

Transcutaneous Electrical Nerve Stimulation (TENS)

Dr. Mohammed TA, Omar, PhD, PT
Rehabilitation Science Department
CAMS-KSU

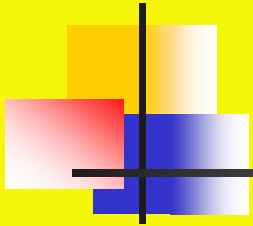
mommarar@ksu.edu.sa





Outlines

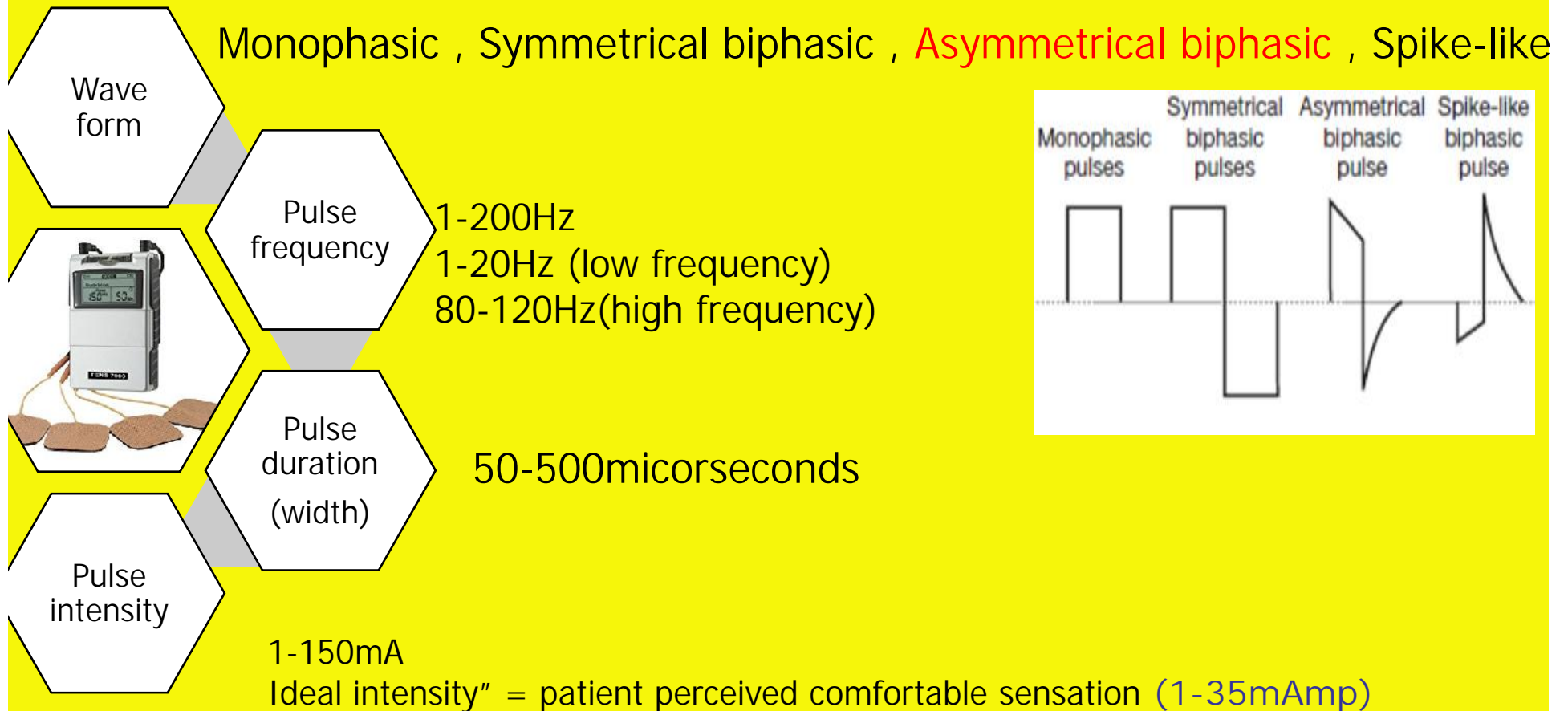
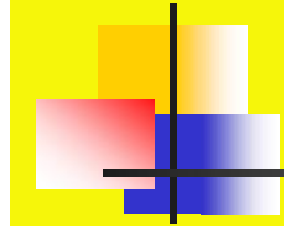
- Definition of TENS and current specifications
- Modes of TENS application in clinical setting
- Physiological effects of TENS.
- Uses (indications) of TENS applications.
- Contraindications of TENS applications.
- Precautions & dangerous of TENS applications



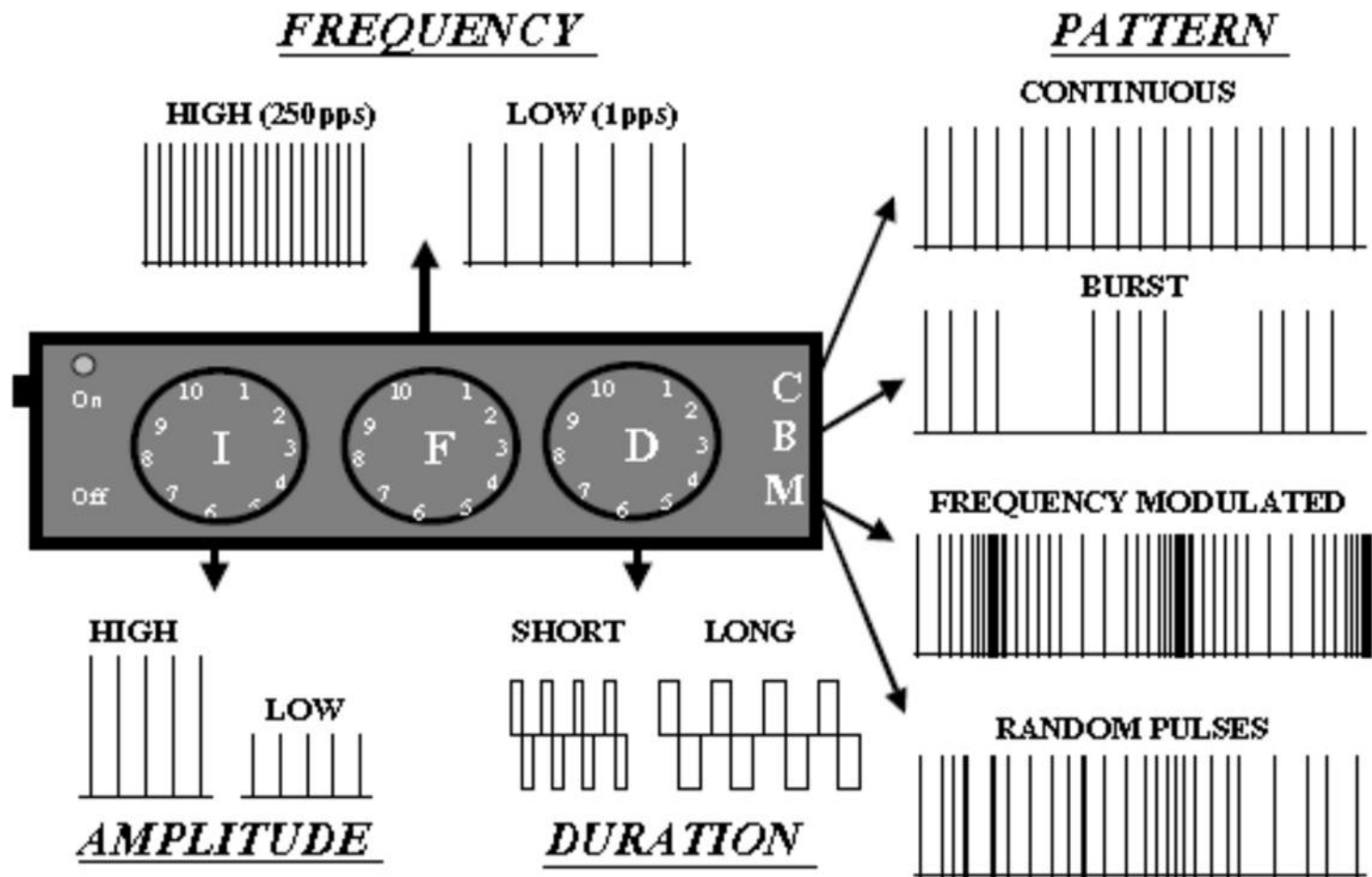
Definition of TENS

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

TENS/variables/specification



Modes of TENS Application



	Conventional-High-frequency Sensory TENS	Acupuncture-Low-frequency Motor TENS	Brief -intense TENS	Burst –TENS
Frequency (Hz)	80-120Hz	1-20Hz	80-130Hz	50-150PPS burst (5-10)
Pulse duration (μS)	50-150μS	200-300μS	150μs	100-300μS
Intensity (mA)	Sensory(Tangling) Sub-motor	Sensory(Tangling) Rhythmic muscles contraction	Sensory(Tangling) Non-Rhythmic muscles contr.	Sensory Strong-Rhythmic muscles contr.
Pain modulation	Spinal Gait Theory	Supra-Spinal (Beta-endorphin / Enkephalin)		
Nerve fibers stimulated	Large mylinated (A) fibers	Large mylinated (A) and C fibers	Sensory/motor/nociceptive fibers A beta/ A delta/C fibers	Sensory/motor
Treatment time	30-60minutes/day	20-30minutes	10-30minutes	20-30minutes
Onset of analgesia	Rapid (30min)	Slow (30-120min)	Rapid (15min)	Slow onset (within hours)
Duration of pain relief	Short (30minutes to 2h)	Long (6-7h)	Short < 30minutes	Long
Uses	Acute/postoperative pain	Chronic pain	Painful procedure	Chronic neuromuscular pain

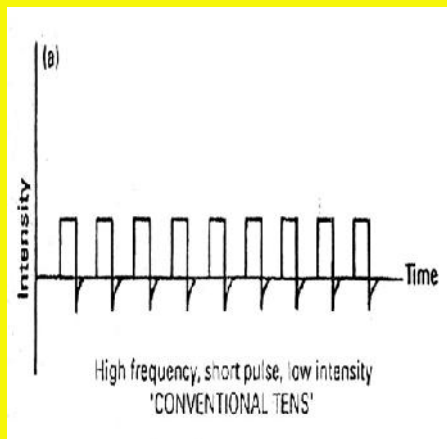
TENS (pattern) Modes

Conventional
High-frequency

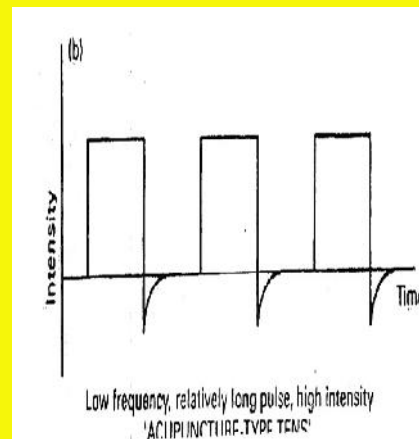
Acupuncture
Low-frequency

Burst

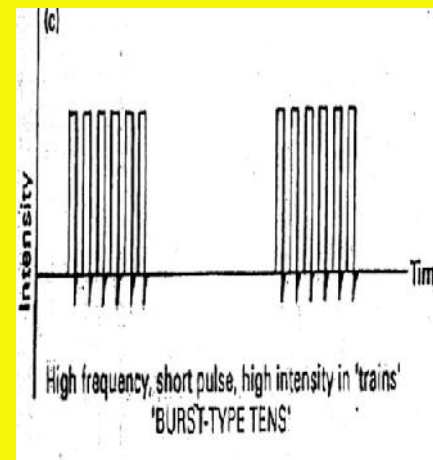
Modulated



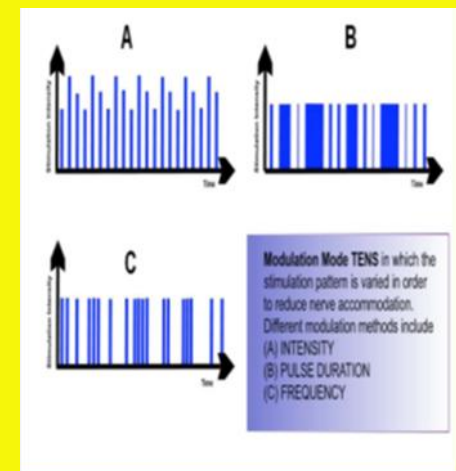
Large myelinated
(A) fibers



Large myelinated (A)
C fibers



fibers
A beta/ A delta/C fibers





Physiological TENS application


- The main therapeutic effect of TENS therapy is to relieve pain via triggering and modulation of complex neurohormonal, neurophysiological , and cognitive systems involving the peripheral as well as the central nervous system,

Discuss.

How does TENS modulate pain perception?



4 theories of pain modulation using TENS

- 
1. Gate control theory
 2. Opiate-mediated control theory
 3. Central basing theory
 4. Local vasodilatation of blood vessels in ischemic tissues

Dual pathways for pain transmission

◎ From peripheral receptors to spinal cord:

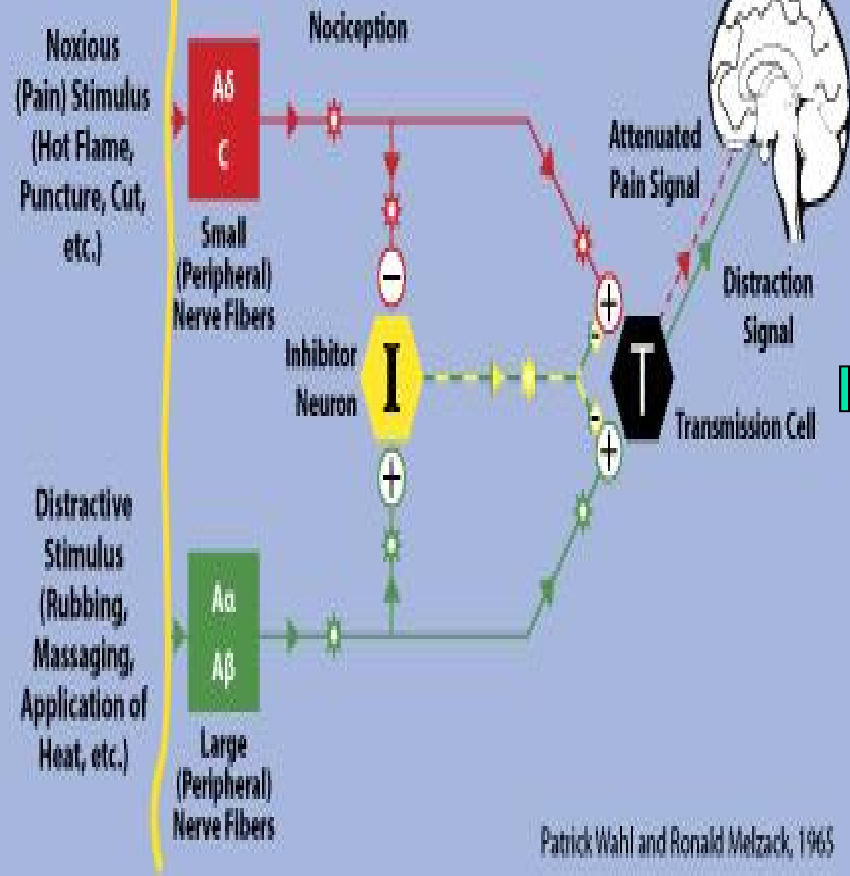
- › **A δ fibers (fast fibers)** – for fast pain
- › **C fibers (slow fibers)** – for slow pain

◎ From spinal cord to brain: via Anterolateral (Spinothalamic) tract

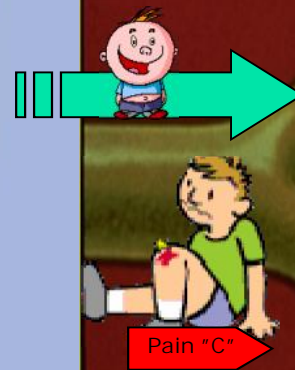
- › **Neo-spinothalamic tract** – for fast pain
- › **Paleo-spinothalamic tract** – for slow pain

Gate control theory

The "Gate Theory" of Pain



**HYPOTHETICAL
GATES** in the
substantia
gelatinosa

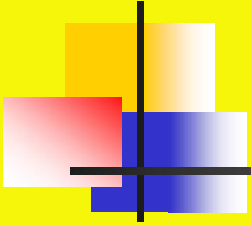




Opiate-mediated pain control

- 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

Central Biasing Theory



- 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 NRM**.
- Enkephalin interneuron in area of the SG blocks A-delta & C neurons

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.
- Systematic reviews suggest that TENS, when applied at adequate intensities, 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.

Evidence based of TENS

Applications for pain management

The factors affecting TENS efficacy :

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

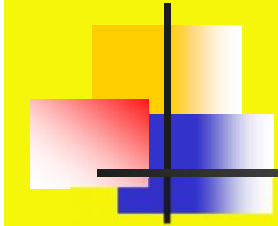
Indication (Uses) of TNES



Indication: A condition(s) that could benefit from a TENS application.

- **Abdominal surgery**
(e.g. inguinal hernia)
- **Thoracic surgery**
(e.g. Thoracotomy & CABG)
- **Urological surgery**
(e.g. Prostatectomy)
- **Orthopedic surgery**
(e.g. Total & hip replacement, Amputation, & Spinal surgery)
- **Obstetrical & gynecological surgery**
(e.g. Hysterectomy & Cesarean)
- **Dental surgery**
(e.g. Molar distraction)
- Post traumatic pain.
- Low back & neck pain .
- Osteoarthritis/Rheumatoid arthritis.
- Ankylosing spondylitis.
- Temporomandibular pain.
- Myofascial pain.
- Peripheral nerve injuries with radiculopathies
- Reflex sympathetic dystrophy
- Neuropathic pain

Contraindications of TENS applications



Cardiac a pacemaker

Undiagnosed pain.

Epilepsy

Over Venous or arterial thrombosis or thrombophlebitis

Near operating diathermy device

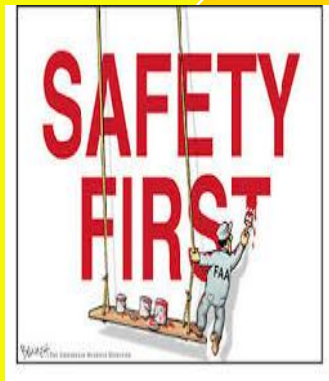
Over the anterior-lateral aspect of neck/ eyes/ mucosal surfaces

Using electrodes on infected (inflamed) skin

Electrodes across the chest of a patient with cardiac disease

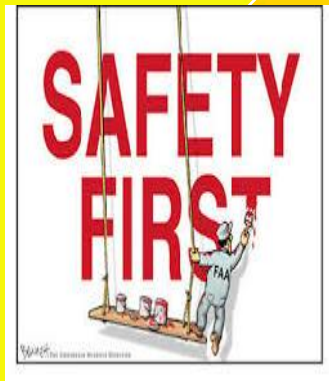
Contraindication: A condition(s) that could be adversely affected if TENS is used

Precautions to TENS



For patients with diagnosed malignancies that have been diagnosed as terminal, TENS can be used for pain control with informed consent of the patient. Otherwise, TENS should not be used when malignancies are present..

Precautions to TENS applications



Areas of skin irritation, damage or lesions

Areas with impaired sensation

Over abdominal, lumbosacral or pelvic regions during pregnancy other than for labor/delivery

Tissues vulnerable to hemorrhage or hematoma

Extreme caution is needed with patients taking narcotic medication or who are known to have hyposensitive areas.

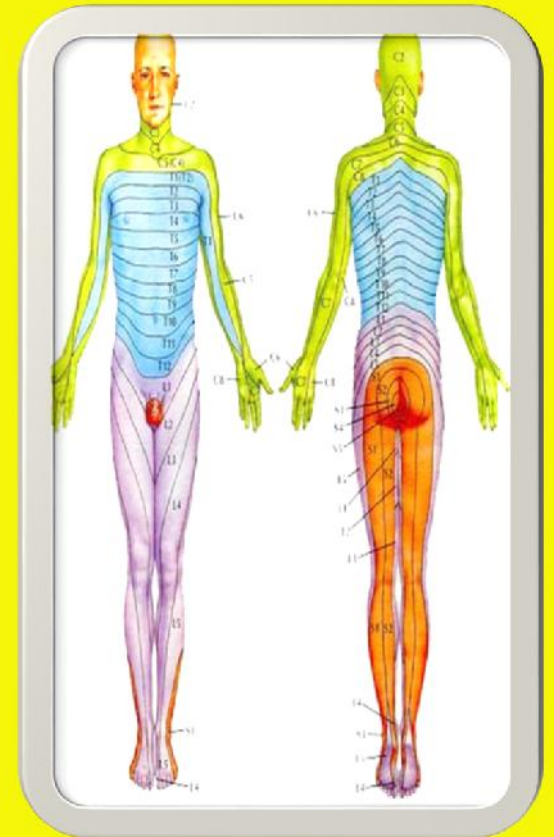
Incompetent patients may not be able to manage the device and it must be kept out of reach of children.

Evidence for Electrodes Placement

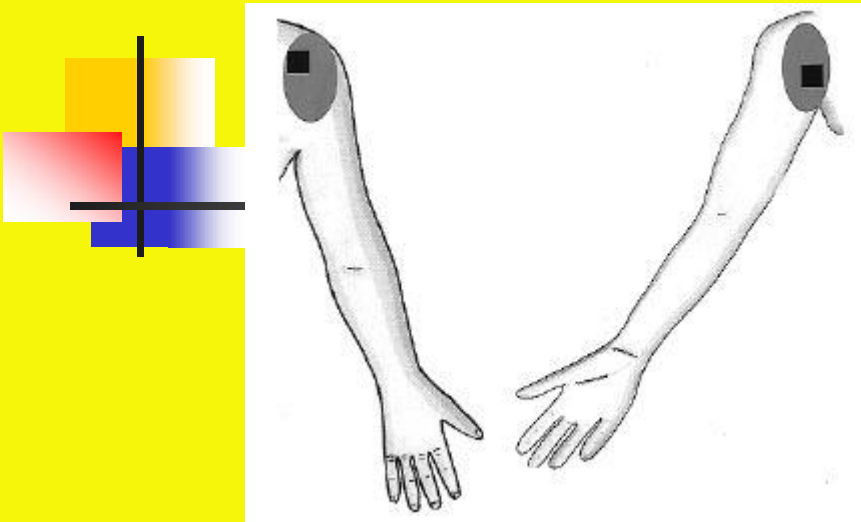
There is considerable variations on site of stimulation and electrodes placement was reported across different studies.

- ❑ Negative Electrodes should be placed distal to the positive electrodes
- ❑ The negative electrodes may be located at

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



Electrode placement for shoulder pain.

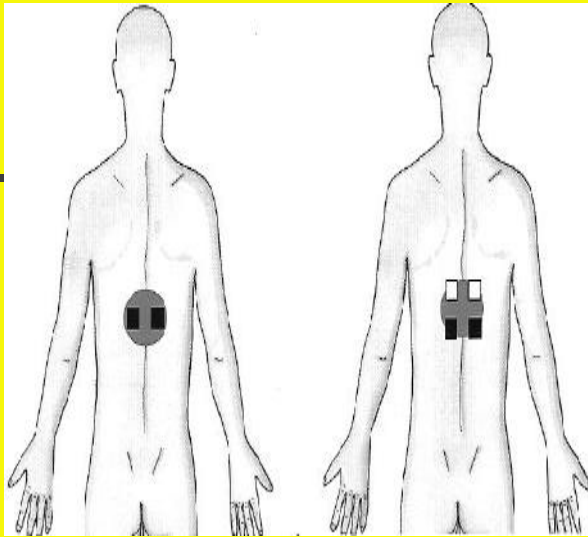
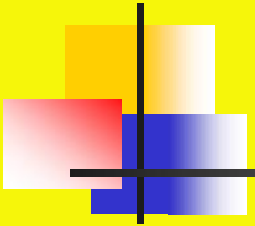


Electrode placement for Knee pain.

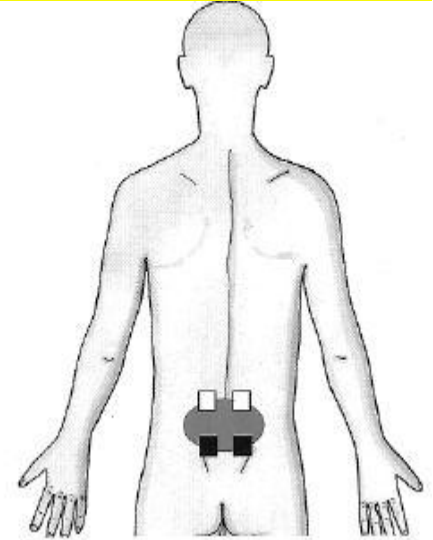


Electrode placement for tennis elbow.

Electrodes Placement



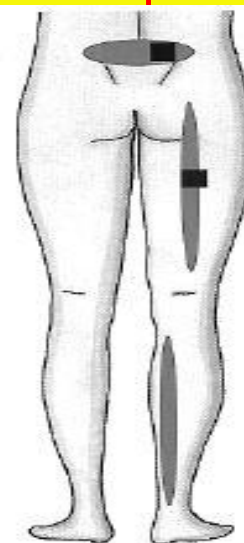
Electrode placement for upper back pain



Electrode placement for lower back pain



Electrode placement for neck pain



Electrode placement for back pain with sciatica.

