



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

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Outlines



Definition of TENS

Parameters of TENS 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(Use)of TENS for Pain Control

Contraindications//Precautions for the Use of TENS

Practical tips and procedures



Pain

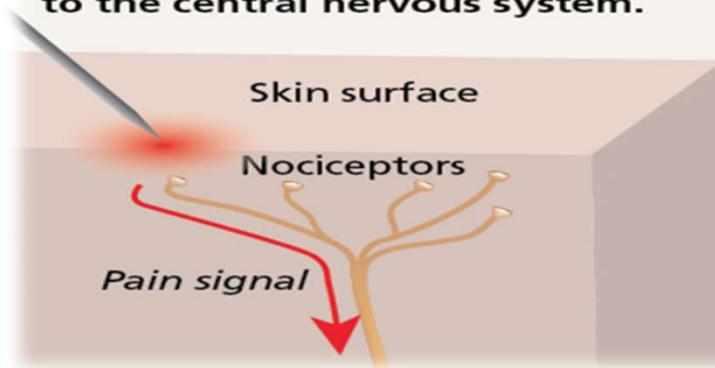
- **Pain** is “An unpleasant sensory & emotional experience associated with actual or potential tissue damage.

Prerequisite for this lecture

- **Pain (physiology and anatomy)**
- **Types of pain**
 - **Acute versus chronic pain**
 - **Nociceptive versus neuropathic pain**

Nociceptive Pain

Special nerve endings called nociceptors send pain signals to the central nervous system.



Neuropathic Pain

Caused by dysfunction in the nervous system or damage to the nerve itself.



Non-pharmacological treatments for pain

Countariratisation

Acupuncture,
Electrical stimulation,
Auriculotherapy
Physiotherapy)

Mind-body technique

Cognitive-behavioral therapy,
Hypnosis,
Relaxation,
Psychotherapy

Transcutaneous Electrical Nerve Stimulation (TENS)



TENS

low frequency pulsed current used to stimulate peripheral nerves through surface electrodes aiming to control and relief pain (acute/ chronic and postoperative pain)



TENS

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

Electrical Current parameters for pain control

Waveforms

Asymmetrical biphasic

Symmetrical biphasic , Monophasic, Spike-like

Frequency

HF: 80-120Hz

Stimulate large myelinated nerve fibers

Immediate relief of pain & used for Acute pain

Pulse amplitude

Patient perceived comfortable sensation

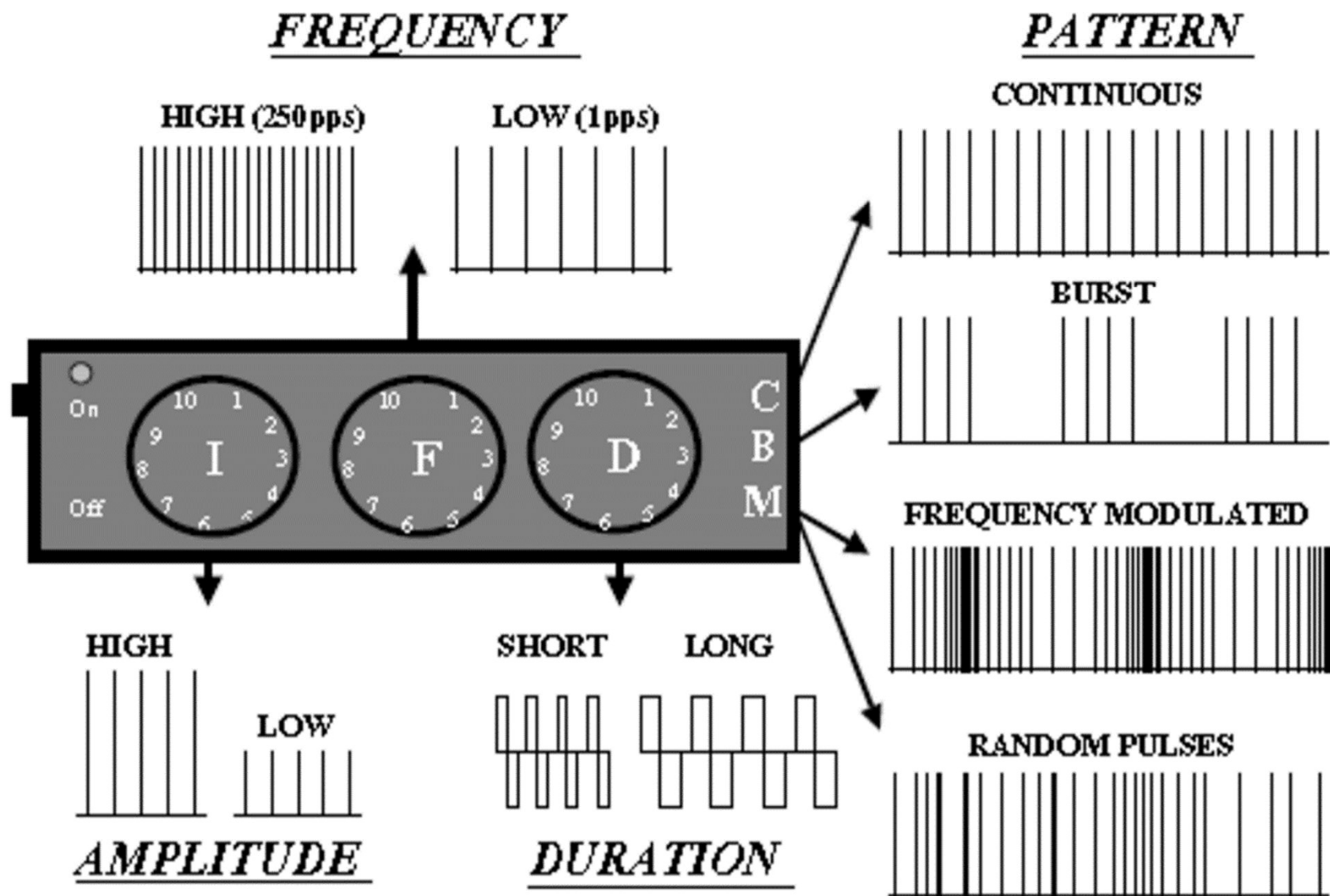
Tingling/vibration sensation to strong but comfortable muscle contraction

Pulse duration

Short: 50-150 μ s stimulates larger diameter fibers (A beta)

Long: 200-300 μ s activate smaller diameter fibers (A delta & C) and motor fibers ,

Modes of TENS Application



Comparison of the TENS modes

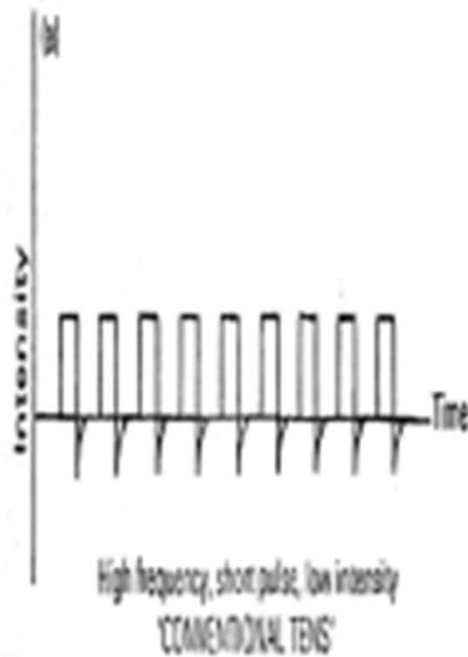
Parameters	Conventional-TENS HF TENS	Acupuncture-like TENS (AL-TENS)	Burst- TENS	Brief-intense TENS
Frequency	80-120Hz	1-20Hz	50-150Hz (5-10)bps	80-150Hz
Pulse duration	$\leq 150\mu\text{S}$	150-400 μS	100-300 μS	$\geq 150\mu\text{s}$
Intensity	Low (5-35mA)	High up to 60 mA	?	?
Intensity perception	Sensory (Tangling)	Sensory (Tangling) + Motor (Rhythmic twitch MS Contraction)	Sensory Strong- Rhythmic muscles contr.	Sensory (Tangling) + Non- Rhythmic MS contraction
Nerve fibers stimulated	Large myelinated (A β) fibers	Large myelinated (A δ) and C fibers	Sensory/motor	Sensory/motor/nociceptive fibers A beta/ A delta/C fibers

Comparison of the TENS modes

Parameters	Conventional-TENS HF TENS	Acupuncture-like TENS (AL-TENS)	Burst- TENS	Brief-intense TENS
Pain modulation	Gate control theory	Supra-Spinal (Beta-endorphin / Enkephalin)		
Analgesia				
Onset	Rapid (≤ 30 min)	Slow (30-120min)	Slow onset (within hours)	Rapid (≤ 15 min)
Duration	Short (30minutes - 2h)	Long (6-7h)	Long	Short < 30minutes
Treatment time	30-60minutes	20-30minutes	20-60minutes	10-15minutes
Indications	Acute/postoperative pain e.g. (Peripheral neuropathic pain, nerve root: compression, amputation)	Chronic pain chronic: musculoskeletal conditions, e.g., fibromyalgia and low back pain	Chronic neuromuscular pain	Painful procedure

Modes of TENS Application

Conventional
High-



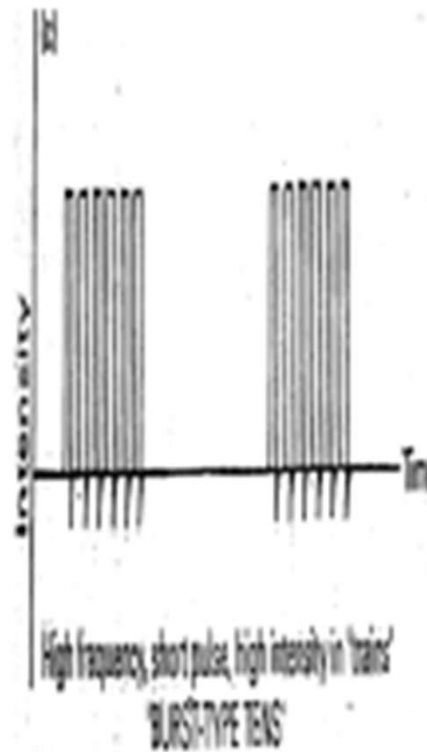
Large myelinated
(A β) fibers

Acupuncture
Low-frequency



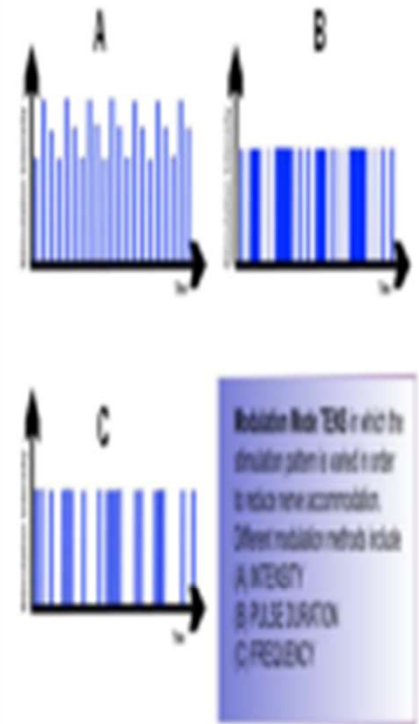
Large myelinated
(A δ)
C fibers

Burst

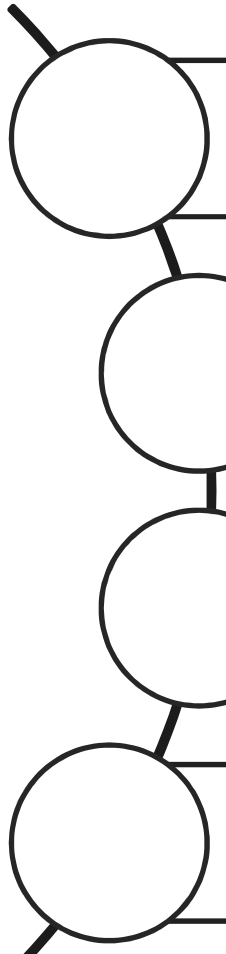


fibers
A beta/ A delta/C fibers

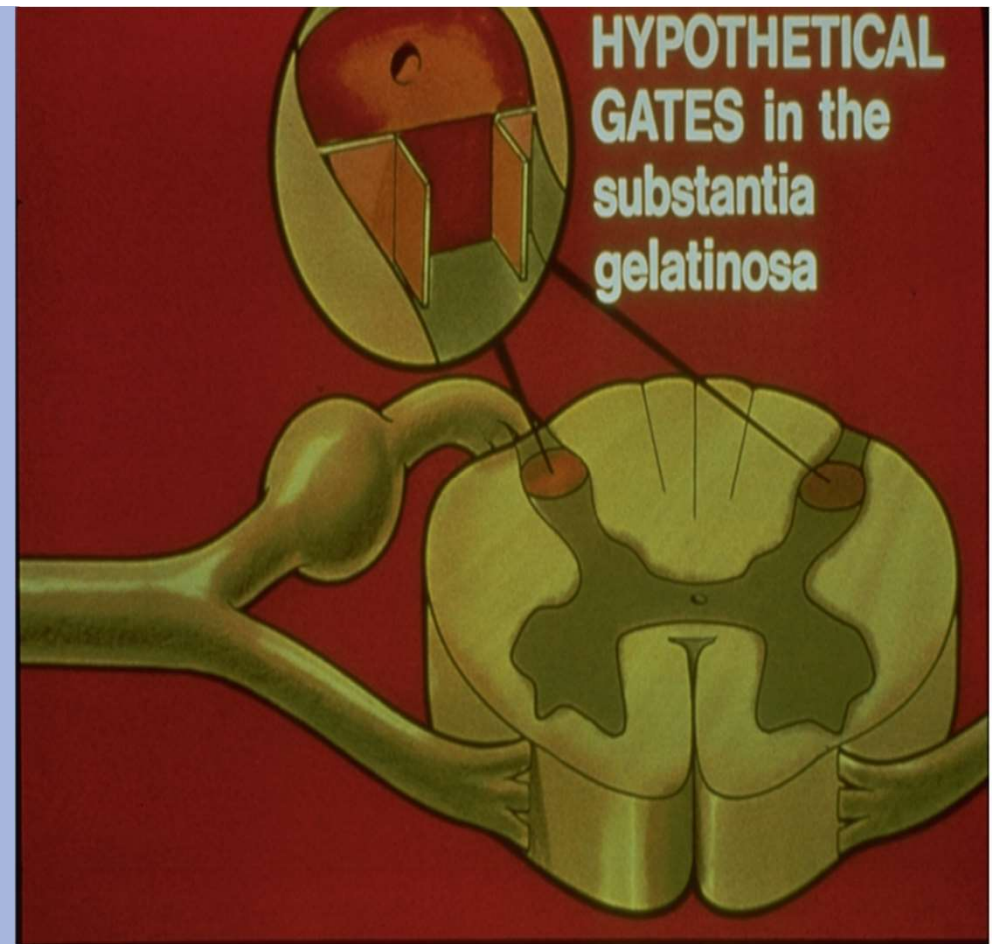
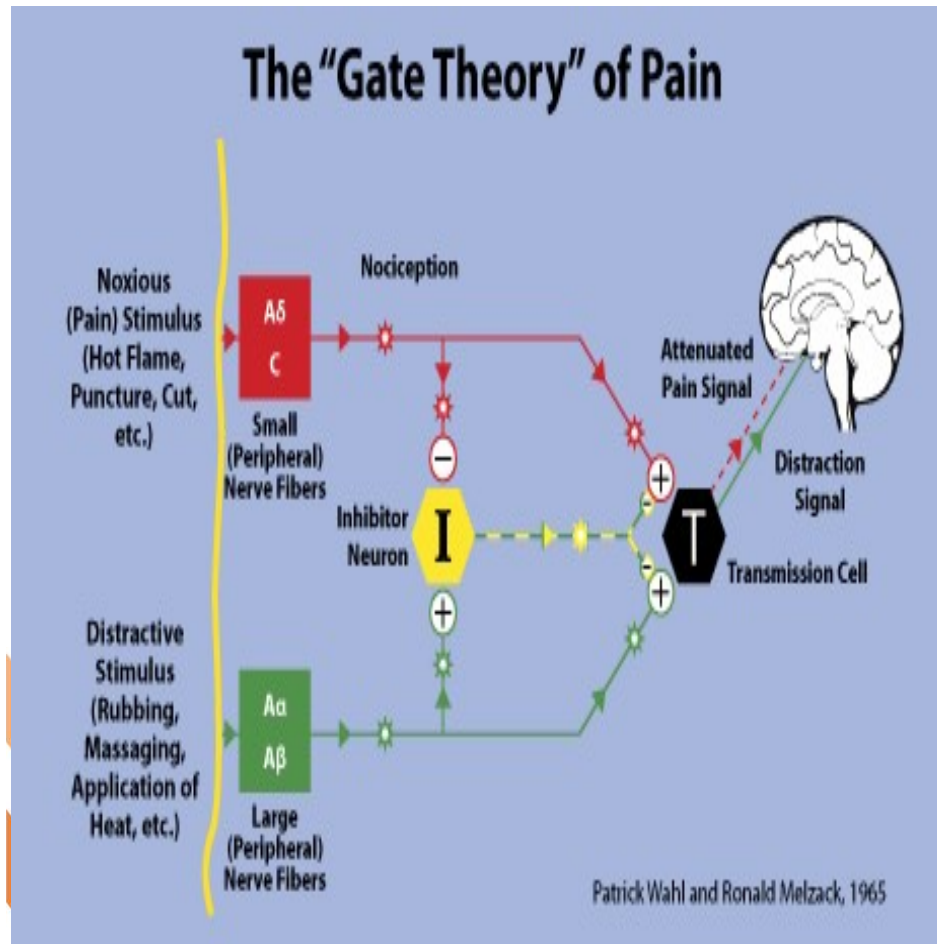
Modulated



Mechanisms of TENS for Pain modulation

- 
- 1-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** from **PAG** and **serotonin** from **NRM**.
- Enkephalin interneuron in area of the SG blocks A-delta & C neurons

Common indications for TENS

Relief of Acute and chronic pain

Myofascial pain,
Dental procedures
Physical trauma
Low back pain
Arthritic pain: RA, OA
Myofascial pain syndrome
Neuropathic pain
e.g. trigeminal neuralgia,
phantom pain,
post-herpes pain

Relief of postoperative pain

Total knee replacement,
Abdominal surgery,
Thoracic surgery
Hysterectomy
Labour and Cesarean pain

Contraindications/ Precautions for TENS

Contraindications

Pacemaker if TENS is to be applied to the chest.
Destruction lemniscal fibers in the spinal cord.
Over anterolateral Stimulation of the neck
Over Venous or arterial thrombosis or thrombophlebitis
Over malignancies
Pregnancy
Difficulty understanding the method,
Electrophobia.
Uncontrolled epilepsy
Undiagnosed pain.

Precautions

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

Factors affecting TENS efficacy

Tolerance to repeated TENS,

- ❖ Modulating between LF and HF TENS within a treatment session
- ❖ Increasing intensity of TENS daily

Intensity of the stimulation: In general using the strongest intensity that remains comfortable

- ❖ Activation of greater numbers of sensory afferents
- ❖ Activate deeper tissue afferents allowing for greater analgesia
- ❖ High intensity TENS decreases post-operative opioid requirements and negative opioid-side effects

Electrode placement

Clinically, application of TENS at these acupoints reduces pain and may be more effective than when applied over non-acupoint sites.

TENS at acupoint sites reduced opioid intake, nausea and dizziness

Evidence based of TENS

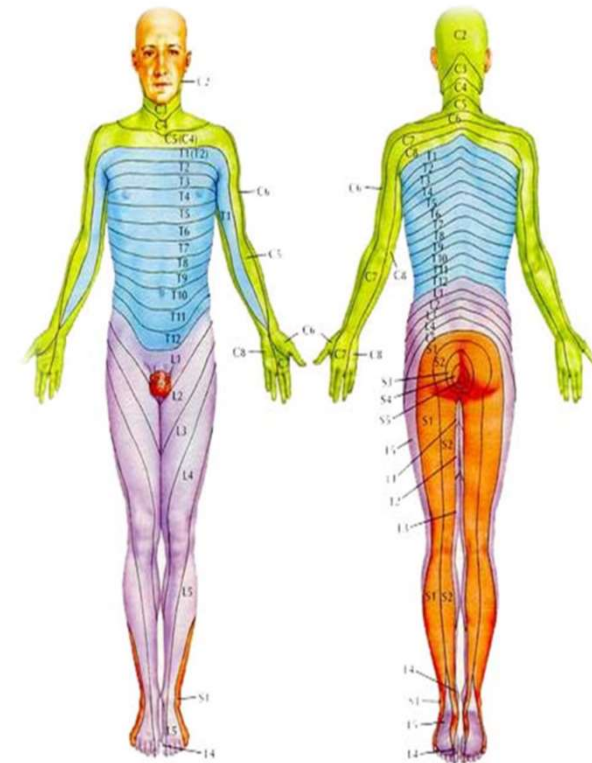
Applications for pain management

- Application of TENS electrodes at acupoint sites may increase 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 people with fibromyalgia and spinal cord injury.

TENS electrodes placement

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

- ❖ **On and /or Around the painful area.**
- ❖ Over specific dermatome of painful area.
- ❖ Over specific myotomes of painful area .
- ❖ Spinal cord segment.
- ❖ Course of peripheral nerve
- ❖ Over trigger point.
- ❖ **Acupuncture point.**
- ❖ Par incisional

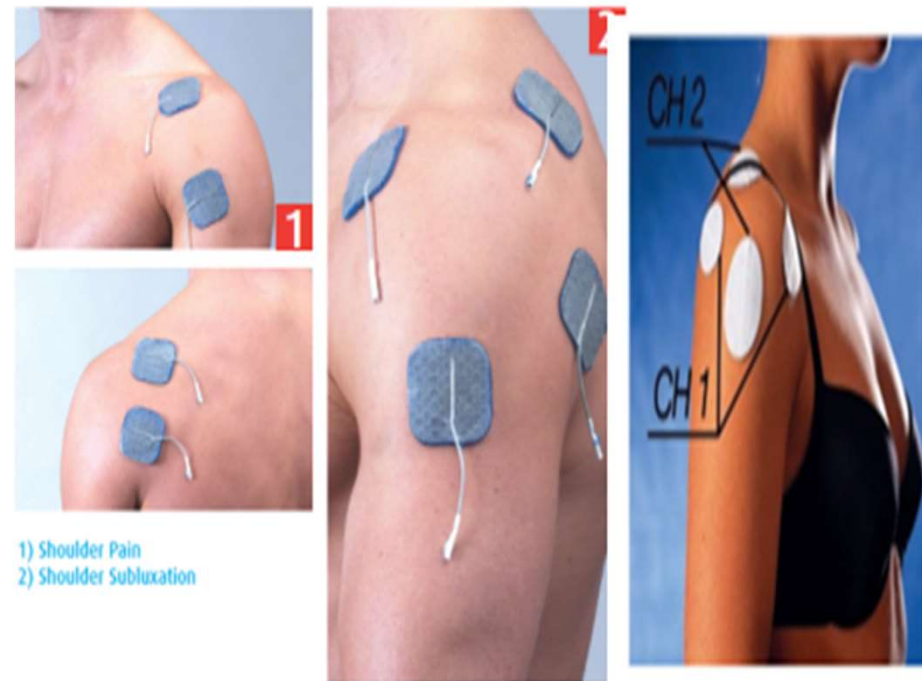


Electrodes Placement for pain control

ELECTRODES PLACEMENT :NECK



ELECTRODES PLACEMENT :SHOULDER



- 1) Shoulder Pain
- 2) Shoulder Subluxation

Electrodes Placement for pain control

ELECTRODES PLACEMENT :BACK



ELECTRODES PLACEMENT :KNEE & ANKLE PAIN





Practical-part
please check the attached files

