Electrical Current to Control Pain: Transcutaneous Electrical Nerve Stimulation (TENS)

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Outlines

Pain Control

Parameters for Electrical Stimulation for Pain Control

- Waveform
- Pulse Duration
- Frequency
- Current Amplitude
- Treatment Time

Modes of TENS application in clinical setting

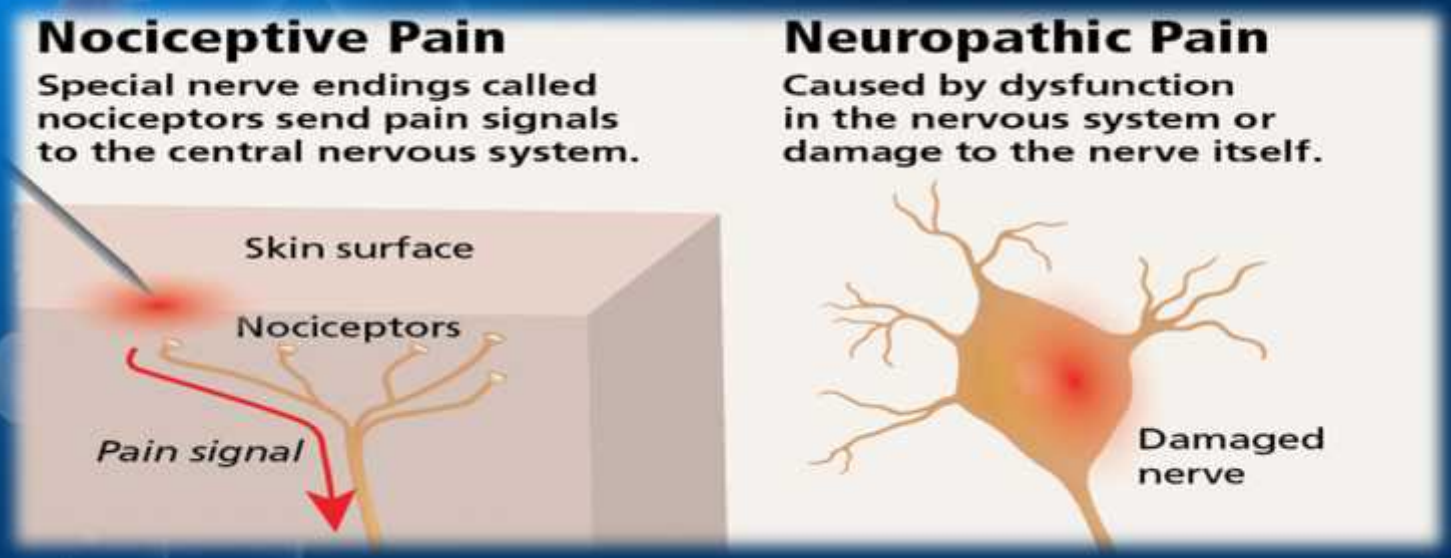
- Conventional TENS
- Low-Rate/Acupuncture-Like TENS
- Burst Mode

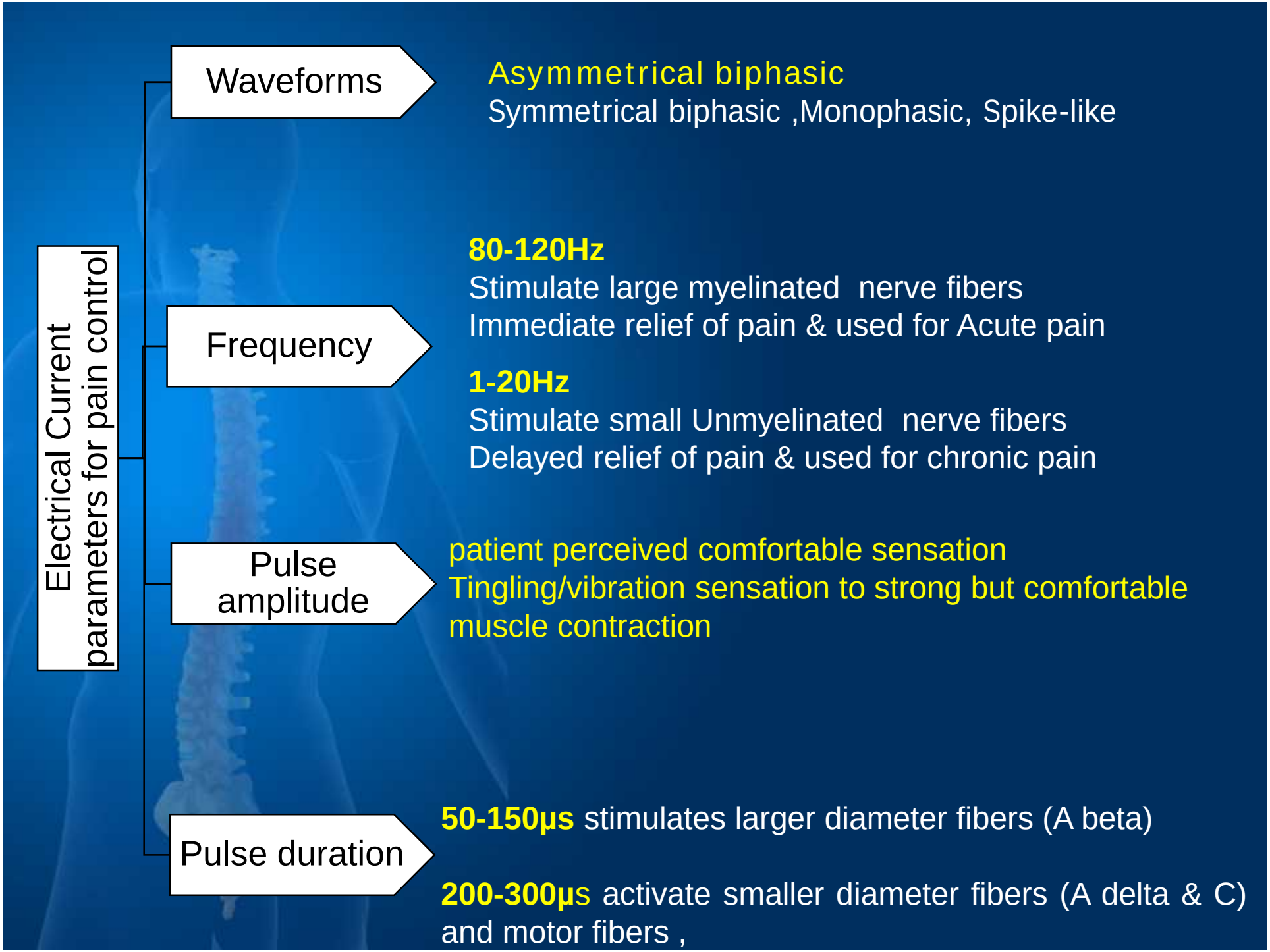
Indications/ for the Use of Electrical Currents for Pain Control

Contraindications//Precautions for the Use of Electrical Currents for Pain Control

Pain

- **Pain** is “An unpleasant sensory & emotional experience associated with actual or potential tissue damage.
- **Ac**ute versus chronic pain
- Nociceptive versus neuropathic pain



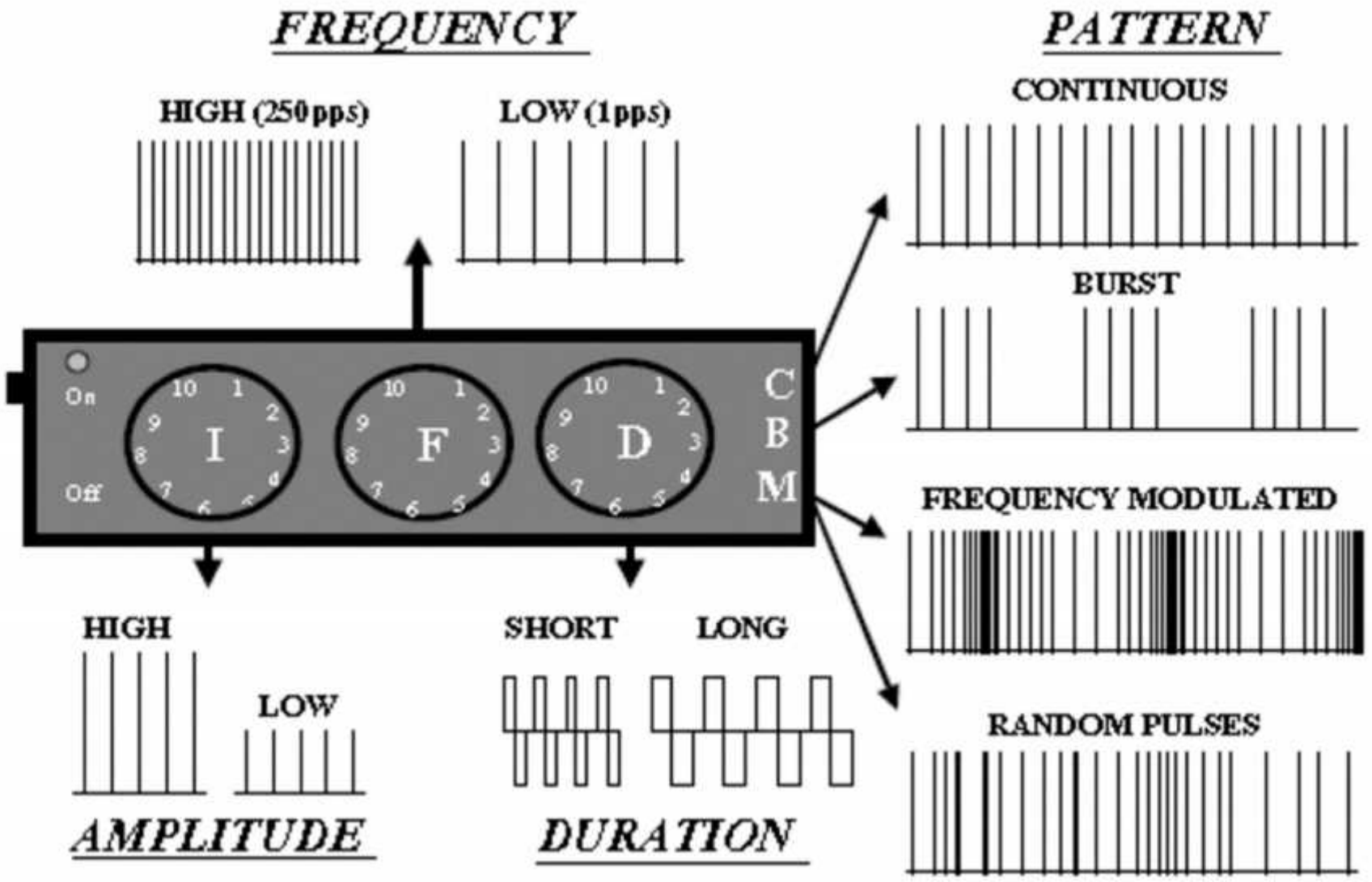

Electrical Current parameters for pain control
Waveforms
Asymmetrical biphasic
Symmetrical biphasic ,Monophasic, Spike-like
Frequency
80-120Hz
Stimulate large myelinated nerve fibers
Immediate relief of pain & used for Acute pain
1-20Hz
Stimulate small Unmyelinated nerve fibers
Delayed relief of pain & used for chronic pain
Pulse amplitude
patient perceived comfortable sensation
Tingling/vibration sensation to strong but comfortable muscle contraction
Pulse duration
50-150µs stimulates larger diameter fibers (A beta)
200-300µs activate smaller diameter fibers (A delta & C) and motor fibers ,

Transcutaneous Electrical Nerve Stimulation (TENS)

TENS is a low frequency pulsed current used to stimulate peripheral nerves through surface electrodes aiming to control and relief pain (acute/ subacute, chronic and postoperative pain).

TENS is non-invasive anon pharmacological physical therapy modalities used to relief pain(acute & chronic) through stimulation of peripheral nerve using surface electrodes.

Modes of TENS Application



Modes of TENS Application

TENS modes	Frequency (Hz)	Pulse duration (μS)	Intensity (mA)	Pain modulation	Nerve fibers stimulated
Conventional-High-frequency; Sensory TENS	80-150Hz	≤150μS	Sensory (Tangling)	Gating at spinal level	Large myelinated (Aβ) fibers
Acupuncture-Low-frequency Motor TENS	1-20Hz	200-300μS	Sensory (Tangling) + Motor (Rhythmic twitch MS Contraction)	Supra-Spinal (Beta-endorphin / Enkephalin)	Large myelinated (Aδ) and C fibers
Burst mode TENS	50-150Hx burst (5-10)	100-300μS	Sensory Strong-Rhythmic muscles contr.		Sensory/motor
Brief-intense TENS	80-150Hz	≥ 150μs	Sensory (Tangling) + Non-Rhythmic MS contration		Sensory/motor/ nociceptive fibers A beta/ A delta/C fibers

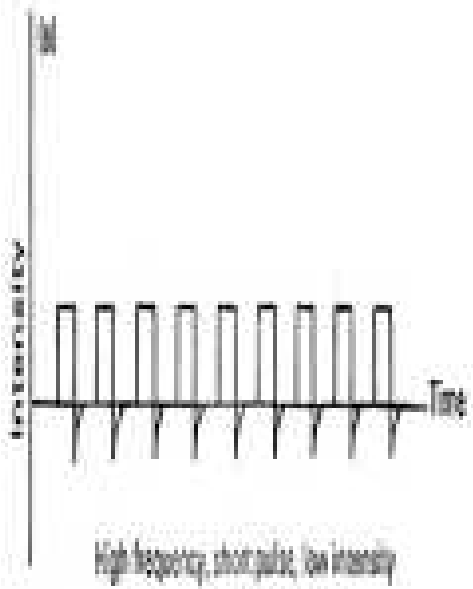
Modes of TENS Application

TENS modes	Treatment time	Onset of analgesia	Duration of pain relief	Uses
Conventional-High-frequency; Sensory TENS	30-60minutes /day	Rapid (≤30min)	Short (30minutes - 2h)	Acute/postoperative pain
Acupuncture-Low-frequency Motor TENS	20-30minutes	Slow (30-120min)	Long (6-7h)	Chronic pain
Burst mode TENS	20-30minutes	Slow onset (within hours)	Long	Chronic neuromuscular pain
Brief-intense TENS	10-30minutes	Rapid (≤15min)	Short < 30minutes	Painful procedure

Modes of TENS Application

Conventional

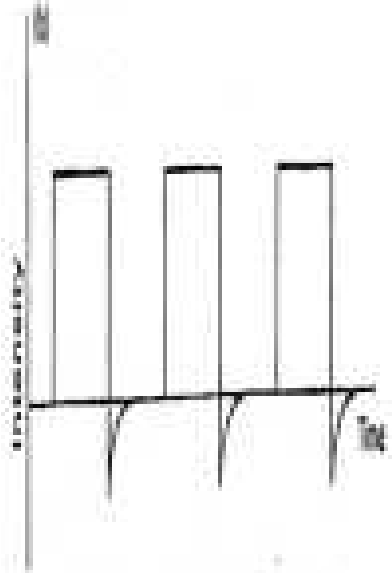
High-



Large myelinated (Aβ) fibers

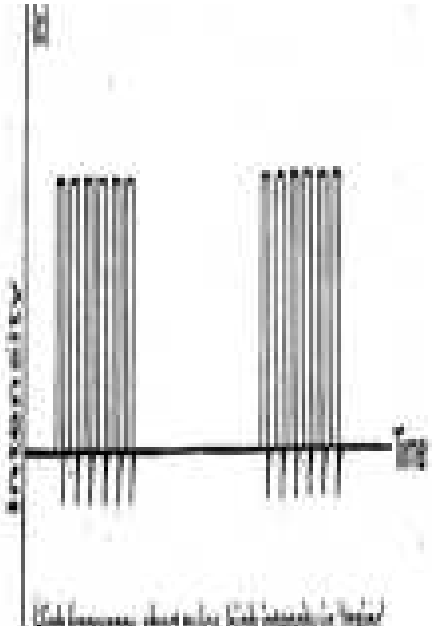
Acupuncture

Low-frequency



Large myelinated (Aδ) C fibers

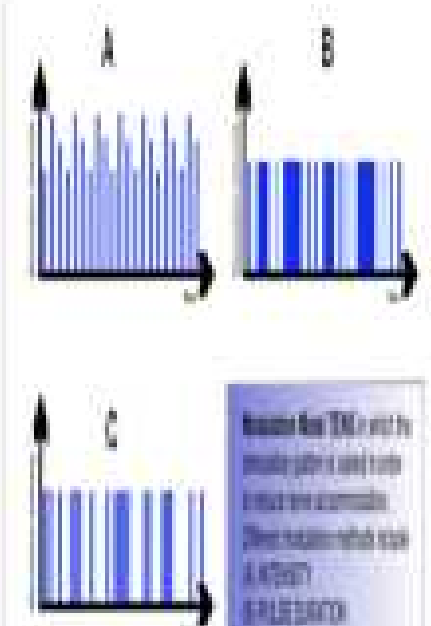
Burst



fibers

A beta/ A delta/C fibers

Modulated

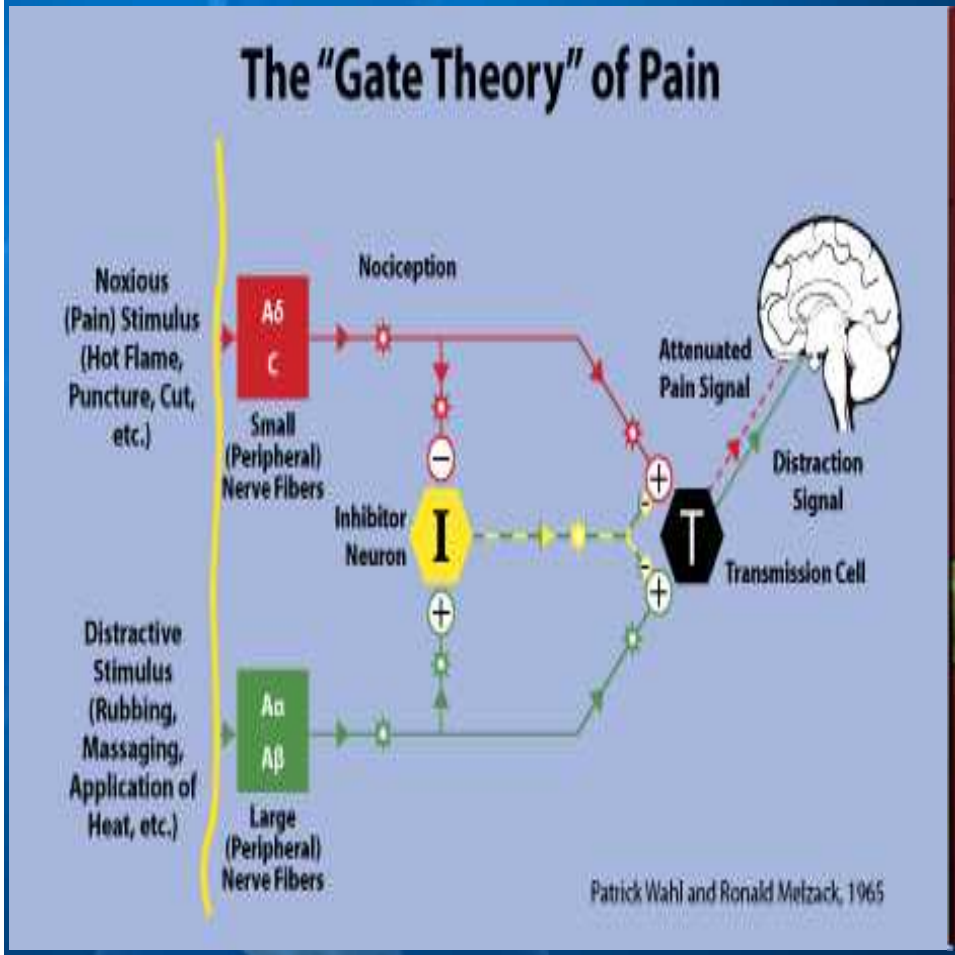


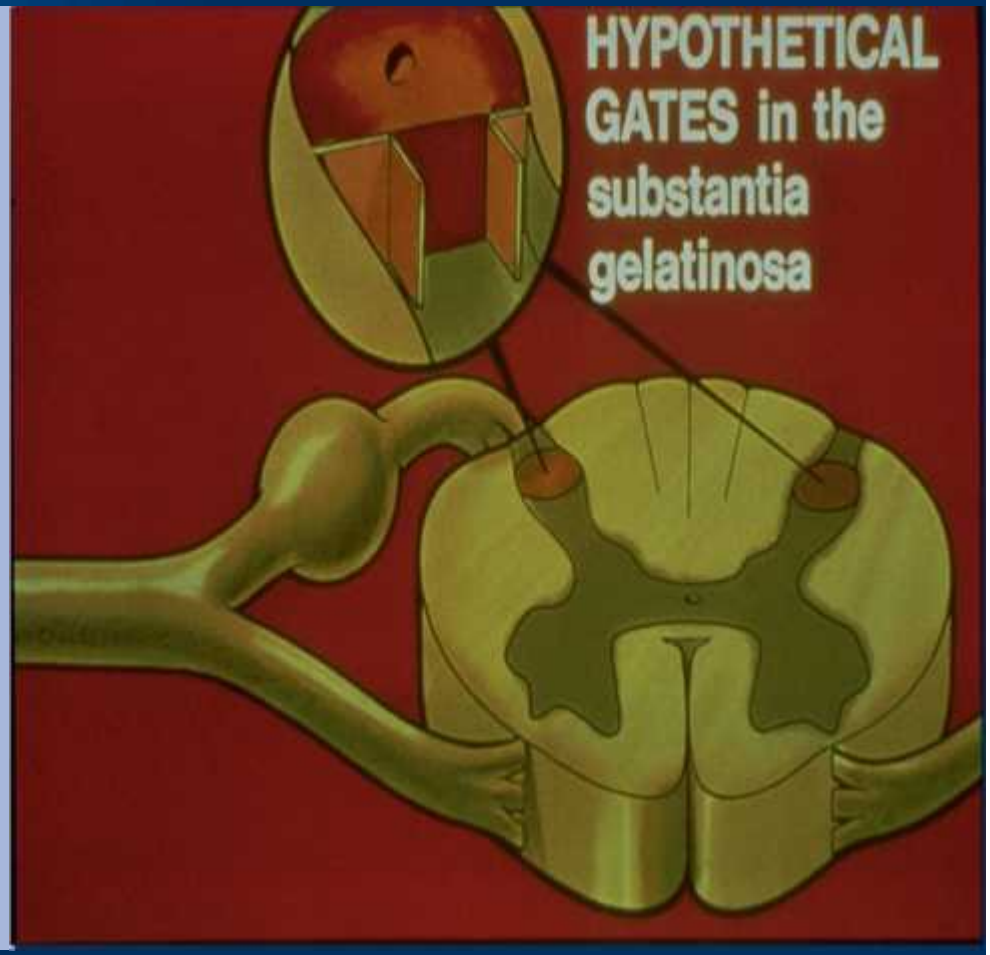
How does TENS modulate pain perception?

Physiology of TENS application

1. Blocking ascending pathways Gate control theory
2. Blocking descending pathway
3. Opiate-mediated pain control
4. Local vasodilatation of blood vessels in ischemic tissues

Gate control theory





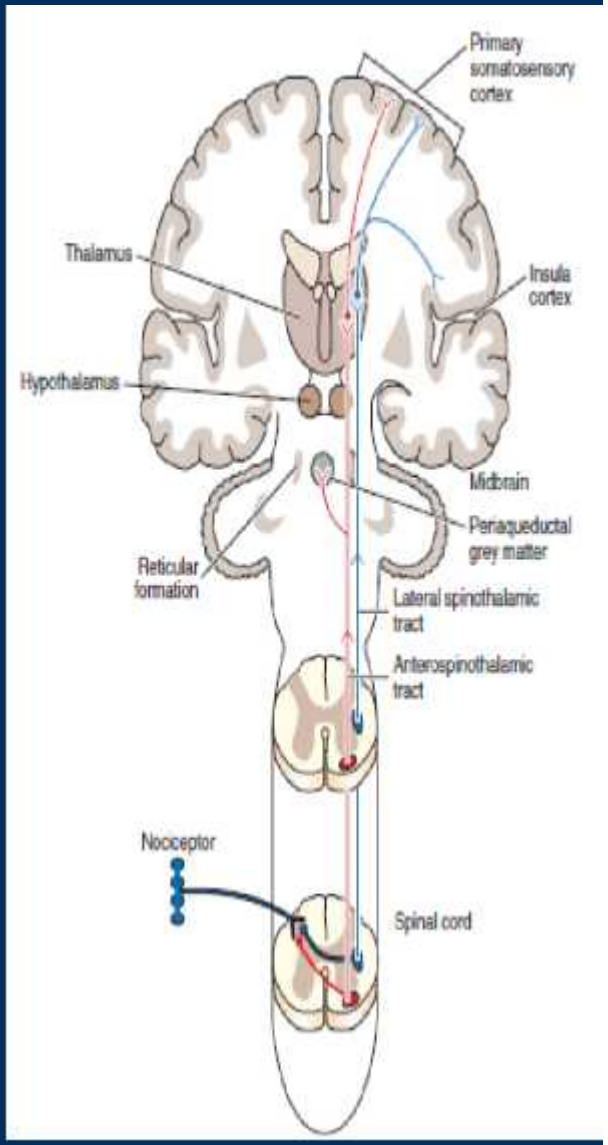
Endogenous opiate pain control

Opiate-mediated pain control

- Stimulation of A-delta & C fibers causes release of B-endorphins from the PAG & NRM
- ACTH/B-lipotropin is released from the anterior pituitary gland in response to pain – broken down into B-endorphins and corticosteroids
- Mechanism of action–similar to enkephalins to block ascending nerve impulses

Blocking descending pathway

- Descending neurons are activated by: stimulation of A-delta & C neurons, cognitive processes, anxiety, depression, previous experiences, expectations
- Cause release of enkephalins form PAG and serotonin NRM.
- Enkephalin interneuron in area of the SG blocks A-delta & C neurons



Indications for the Use of TENS for Pain Control

- **Post traumatic pain.**
- **Postoperative pain**

  (e.g. total knee replacement, abdominal surgery, Hysterectomy & Cesarean)
- **Musculoskeletal pain**
  - Low back pain & neck pain .
  - Osteoarthritis/Rheumatoid arthritis.
  - Ankylosing spondylitis.
  - Temporomandibular pain.
  - Myofascial pain syndrome
- **Neurological pain**
  - Peripheral nerve injuries with radiculopathies
  - Reflex sympathetic dystrophy
  - Neuropathic pain

Contraindications//Precautions for the Use of TENS for Pain Control

Contraindications

- Cardiac a pacemaker
- Undiagnosed pain.
- Epilepsy
- Over Venous or arterial thrombosis or thrombophlebitis
- Over the anterior-lateral aspect of neck
- Using electrodes on infected (inflamed) skin
- Over malignancies

Precautions

- Patients with malignancies in terminal stage
- Areas of skin irritation,
- Areas with impaired sensation
- Over abdominal, or pelvic regions during pregnancy
- Patients taking narcotic medication
- Incompetent patients

Evidence based of TENS Applications for pain management

- Application of TENS electrodes at acupoint sites may increases analgesia.
- The use of TENS during movement or activity may be most beneficial.
- TENS is effective for postoperative pain, osteoarthritis, painful diabetic neuropathy and some acute pain conditions.
- Emerging evidence suggests TENs may be helpful for peoples with fibromyalgia and spinal cord injury.

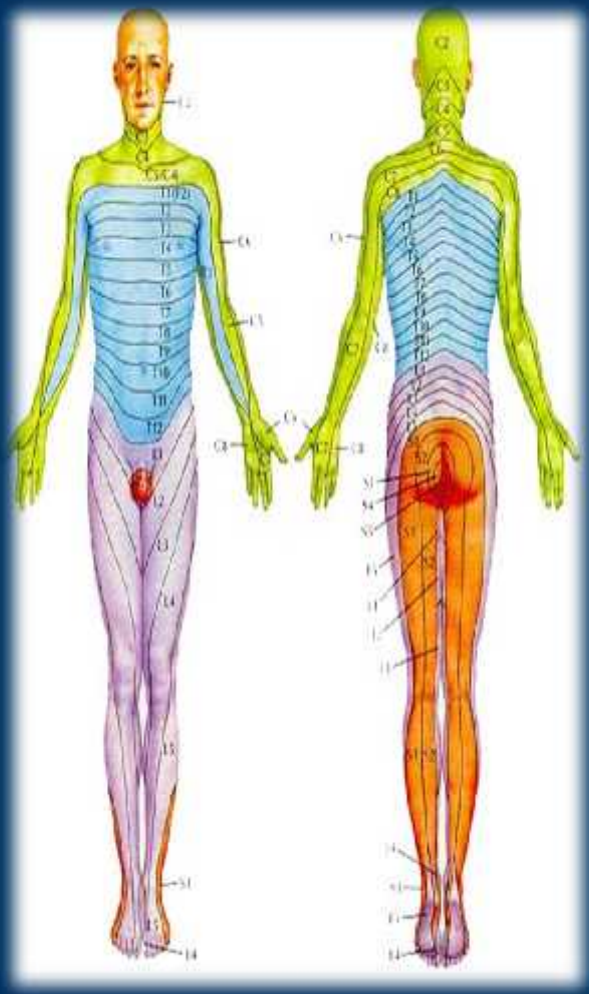
Factors affecting TENS efficacy

- Population and the outcome assessed,
- Timing of the outcome measures,
- Negative interaction of opioid use
- The parameters of the TENS applications.
    1. Tolerance to repeated TENS,
    2. Intensity of the stimulation
    3. **Electrode placement**.

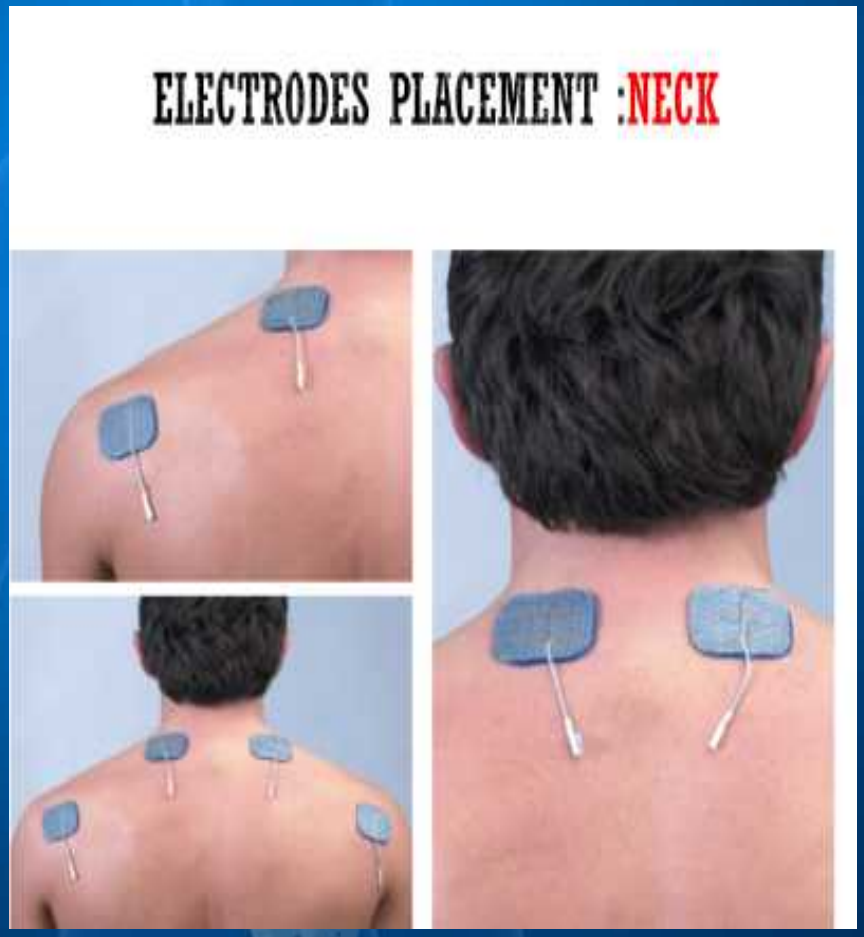
Evidence for Electrodes Placement for pain control

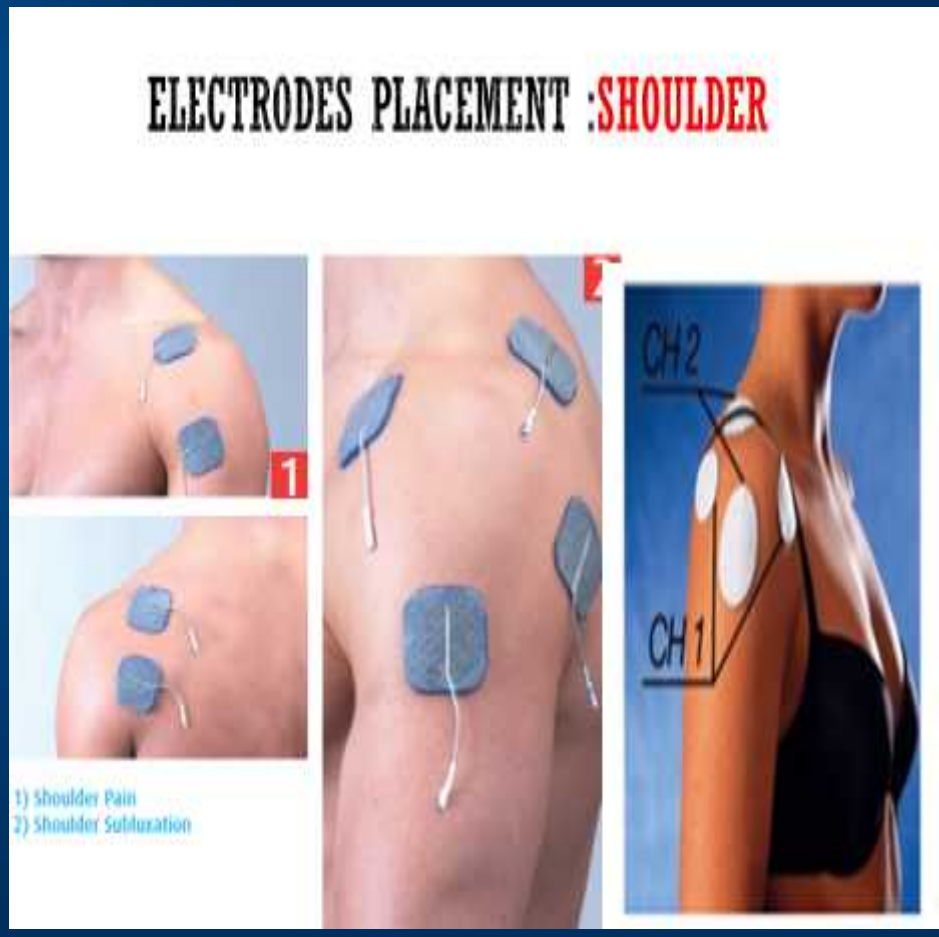
There is considerable variations on site of stimulation and electrodes placement was reported across different studies.

1. **On and /or Around the painful area.**
2. Over specific dermatome of painful area.
3. Over specific myotomes of painful area .
4. Spinal cord segment.
5. Course of peripheral nerve
6. Over trigger point./Acupuncture point.
7. Par incisional



Electrodes Placement for pain control





Electrodes Placement for pain control

Practical-part

- Case Studies
- Please check the attached file