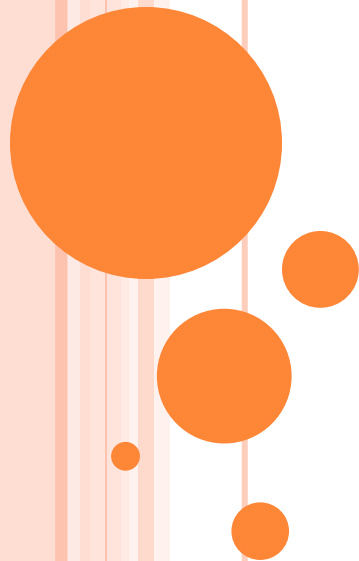


# **TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS)**

**Aakanksha Bajpai**  
**Assistant Professor**  
**School Of Health Sciences**



- Transcutaneous electrical nerve stimulation, or TENS, is the term used to describe an electrotherapeutic modality used in pain control.
- “**Transcutaneous**” means “through the skin,” and “**nerve stimulation**” implies that the current has sufficient intensity to cause the depolarization of sensory, motor, or pain nerves.
- Therefore, whenever electrodes are attached to the body, an electrical current is passed through them, and the patient first reports a tingling sensation, TENS is being performed.



# HIGH-FREQUENCY TENS (SENSORY LEVEL)

- Conventional TENS treatment, applied with a high pulse frequency (60 to 100 pps), short pulse duration (less than 100  $\mu$ sec, yielding a phase duration of approximately 50  $\mu$ sec), and sensory-level intensity that stimulates A-beta fibers, activates the pain-modulating gate at the spinal cord level.
- In other words, the gate is closed to pain transmission and opened to the transmission of sensory information. The result is segmental analgesia within the dermatome(s) treated.



- The benefits of sensory-level pain control are short lived. Touch sensation returns to the pre-treatment level within 30 minutes after the TENS was discontinued, although thermal thresholds may remain elevated.
- High-frequency TENS is effective in the treatment of acute soft tissue injury, but care must be taken to avoid unwanted muscle contractions.
- Other indications for high frequency TENS include treatment of pain associated musculoskeletal disorders, post-operative pain, inflammatory conditions, and myofascial pain.



# LOW-FREQUENCY TENS (MOTOR LEVEL)

- Low-frequency TENS (low TENS) is applied with a low pulse frequency (2 to 4 pps), long phase duration (150 to 250  $\mu$ sec, yielding a phase duration of approximately 75 to 125  $\mu$ sec), and a strong, but nonpainful motor-level intensity in treatment bouts lasting a minimum of 45 minutes. These stimulation parameters activate small-diameter motor nerve fibers and possibly C fibers. This protocol also activates A-beta fibers.



- Some studies have concluded that there is no difference in pain reduction between sensory and motor-level TENS. Motor-level TENS significantly increases the mechanical pain threshold relative to sensory-level TENS. In cases where pain is the result of mechanical pressure, such as swelling, muscle spasm, or trigger points, the patient may gain more benefit from motor-level TENS.



# BRIEF-INTENSE TENS (NOXIOUS LEVEL)

- This method of TENS application is delivered at a high pulse frequency (greater than 100 pps), long pulse duration (300 to 1000  $\mu$ sec, yielding a phase duration of approximately 150 to 500  $\mu$ sec), and a motor-level intensity in treatment bouts lasting a few seconds to a few minutes.
- Pain relief is achieved by activating mechanisms in the brain stem that dampen or amplify pain impulses.



- A high level of analgesia is achieved through this application protocol, but the effects are more transitory than those derived from high- and low-frequency TENS. Because of the short duration of pain relief, this technique is recommended for pain reduction before rehabilitation exercise.





**TABLE 13-1 Protocol for Various Methods of Transcutaneous Electrical Nerve Stimulation Application**

| PARAMETER          | HIGH TENS        | LOW TENS          | BRIEF-INTENSE TENS  |
|--------------------|------------------|-------------------|---------------------|
| Intensity          | Sensory          | Motor             | Noxious             |
| Pulse frequency    | 60–100 pps       | 2–4 pps           | Variable            |
| Pulse duration*    | 60–100 $\mu$ sec | 150–250 $\mu$ sec | 300–1000 $\mu$ sec  |
| Mode               | Modulated rate   | Modulated burst   | Modulated amplitude |
| Treatment duration | As needed        | 30 min            | 15–30 min           |
| Onset of relief    | <10 min          | 20–40 min         | <15 min             |
| Duration of relief | Minutes to hours | Hours             | <30 min             |

*\*The sum of the two phases forming the pulse.*

*Source: Adapted from Bechtel and Fan, p 41.*

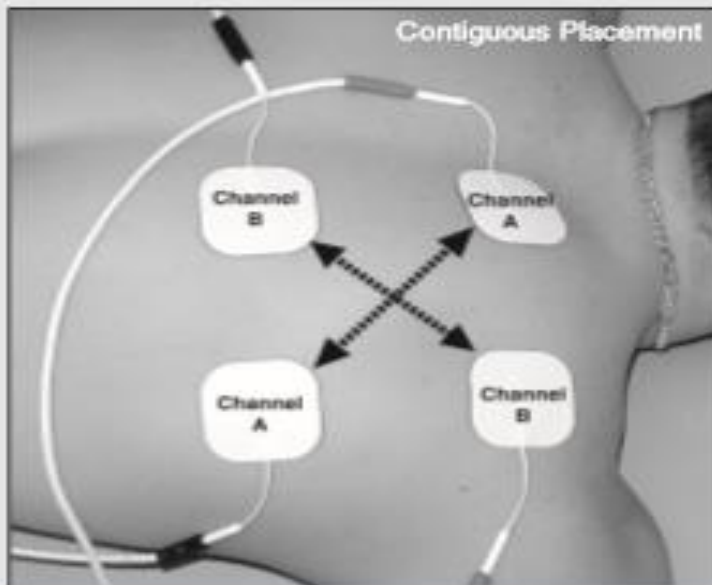
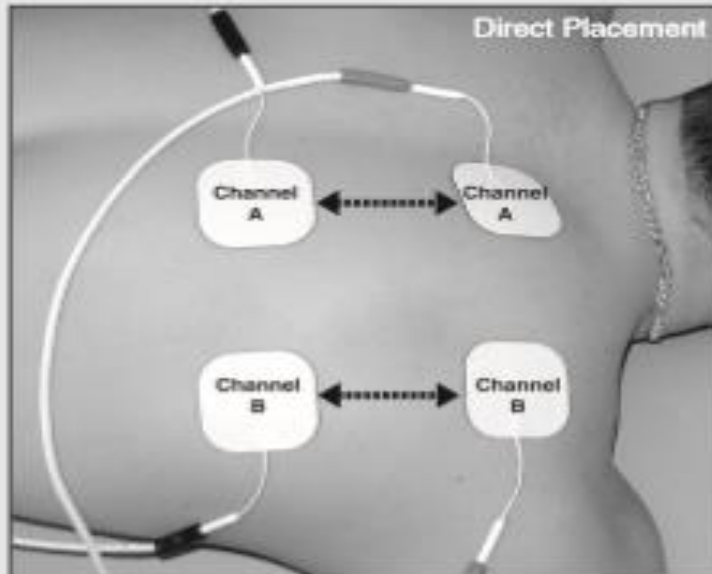


# OTHER BIOPHYSICAL EFFECTS OF TENS

- Range of motion and muscle strength may be improved secondary to pain reduction.
- The use of low-frequency TENS may be more effective at improving range of motion than the high-frequency TENS protocol.
- During the early stages of rehabilitation, patients using TENS have demonstrated the ability to reduce the need for pain medication and a more rapid return to active exercise relative to patients not using TENS.



## Box 13-4. TENS ELECTRODE PLACEMENT



### Direct Placement

Electrodes are placed directly on the painful site. The electrical channels run parallel to each other.

### Stimulation Point Placement

Motor, trigger, and/or acupuncture points are targeted (see Box 11.3). Because of the close location of these areas, a single TENS electrode may stimulate all three points at once.

### Spinal Cord–Level Placement

The spinal cord nerve roots associated with the pain are targeted. The electrodes are placed between the spinous process parallel to the spinal column.

### Contiguous Placement

Used when direct placement is contraindicated. Electrodes are placed around the painful tissues. Electrical channels can run parallel to each other or their currents can cross over the target tissue.

### Dermatome Placement

One electrode is placed at the corresponding spinal cord nerve root and the other at the distal end of the dermatome. When pain is distributed across one or more dermatomes, place the electrodes within the affected dermatome and the contralateral dermatome.<sup>148</sup>

### Contralateral Placement

Based on the concept of bilateral transfer, electrodes are placed on the opposite side of the body, approximating the location from which the pain is arising on the injured side.

# INSTRUMENTATION

- **Intensity:** On most units there is one intensity dial for each channel. Although the intensity of each channel is individually controlled, the other current parameters (pulse duration and pulse frequency) regulate the activity in all channels.
- **Pulse duration:** Usually labeled “PULSE WIDTH” on the unit, this adjustment should be set according to the treatment method being used. Lower durations are used for sensory level approaches, moderate durations are used for motor-level technique, and long durations for noxious stimulation.



- **Pulse frequency:** Also labeled “PULSE RATE,” this adjustment sets the number of pulses per second used during the treatment. Increasing the pulse frequency decreases the interpulse interval.
- **Modulation Mode:** Modes are used to alter the current in an attempt to reduce the amount of accommodation that occurs. The various modes that are commonly selectable are:



- ✓ **Constant:** Current flow occurs at a constant amplitude, rate, and pulse duration. This mode is best described as unmodulated, to avoid confusion with uninterrupted current. This mode is used when the treatment is not required for an extended length of time and accommodation is not a concern.
- ✓ **Burst modulation:** In the burst mode, pulse frequencies are interrupted at regular intervals. Bursts allow “OFF” time from stimulation and assist in reducing muscle fatigue in low-frequency TENS treatments.



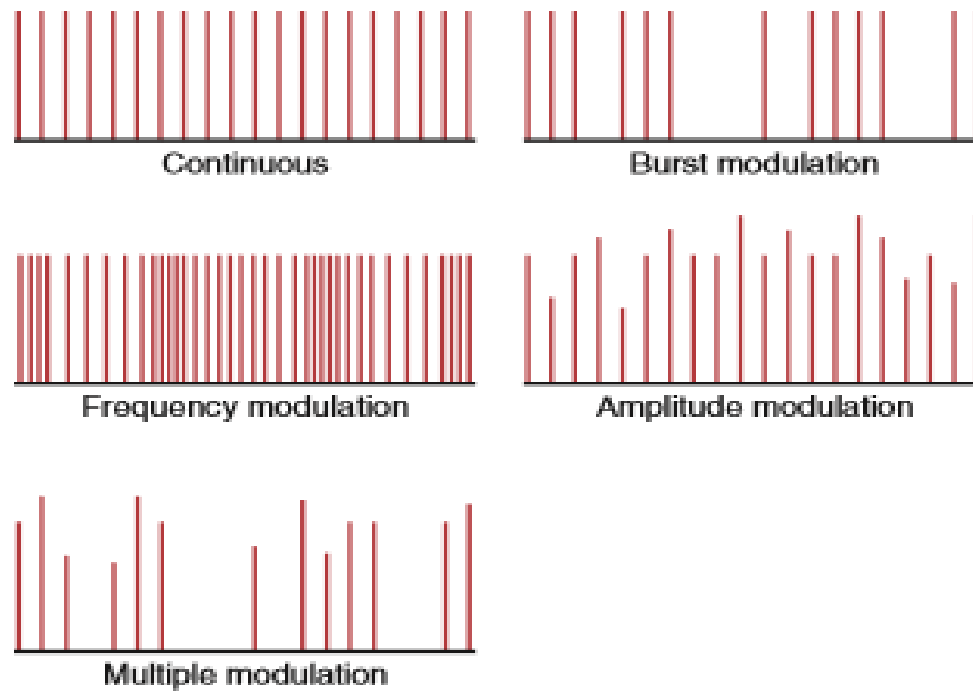
- ✓ **Frequency modulation:** This setting alters, at a preset percentage, the frequency at which the stimulus is delivered. For example, if the pulse rate were adjusted to 100 pps, the unit would alternate the rate between 90 and 110 pps. Modulating the frequency has been found effective in the treatment of chronic musculoskeletal pain.
- ✓ **Amplitude modulation:** The pulse amplitude is increased and decreased by a preset percentage. Modulating the amplitude has been shown to provide short-term analgesia in the area.



- ✓ **Multiple modulation (random):** Intensity, frequency, and pulse duration are alternately modulated in such a way that there is delivery of a steady amount of current to the body, but the body has a varying sensory perception of the treatment. This mode decreases the effects of accommodation during prolonged TENS application.







**Figure 13-3. Output Modulation.** To prevent accommodation and habituation the generator can randomly alter several output parameters.



# SETUP AND APPLICATION

## ○ **Initiation of the Treatment**

- ✓ **Adjust output parameters:** Depending on the method of TENS application used, set the pulse duration (WIDTH) and pulse frequency (RATE) dials to the midrange of the recommended parameters.
- ✓ **Select the electrodes:** High-frequency TENS should be applied with larger electrodes. Low-frequency TENS and brief-intense TENS should use progressively smaller electrodes.



- ✓ **Set the output mode:** Select the appropriate MODE for the method and duration of the TENS application.
- ✓ **Make sure the unit is off:** Make sure that the output intensity is reset to zero, and turn the unit on. Note that many TENS units have the power switch built into the intensity knobs. In this case, the intensity level of zero is equal to “OFF.”
- ✓ **Increase the output intensity (channel 1):** Slowly turn up the INTENSITY of channel 1. If this treatment involves sensory-level stimulation, continue increasing the intensity until a slight muscle contraction is visible, then reduce the intensity by approximately 10%.  
(Monitor the patient for comfort while increasing the intensity.)

- ✓ **Increase the output intensity (channel 2):** If more than one channel is used, increase the intensity of the remaining channels.
- ✓ **Balance the channels:** Adjust the intensity of the channels so that an equal amount of stimulation occurs under each set of electrodes.
- ✓ **Fine-tune the output:** When “fine-tuning” the treatment parameters, most manufacturers recommend first adjusting the intensity, then the pulse duration, and finally the pulse frequency.



- ✓ **Provide home-care instructions:** If the patient is being sent home or to class while wearing this unit, instruction should be provided on how to adjust the intensity. If indicated, provide instructions on how to disconnect the unit before taking a shower or retiring for the night, and during recharging.



# INDICATIONS

- Control of acute or chronic pain
- Management of postsurgical pain
- Reduction of post-traumatic acute pain
- Low back pain
- Arthritis (RA, OA etc)
- Neuropathic pain
- Acute post-operative pain
- Visceral pain & dysmenorrhea
- Sports injuries
- Phantom pain



# CONTRAINDICATIONS

- Cardiac disability
- Demand-type pacemakers
- Arterial disease Uncontrolled hemorrhage Sites of infection
- Blood clots
- Pregnancy
- Cancerous lesions Exposed metal implants History of seizures
- Sensory or mental impairment Unstable fractures



# PRECAUTIONS

- Transcutaneous electrical nerve stimulation is a symptomatic treatment that can mask underlying pain and other conditions.
- Improper use can result in electrode burns or skin irritation.
- Intense or prolonged stimulation may result in muscle spasm and/or muscle soreness.
- Intake of 200 mg or more of caffeine may reduce the effectiveness of TENS.
- Narcotic use decreases the effectiveness of TENS.





# REFERENCE

- Therapeutic modalities. Chad starkey. Fourth edition.



**THANK YOU**

