

WHAT IS TENS ?

A Transcutaneous Electric Nerve Stimulator (TENS) is a device used as an alternative to medication in controlling pain. It utilizes a portable, battery operated, patient-wearing device which transmits mild electrical currents to underlying nerves through lead wires and conductive electrodes placed on the skin. Unlike drugs, it is safe, non-addictive, non-invasive and has no side effects.

INDICATIONS

TENS has been used successfully in the symptomatic management of mild to severe pain including, but not limited to:

Chronic

low back syndrome
headache
arthritis
causalgia
phantom limb pain
herpes zoster
tic douloureux
cancer pain

Post-Surgical Acute

meniscectomy
laminectomy
total hip
gastrectomy
cholecystectomy
various abdominal operations with upper mid-line incisions

Post-Traumatic Acute

sports related injuries including:
hip pointers
elbow
epicondylitis
rib contusions
trapezius strains

THE TENS UNIT

The TENS unit utilizes a nine (9) volt disposable or Ni-Cad rechargeable battery as a power source.

There is one lead wire hole for each of two (2) channels of stimulation, with each channel individually adjustable in amplitude. Each site of pain requires one channel with two electrodes applied closely together.

Application to the skin is done through a conductive electrode which evenly transmits electrical current to the skin. The electrodes are available as a separate carbon rubber square requiring a conductive gel and a tape adhesive over it, or as a complete unit utilizing various conductive mediums; such as Karaya gums, gel, synthetic blue or clear conductive adhesive polymers.

ADJUSTMENT DIALS

The electrical current used in a TENS unit is an alternating current with a square pulse (see Figure 1). The adjustments that can be made to this waveform are represented by dials on the unit.

RATE - This is the number of square pulses which occur within each second of stimulation. This is usually measured in Hertz (Hz). Adjustment of this dial will affect both channels on the TENS unit simultaneously.

WIDTH - This is the duration of each pulse. It is measured in microseconds (μs). This adjustment widens the pulse and is similar to intensity in that it increases current through the electrodes. It is a comfort setting, but may require adjustments for patients with a high degree of tissue mass to penetrate.

AMPLITUDE - This is the height of each pulse and is measured in milliamperes (MA). It increases the current to the electrode. On a dual channel unit there is an amplitude dial to control each channel independently.

TREATMENT MODE SWITCHES

There are various modes of treatment available with most TENS units. These have been added to the design of the units over the years to incorporate various theories on electrical pain management. The conventional mode is the most researched and used form of stimulation. The other modes, though not as well researched, are included and can be used as an alternative if the conventional mode fails to mask the patient's pain adequately.

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HIGH RATE/CONVENTIONAL MODE - Conventional High Rate mode is the most frequently used and successful mode. High Rate TENS (60-150 Hz, 70-100 μ s) is generally preferred for long-term management of chronic pain and for controlling the dull throbbing pain associated with acute and post-operative pain. Because of its comfortable sensation, patient compliance is high.

It should be worn at an amplitude setting just below muscle contraction levels. Patients may use this mode for as long as they need to during the course of the day. Some patients use this setting for up to 24 hours a day, although the average is 12-14 hours.

LOW RATE/ACUPUNCTURE-LIKE MODE - Low Rate/Acupuncture mode (2-9 Hz) is generally used as a treatment modality for short-term therapy. It is most commonly used as an adjunct to the Conventional mode or as an alternative when the Conventional mode is ineffective. In the Low Rate mode the unit is worn for 15-30 minutes above muscle contraction level or at a maximum tolerable stimulation level. It is used on an as-needed basis to control pain but should not be worn for long intervals. Conventional mode TENS can be applied during the intervals between the Low Rate treatment sessions.

BURST MODE - Low Rate/Burst mode (2-9 Hz) is also used as a treatment modality for short-term therapy. It utilizes a series of higher frequency pulses delivered in "bursts" at a low rate. It is used as a comfortable alternative to Low Rate/Acupuncture mode and follows the same usage guidelines.

MODULATION MODE - This mode constantly alters the pulse rate and width to produce a rhythmic, massaging sensation at the stimulation site. This mode can be used as an alternative to Conventional simulation when used at below muscle contraction levels, or as a Low Rate stimulator when used at maximum tolerable levels.

This mode was thought to minimize the chances of the patient accommodating to the TENS device. We now know that this phenomena does not exist in regards to TENS usage.

These are general guidelines for the application of the various modes available in most TENS units. You should read the operation manual of each manufacturer's particular device to fully understand their recommendations on how their modes should be adjusted or if they are available with that device.

WHY SO MANY DIFFERENT MODES?

There has been a lot of discussion as to the efficacy of using these various waveforms and what exactly they are doing to reduce pain.

Although Conventional High Rate TENS success has been extensively documented, there is very little known about the mechanism under which it is managing the patients' pain. The other newer forms of stimulation, Burst, Modulation, and Low Rate, have all been proposed by various manufacturers over the years as the definitive answer to controlling pain with electrical current.

In fact, however, there has been little research to reinforce the claims of success made by these manufacturers who propose these new waveform types. We actually have experienced a decline in overall success rates with TENS since the advent of the new stimulation modes.

Generally, the experts agree that the way to control pain is through a combined effort on the part of the manufacturer, dealer, physician, therapist and patient. It seems that the simple and comfortable conventional High Rate stimulation has the greatest compliance by the majority of patients and produces the highest level of patient success in reducing pain.

The Low Rate, Burst and Modulation modes seem to massage the patient when worn at muscle contraction levels and patients with muscle tightness may prefer it as an initial treatment. In all cases, they should treat themselves only for short periods and eventually switch over to the conventional mode for long term pain management.

FITTING THE TENS UNIT

Application of the TENS unit is a simple process and the patient should have received instruction from the clinician who prescribed the unit to him. If, however, the patient has been told that you would be instructing him on how to fit the system, just follow these guidelines for application. Plan to spend up to an hour with the patient. Schedule an appointment which allows you to have the time available to explain the system completely.

1. Make sure you have a complete TENS unit available for the patient to take home.
2. Briefly explain to the patient about TENS and its benefit over medication.
3. Insert a fresh battery into the unit. Prepare the electrodes for application.
4. Set the unit to conventional stimulation levels:

Adjust the pulse rate (Hz) dial to a value between 60-100 Hz.

Adjust the pulse width dial (μ s) to a value between 100-150 μ sec.

5. Find the location for the application of the electrodes using the ELECTRODE PLACEMENT GUIDE. Clean the skin at the application site with a mild skin cleaner (alcohol will dry out the skin and may contribute to skin breakdown). Apply the electrodes to the skin. If it is a large area or two separate areas of pain, you may need to use both channels of the stimulator. If you have an intense or localized pain, you can cross the channels of current directly over the area.
6. Slowly increase current through the amplitude dial until the patient feels the stimulation. They should experience a tingling, prickly, warm or slight pulling sensation. Once they tolerate the sensation, increase the dial further until a slight muscle pull or contraction is seen by you or felt by the patient. Pause. Turn intensity down to a level just below this contraction. This will be the patient's normal wearing amplitude.
7. Have the patient wear the TENS unit on a continuous basis until they experience pain relief. Once pain relief is achieved, they may reduce their wearing time by one hour each day to find their optimum wearing time. The average wearing time is 10-14 hours per day, although 24 hours a day wearing is not uncommon.
8. The patient may want to try the other forms of stimulation such as Low Rate, Burst, and Modulation if the Conventional mode is either ineffective or uncomfortable. Follow the suggestions for application for these modes in the TREATMENT MODES section above.

PATIENT SKIN CARE GUIDELINES

Skin irritation ranks as the number one cause of patient rejection of the TENS device. Although it is a major problem, almost all breakdown can be remedied with a systematic approach to skin care and a working knowledge of the alternatives that are available in adhesive systems.

It is very rare for patients to develop skin irritation due to the electrical stimulation. Because of the advancements in conductive gels, we also do not expect to see irritation developing from the type of gels used. The clear majority of skin breakdown will occur immediately under the area covered by the tape or conductive adhesive.

General Preventive Tips

The best approach to skin irritation is to prevent it from occurring. Here are a few helpful hints for general patient care.

1. Wash the electrode placement area carefully, using a mild soap and water. Do not scrub the skin; pat dry. Do not use alcohol. It will dry out the skin and enhance the chances of skin irritation.
2. Many skin problems will surface because of the stress caused by "skin shear". This occurs when you excessively stretch the surface of the skin. Make sure you apply the electrode tape by pressing the center and working the adhesive outward to apply. Allow room for the skin to move beneath the tape, if possible. Do not rip tape off the skin; moisten with water and remove carefully. Stretchable, extended wear systems will help to minimize this common problem.
3. It may be helpful to swab the area under the electrode after removal with unflavored milk of magnesia to help balance the Ph of the skin between applications.
4. United Skin Prep or similar inexpensive skin barrier wipe-on solutions should be considered as the first step in combating minor irritation.
5. If the patient perspires heavily, but has sensitive skin which will limit the use of highly aggressive tapes, try wiping the area with a five day anti-perspirant pad prior to tape application. Do not use a spray or heavily perfumed pad.
6. Due to drying out of the gel, carbon rubber electrodes which are gelled by the patient should be removed and gel re-applied once every 8-12 hours.

Suggested Treatment Tips

1. Reusable carbon rubber electrodes that have to be gelled by the patient may create some unique problems of their own. Electrical burns directly under the electrode may be caused by inadequate or excessive gel under the carbon rubber electrode. The gel should be about the thickness of a dime applied evenly over the pad. Too much gel may cause the current to arc to the skin, causing burns. Too little gel will result in redness and blisters.

Carbon rubber electrodes will diminish in their ability to conduct current as they are impregnated with body salts. Should the patient's unit slowly weaken in power output, replacement electrodes should be tried. Skin burns can also occur due to uneven stimulation from a dying electrode.

2. Once the skin has broken out, there are many treatment creams and gels available to use. Sween cream, Hollisters skin gel, or any non-greasy ointments may be used.

While the area is healing, you can apply the electrode in a circular pattern around the inflamed area until the area heals.

If the electrode placement site is so specific that you must treat over an irritated, weeping or broken skin area, you may apply a karaya gum powder to the area prior to application as it will not impair the adhesiveness of the tape and will protect the area from further irritation.

TAPES/CONDUCTIVE ADHESIVES

There are many types of adhesive systems available. They all have specific functions and vary in cost depending on their characteristics and longevity. Choosing the correct system for the patient is the most important part of the success of the TENS device. The following systems are listed by cost to the patient and effectiveness in reducing irritations. They should be tried in the order listed.

1. Surgical Tape - The least expensive and readily available at any drug store. It is difficult for an individual to apply themselves. Inadequate coverage will result in premature drying out of the gel. Paper will not hold up as well under moist conditions.
2. Precut Paper Tapes - Precut to fit electrode makes application simple. Permeability allows skin to breathe. Paper will not hold up as well as tape under moist conditions. Does not stretch, will cause skin shear.
3. Precut Plastic Tapes - Precut to fit electrode makes application simple. Plastic backing will hold up well under moist conditions or during periods of heavy activity. Does not allow the skin to breathe. Does not stretch, will cause skin shear.
4. Foam Tape - Precut to fit electrode makes application simple. Backing will hold up well under moist conditions or during periods of heavy activity. Does not allow the skin to breath. Stretches, minimizes skin shear.
5. Woven Fabric Flesh-Tone Tape - Precut to fit electrode makes application simple. One way stretch fabric minimizes skin shearing. Allows skin to breathe. Flesh tone is inconspicuous.
6. Pre-Electroded: Tape-Backed Karaya Pads - A smaller karaya pad (see below) and electrode is backed by a flesh-toned woven cloth-like material. Peel backing, moisten karaya pad and stick. Tape allows for better stick and woven material stretches. Usually worn for 3 days at a time.
7. Pre-gelled Foam-Backed - Will last up to three days. Minimizes skin shear since it is removed less frequently. Stretches, minimizes skin shear. Backing will hold up well under moist conditions or during periods of heavy activity. Simple to apply, just remove protective paper and apply, no fuss. Carbon rubber is included and disposable with system. Eliminates saturation problem with reusable electrodes.
8. Karaya Pads - Karaya gum is hypo-allergenic, self adhesive and reusable for up to 14 days. Apply directly to carbon rubber electrode as a replacement to tape and gel. Simple to use, just moisten and stick. Does not stick as well as tape. Not suitable for active patients. Adhesiveness is greatly affected by heat and moisture.

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9. Pre-Electroded Karaya Pads - Includes carbon rubber electrode. Otherwise, same as above.
 10. Synthetic Conductive Adhesives - There are many types of man-made polymers on the market which eliminate some of the problems usually associated with tapes and karaya pads. They are available as a complete unit, which includes the carbon rubber electrode. They tend to last longer than Karaya pads and stick more aggressively. They are not as affected by heat and moisture. They should all be moistened prior to application. Newer types entering the market will be less expensive, stick as well as tape and have extended lives. This will eventually be the application of choice.

This list in no way covers all of the adhesive systems that are available from all of the various manufacturers in the lucrative TENS accessories marketplace. It will, however, give you a general idea of the variety of options available to you and your patients and will show you the importance of trying different systems before giving up with the patient.

CONTRAINDICATIONS

Federal law restricts TENS to be sold "by or on the order of a physician".

TENS is contraindicated for use with patients who use "demand type" pacemakers as the TENS can simulate heart rate to the pacemaker. Pregnant women should use a TENS unit only under careful supervision from their physician. TENS applied over the carotid sinus, laryngeal or pharyngeal muscles may be hazardous.

HOW IT WORKS

Although the explanation as to why TENS works is unclear, there are two current theories on the mechanics of pain management which are being proposed.

1. Conventional/Long Wearing TENS (High Rate) Although not clearly defined, seems to work by altering the pain signal at the periphery that is normally transmitted to the brain. The pain still exists, but the patient's brain does not receive the information in order to process it. 95% of all TENS patients utilize conventional forms of stimulation.
2. Low Frequency/High Intensity TENS (Low Rate, Burst, Modulation) This mode is believed to stimulate the body's own chemical pain killer (endorphins) to mask pain. Results are similar to the effect of pain medication and this mode is used in similar indications.