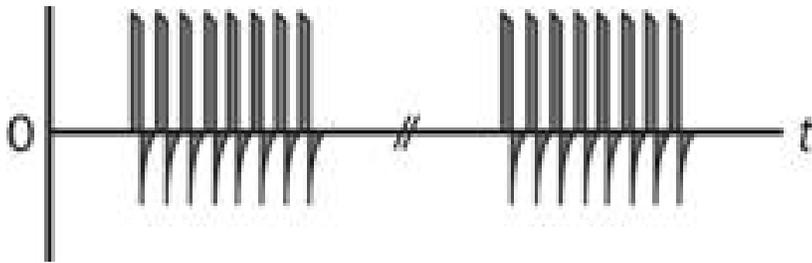
Typically the pain sensation is relieved while the TENS unit is on, but once the unit is removed the pain usually returns. For this reason, TENS units are worn continuously by many users. However, over time the body can learn to accommodate to the TENS sensation and adjustments to the parameters of the electrotherapy device are sometimes necessary to keep this from occurring.

Types of TENS Units

TENS units are typically about the size of a pack of cigarettes. There are usually several predetermined stimulation options available with preset variables. This variety of parameters is used to reduce the problem of adaptation to one stimulus parameter, therefore reducing the effectiveness of the TENS units. There are typically two channels and the user has the ability to control each channel separately, however in most situations the channels are set to be identical.

TENS devices are characterized based on the intensity of the stimulation. Intensity is basically a combination of amplitude, duration and frequency of the pulses. There are three major forms of TENS which are commonly referred to as high frequency, low frequency and noxious. Within these three categories, there are sensory-level stimulators and motor-level stimulators. During sensory-level stimulation, the client will feel a slight tingling or buzzing to the skin, and during motor-level stimulation the client will feel a muscle contraction. Motor-level stimulation is typically used for chronic pain.

High-frequency (or conventional) TENS (sensory and motor)

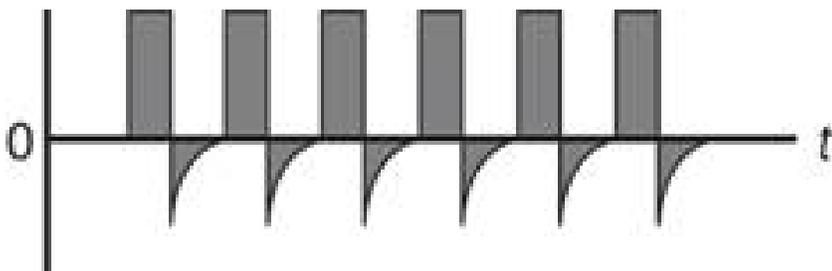


Example of High-Frequency TENS Stimulation Pattern

These TENS units stimulate sensory nerves and can cause an increase in the pain threshold. At the highest frequencies, the TENS devices can stimulate motor nerves. The analgesic effect is thought to occur due to the activation of acetylcholine, a neurotransmitter. In addition, there is some current research showing that the release of endogenous opiates occurs with high-frequency TENS. The release of opiates was originally thought to only occur with low-frequency stimulation.

High-frequency TENS uses short pulse durations of around 20 microseconds combined with a 50-200 pps frequency of stimulation. The client can tolerate the stimulation for hours, but the resultant pain relief generally lasts for a short period of time.

Low-frequency TENS (sensory and motor)



Example of Low-Frequency TENS Stimulation Pattern

Low-frequency TENS will cause pain relief due to the release of endogenous opiates, activation of serotonin and acetylcholine. The frequency is less than 10 pps (typically 1 to 4 pps) with long pulse durations of 150–200 microseconds. The amplitude can be adjusted so that a muscular contraction is elicited. This form takes longer to provide pain relief after initiation of treatment, and analgesia lasts for some time after the stimulation has ended. The treatment is typically less tolerated by the client and lasts 20–30 minutes.

Noxious also referred to as Brief or Intense TENS (high-frequency and low-frequency)

This type of TENS has an extremely long pulse duration that can last up to 1 second. The frequency can be low intensity of 1–5 pps of high intensity of up to 100 pps. Current amplitude is adjusted to the greatest intensity tolerated. Noxious TENS can be used in an attempt to produce a longer lasting and more generalized pain relief. This may be due to the activation of serotonin and noradrenergic receptors as well as the release of endogenous opiates.

Waveforms

Early models were unbalanced in phase charge, but the most recent models are balanced. Most current TENS devices have similar current features.

- Pulsed
- Rectangular
- Asymmetric
- Biphasic

Clinical Considerations

Adjustments of the stimulation frequency, pulse duration and amplitude are necessary to find optimal results. TENS users should experiment with electrode placement, placing the electrodes over the painful area, surrounding the painful area, or even on the opposite side. Chronic pain relief is generally not long lasting and frequently returns after the TENS device is removed. Noxious level TENS is not usually an option for animals due to the higher amplitudes necessary to produce a painful sensation.

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