FARADIC CURRENT

BY

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Learning Objectives:

The lecture aims to brief students about the following:

Nature of faradic currents.
Therapeutic & Physiological effects of faradic currents.
Techniques of application.
Indication & Contraindication.
Clinical applications of faradic currents.
Precaution & Dangers

Learning Outcomes:

Successful student therapist will be able to explain about the following:

1.Explain about accommodation

2.Explain about the nature of faradic currents

3.Explain about the therapeutic and physiological effects

4.Techniques of application

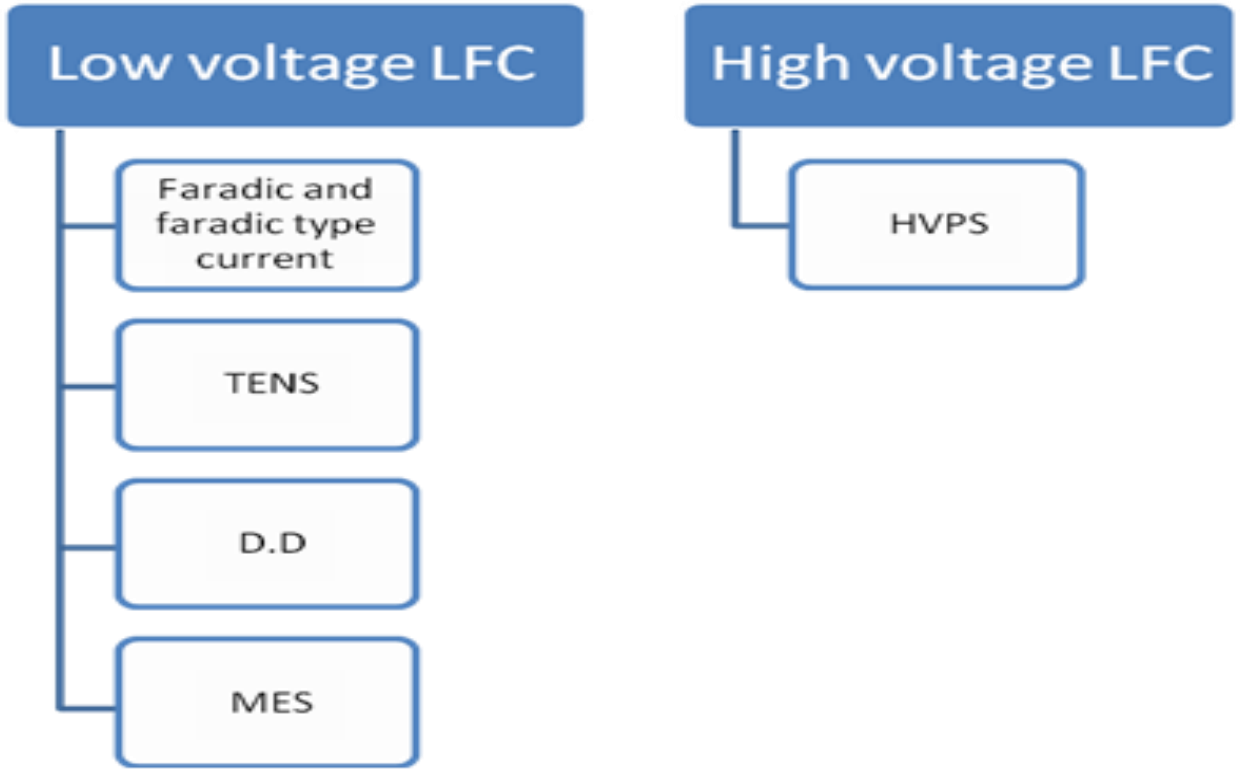
5.Clinical applications of faradic currents.

Electrical Stimulating Currents

- Low frequency currents
- Medium frequency currents

Electrical Stimulating Currents

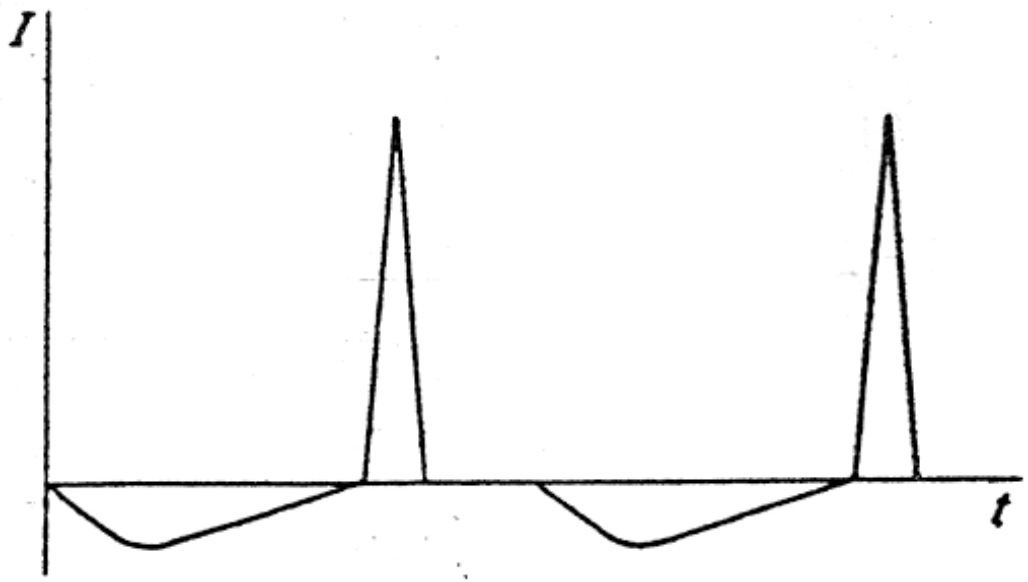
Low Frequency Currents



Faradic current

The original faradic current is unevenly alternating biphasic pulses. The effective nerve stimulus is the spike of voltage, which can be ultra-short in duration; the rest of the pulse,

(Balanced asymmetric)

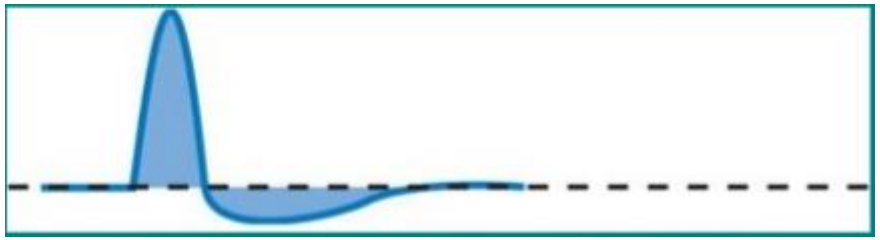


Definition

It is a short-duration interrupted current, with a pulse duration ranging from 0.1 and 1 ms and a frequency of 30 to 100 Hz.

Wave forms:

1. **Induced asymmetrical alternating current.**



2. **Biphasic, Asymmetrical, Unbalanced, Spiked.**

3. **Positive portion-** short duration, high amplitude and spiked.

4. **Negative portion-** long duration, low amplitude and curved

Modifications

Faradic currents are always surged for treatment purposes to produce a near normal tetanic-like contraction and relaxation of muscle.

Current surging means the gradual increase and decrease of the peak intensity.

Forms of faradic current

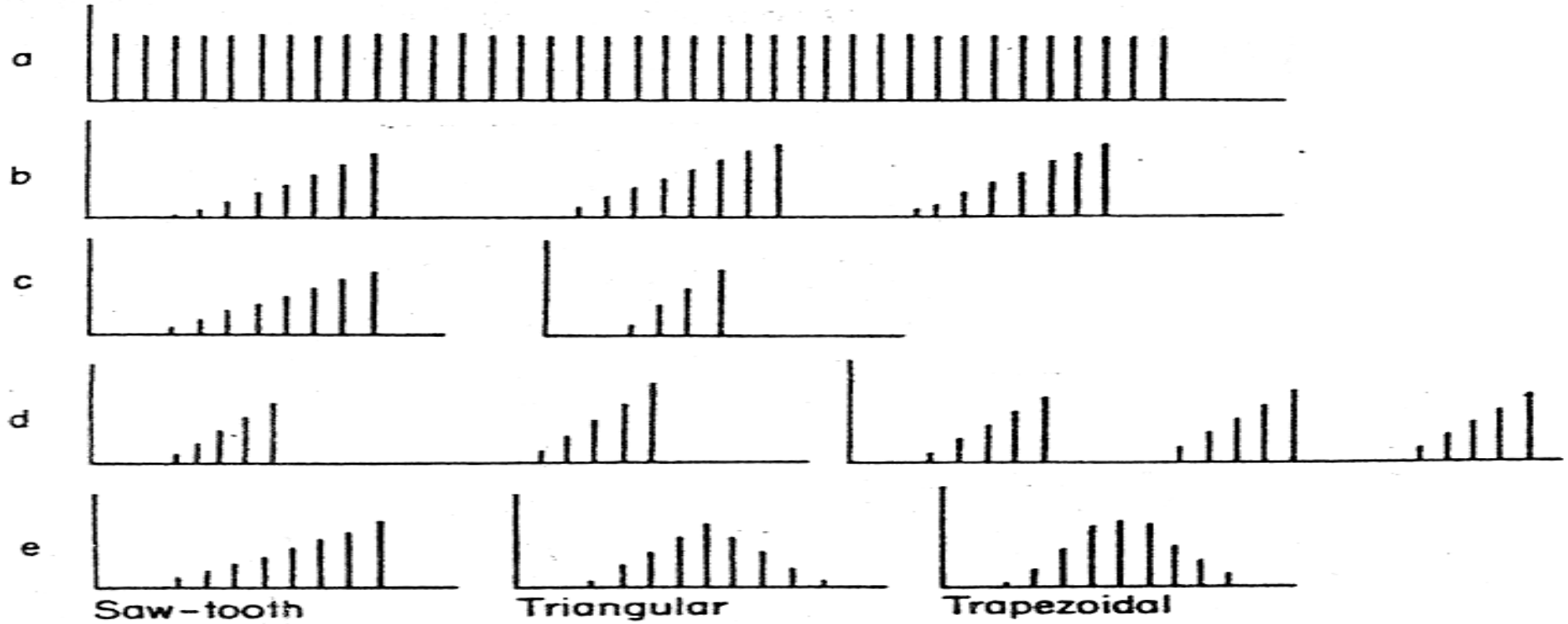
Each represents one impulse:

* In surged currents, the intensity of the successive impulses increases gradually, each impulse reaching a peak value greater than the preceding one then falls either suddenly or gradually.

* Surges can be adjusted from 2 to 5-second surge, continuously or by regularly selecting frequencies from 6 to 30 surges / minute.

* Rest period (pause duration) should be at least 2 to 3 times as long as that of the pulse to give the muscle the sufficient time to recover (regain its normal state).

Types of faradic current



Forms of faradic-type current available from modern stimulators (each stroke represents one impulse):

(a) Unmodified.
(b) In surges.
(c) Surges varying in duration.
(d) Varying interval between surges.
(e) Surges varying in wave form.

Effects of faradic currents

1. ***Stimulation of sensory nerves:***

- It is not very marked because of the short duration.
- It causes reflex vasodilatation of the superficial blood vessels leading to slight erythema.
- The vasodilatation occurs only in the superficial tissues.

2. Stimulation of the motor nerves:

It occurs if the current is of a sufficient intensity, causing contraction of the muscles supplied by the nerve distal to the point of stimulus.

A suitable faradic current applied to the muscle elicits a contraction of the muscle itself and may also spread to the neighboring muscles.

The character of the response varies with the nature and strength of the stimulus employed and the normal or pathological state of muscle and nerve.

2. Stimulation of the motor nerves:

The contraction is tetanic in type because the stimulus is repeated 50 times or more / sec.

If this type is maintained for more than a short time, muscle fatigue occurs.

So, the current is commonly surged.

Why???

To allow for muscle relaxation i.e. *“when the current is surged, the contraction gradually increases and decreases in strength in a manner similar to voluntary contraction”.*

3. Stimulation of the nerve is due to producing a change in the semi-permeability of the cell membrane:

This is achieved by altering the resting membrane potential.

When it reaches a critical excitatory level, the muscle supplied by this nerve is activated to contract.

4. Faradic currents will not stimulate denervated muscle:

The nerve supply to the muscle being treated must be intact because the intensity of current needed to depolarize the muscle membrane is too great to be comfortably tolerated by the patient in the absence of the nerve.

5. Reduction of swelling and pain:

It occurs due to alteration of the permeability of the cell membrane, leading to acceleration of fluid movement in the swollen tissue and arterial dilatation.

Moreover, it leads to increase metabolism and get red of waste products.

6. Chemical changes:

The ions move one way during one phase of the current; and in the reverse direction during the other phase of the current if it is alternating.

If the two phases are equal, the chemicals formed during one phase are neutralized during the next phase.

In faradic current, chemical formation should not be great enough to give rise to a serious danger of burns because of the short duration of impulses and biphasic manner.

Diagnostic objectives

Investigation of myasthenic reaction;

Investigation of myotonic reaction;

Localization of a neurapraxia(nerve compression) block.

Indications:

1. Facilitation of muscle contraction inhibited by pain:
   Stimulation must be stopped when good voluntary contraction is obtained.

2. Muscle re-education:
   Muscle contraction is needed to restore the sense of movement in cases of prolonged disuse or incorrect use;

and in muscle transplantation. **The brain appreciates** movement not muscle actions, so the current should be applied to cause the movement that the patient is unable to perform voluntarily.

3. Training a new muscle action:

After tendon transplantation, muscle may be required to perform a different action from that previously carried out. With stimulation by faradic current, the patient must concentrate with the new action and assist with voluntary contraction.

4. Nerve damage:

- When a nerve is severed, degeneration of the axons takes place after several days.
- So, for a few days after the injury, the muscle contraction may be obtained with faradic current.
- It should be used to exercise the muscle as long as a good response is present but must be replaced by modified direct current as soon as the response begins to weaken.

5. Improvement of venous and lymphatic drainage:

In oedema and gravitational ulcers, the venous and lymphatic return should be encouraged by the pumping action of the alternate muscle contraction and relaxation.

6. Prevention and loosening of adhesions:

After effusion, adhesions are liable to form, which can be prevented by keeping structures moving with respect to each other.

Formed adhesions may be stretched and loosened by muscle contraction.

7. Painful knee syndromes:

After trauma, there is inhibition of muscle contraction, leading to muscle atrophy.

Contraindications:

- ***Skin lesions:*** **The current collects at that point causing pain.**
- ***Certain dermatological conditions:*** **Such as psoriasis, tinea and eczema.**
- **Acute infections and inflammations.**
- **Thrombosis.**
- **Loss of sensation.**
- **Cancer.**
- **Cardiac pacemakers.**
- **Superficial metals.**

Methods of Application

Unipolar

Bipolar

Technique of Application

Group muscle stimulation; and

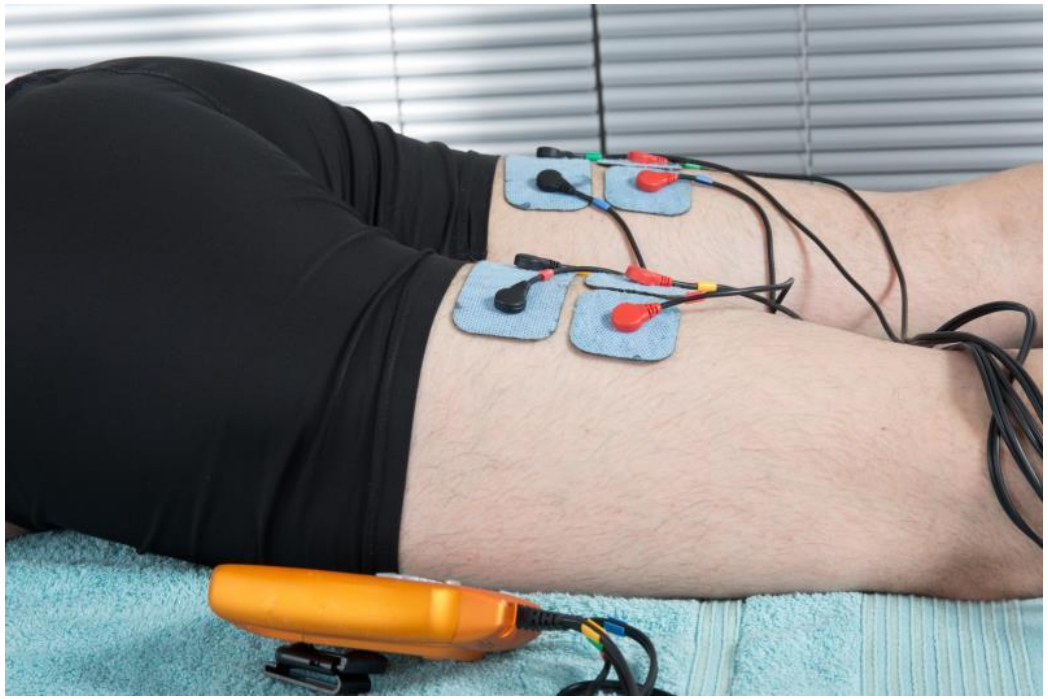
Motor Point stimulation.

Group Muscle Stimulation

Stationary stimulation

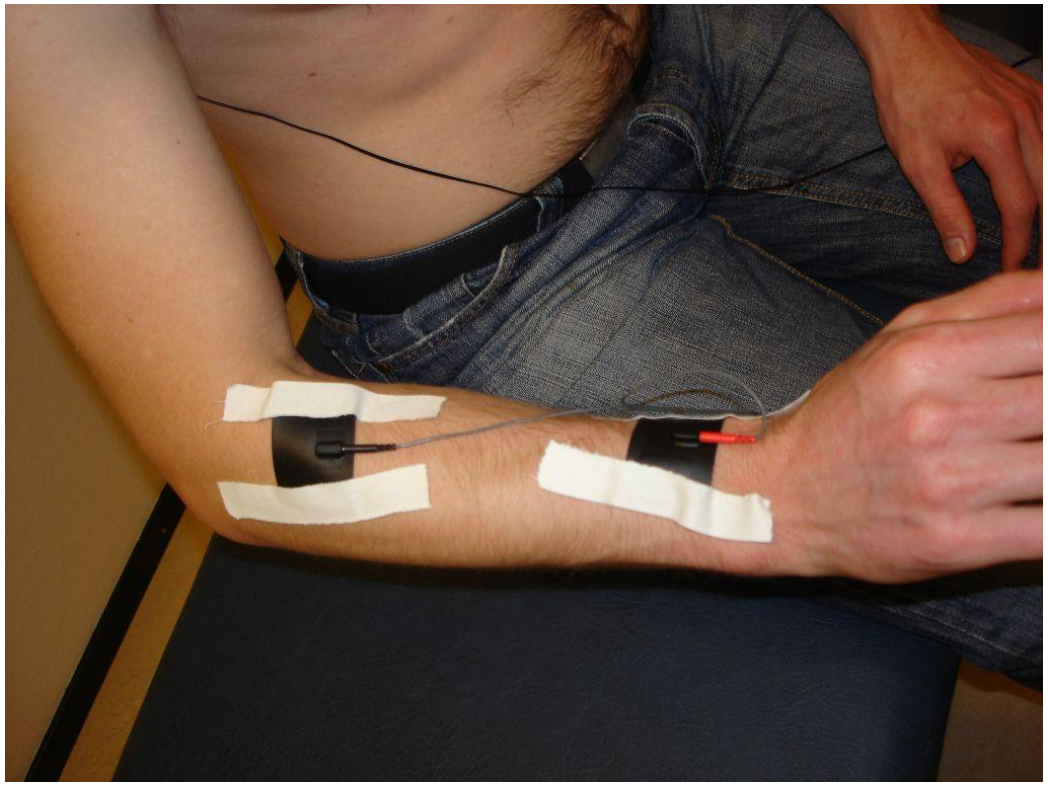
Active electrode & Passive electrode will be kept stationary

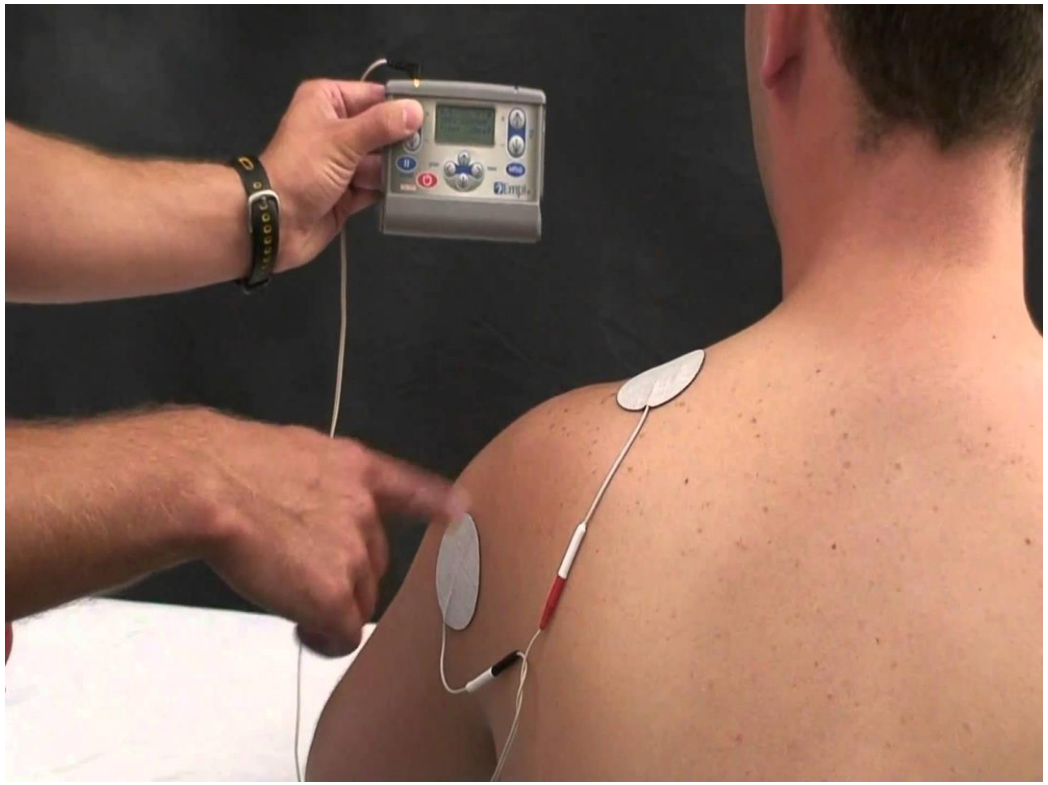
Group Muscle Stimulation



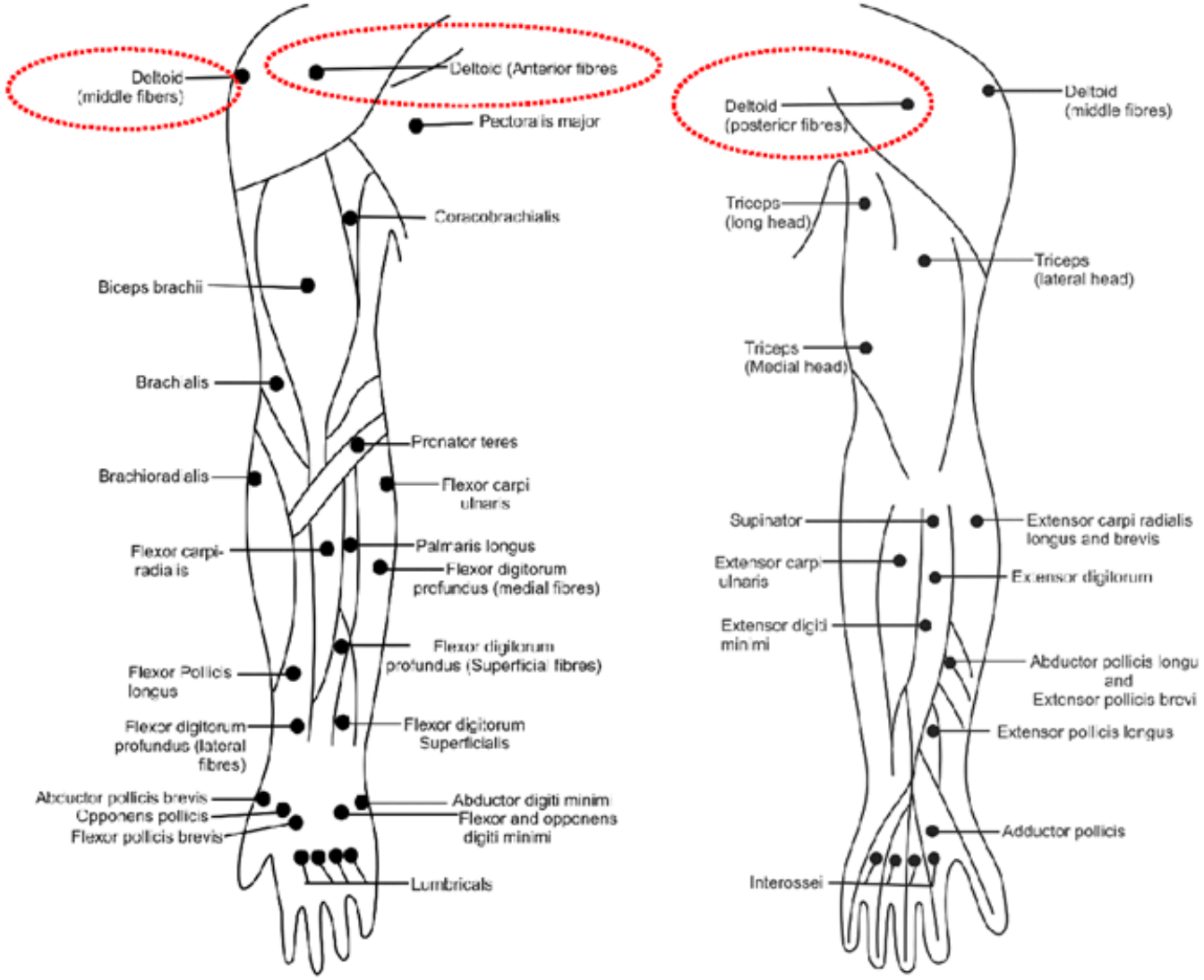
Motor Point Stimulation

Group Muscle Stimulation

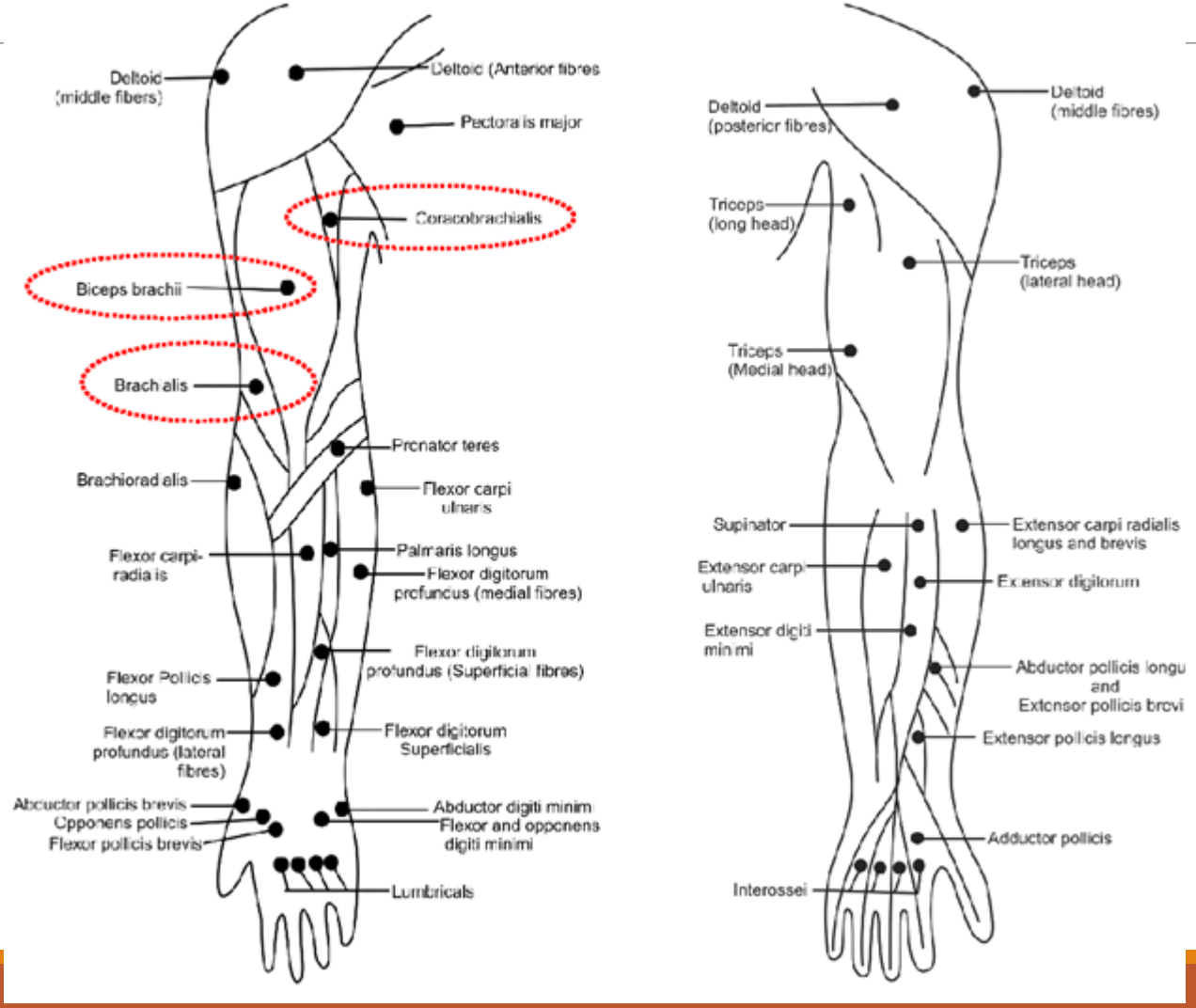




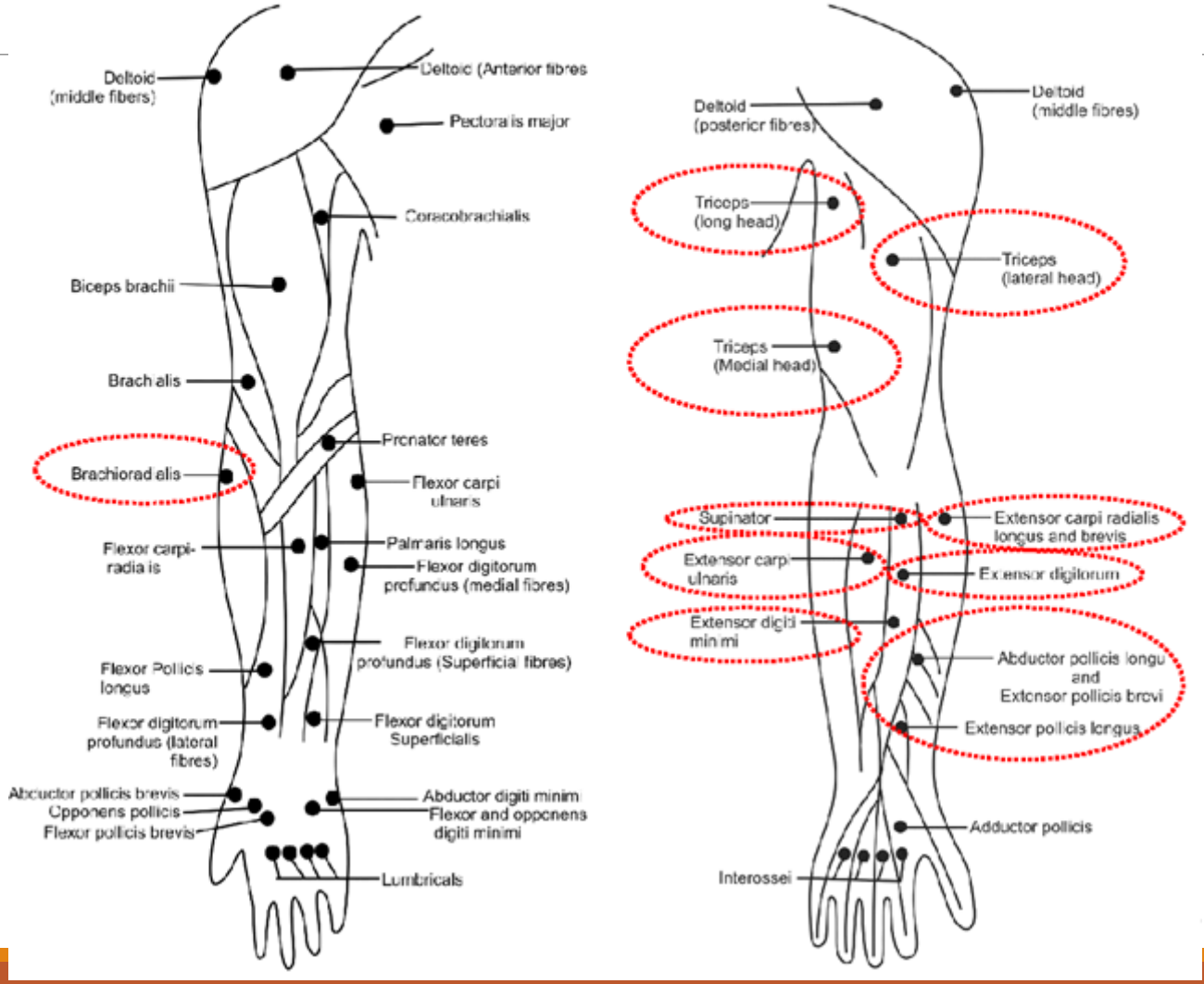
Motor Points of Axillary Nerve



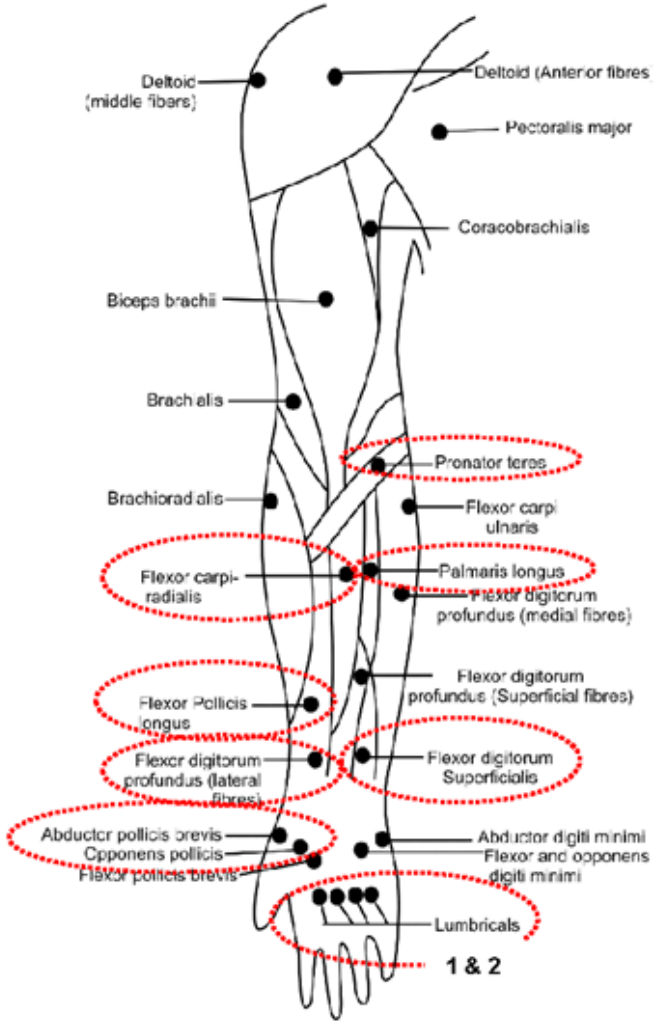
Motor Points of Musculocutaneous nerve



Motor Points of Radial Nerve



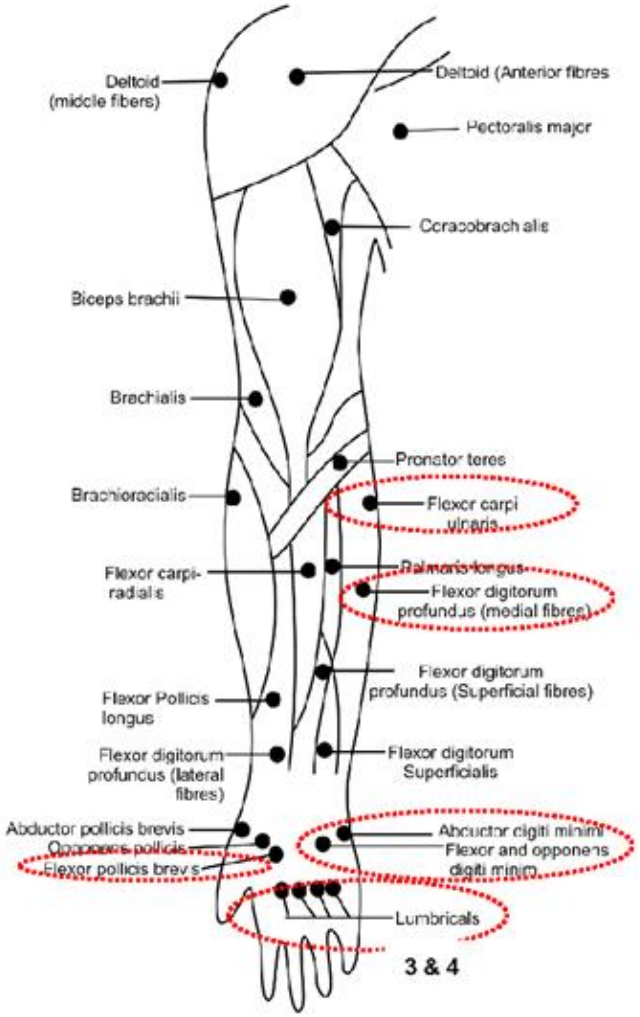
Motor Points of Median Nerve

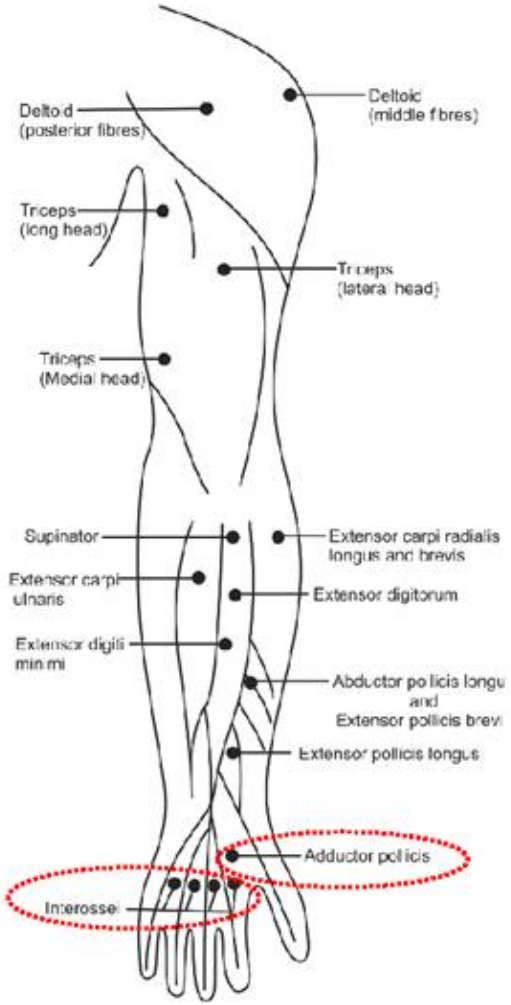


LOAF

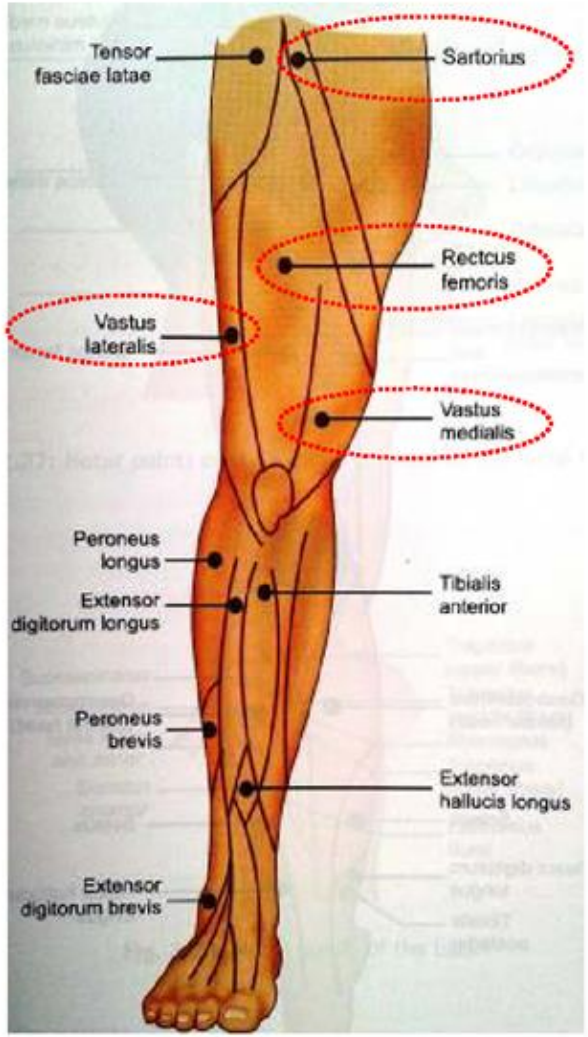
- **L**umbricals 1 & 2,
- **O**pponens pollicis,
- **A**bductor pollicis brevis and
- **F**lexor pollicis brevis.

Motor Points of Ulnar Nerve

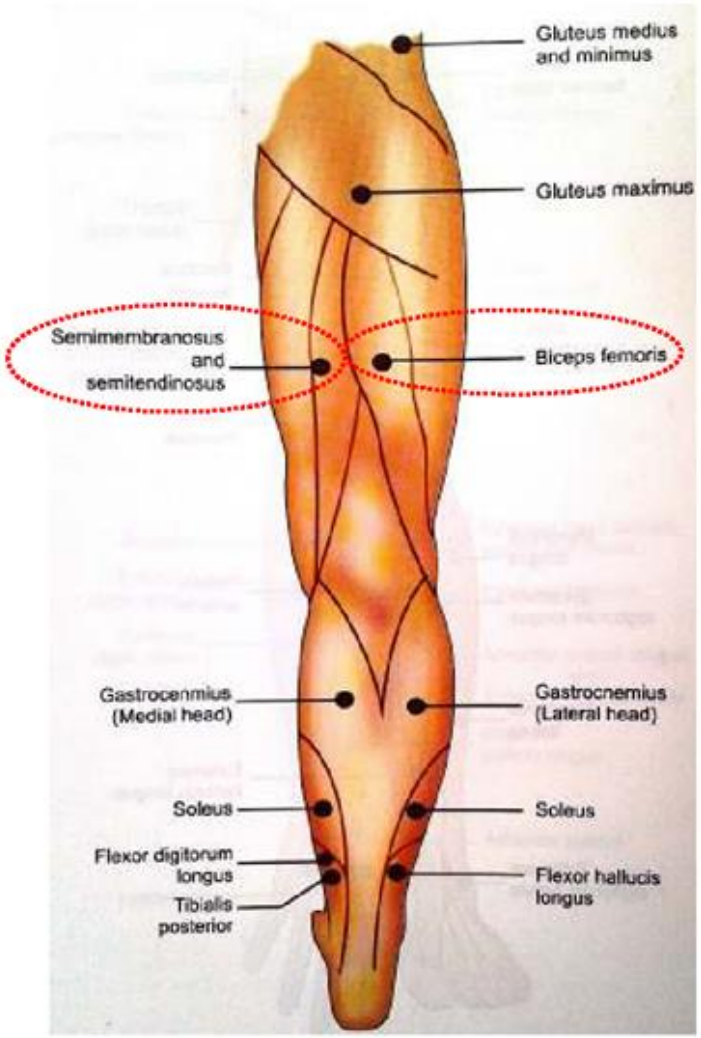




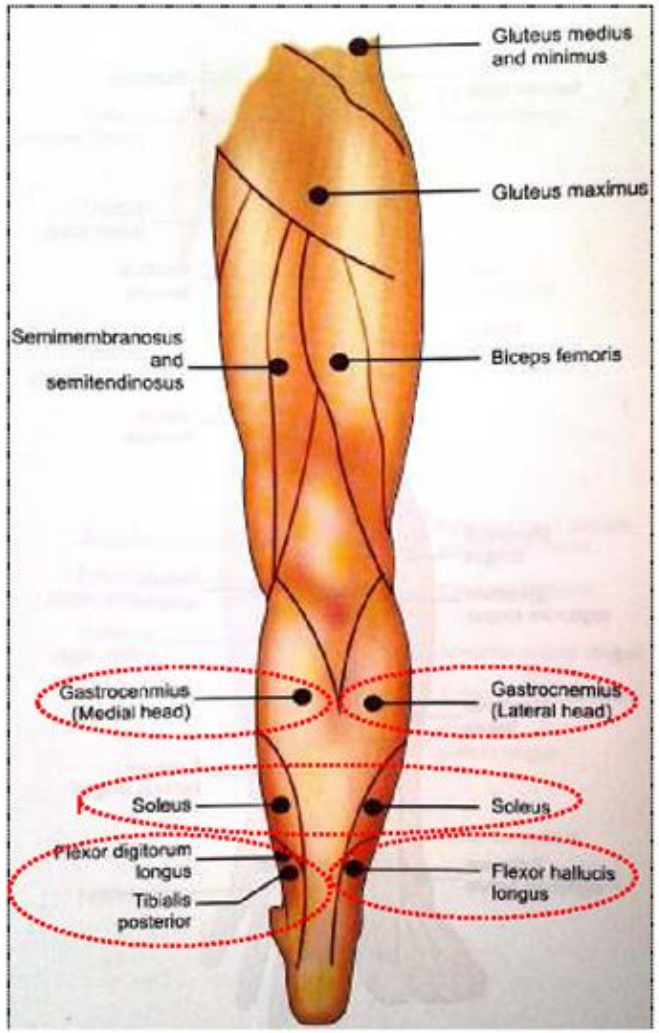
Motor Points of Femoral Nerve



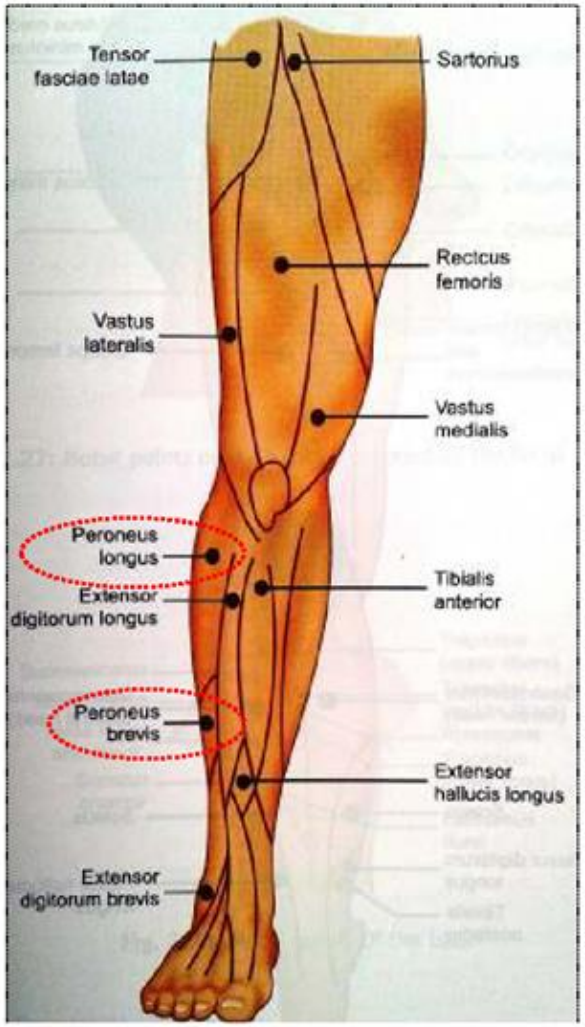
Motor Points of Sciatic Nerve



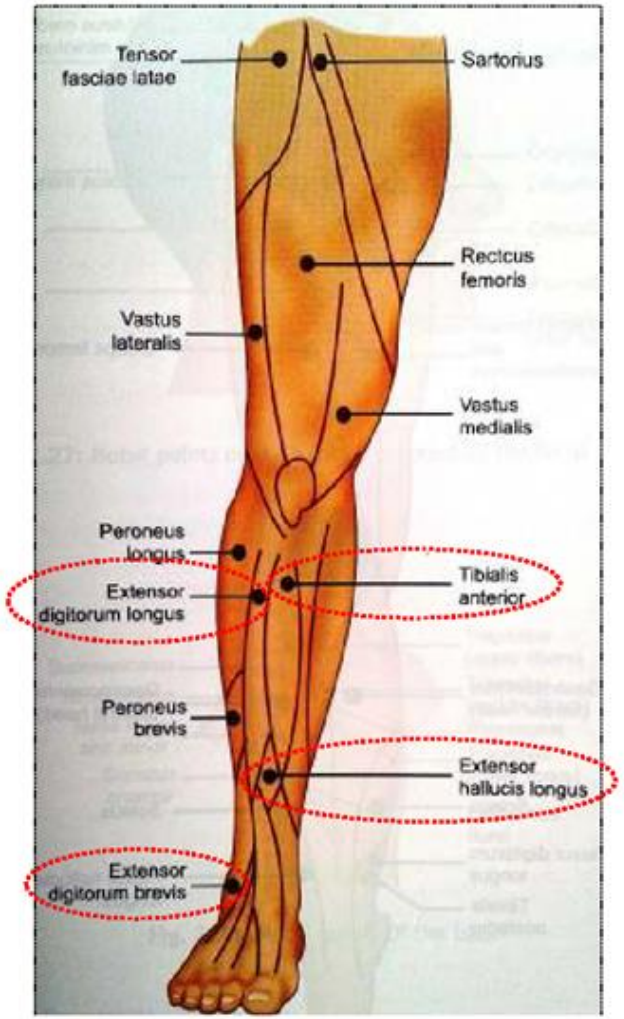
Motor Points of Tibial Nerve



Motor Points of Sup. peronei Nerve



Motor Points of Deep peronei Nerve



Precaution & Dangers

If the skin sensation is not normal, it is preferable to position the electrodes at an alternative site which ensures effective circulation.

Avoid active epiphyseal regions in children.

Select stimulation parameters appropriate to the effect desired.

Inappropriate stimulation parameters may cause muscle damage, reduction in blood flow through the muscle and low frequency muscle fatigue.

Appropriate care should be taken to ensure that the level of muscle contraction initiated does not compromise the muscle nor the joint(s) over which it acts.

Patients with a history of epilepsy should be treated at the discretion of the physiotherapist in consultation with the appropriate medical practitioner.

Dangers

Burns

Electric shock

Hypovolemic shock

PHYSIOLOGICAL EFFECTS AND THERAPEUTIC USES OF FARADIC TYPE CURRENT:

1- Muscle contraction

2- Muscle strengthening

3- Facilitation of muscle control

4- Maintenance or increase of range of joint motion

5- Effects on muscle metabolism and blood flow

6- Pain modulation

Cont.

7- Electrical stimulation for the control of spasticity.

8- Effects on blood flow

9- Reduction of edema

10- Effects on the autonomic nervous system

Diadynamic currents

DIADYNAMIC CURRENT (DD)

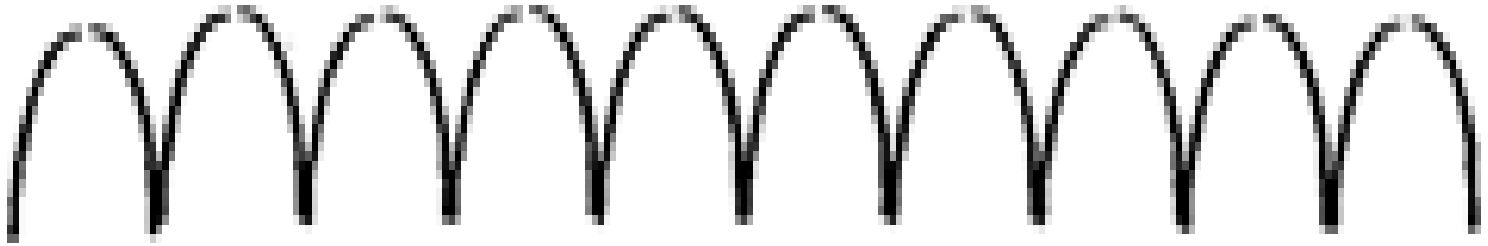
Diadynamic currents are basically a variation of sinusoidal currents.

They are **monophasic** sinusoidal currents, being rectified (rectified alternating current.)

Physical properties of DD:

1. ***DF*** *(Fixed di-phase):*

Full-wave rectified alternating current, with a frequency of 50 Hz.



The patient feels tickling sensation and muscle contraction occurs only at high intensities. Used for initial treatment and has analgesic effect.

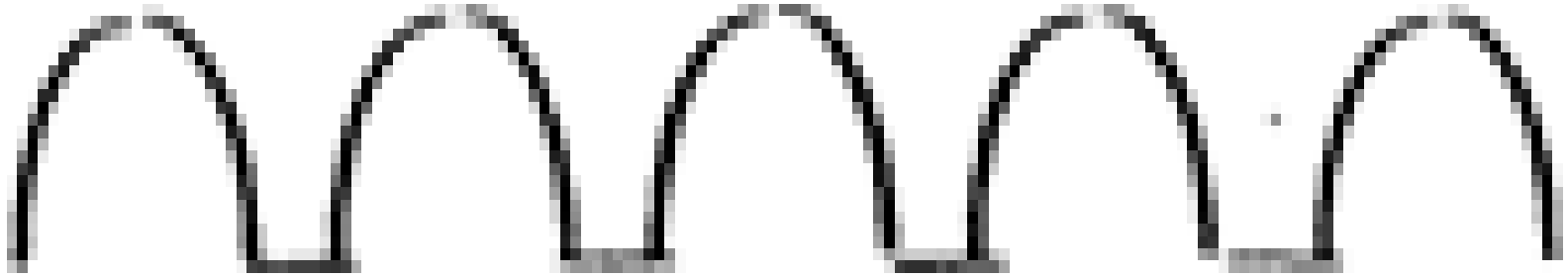
MF

2. MF (Fixed mono-phase):

Half-wave rectified alternating current, with a frequency of 25 Hz.

The patient feels strong vibration sensation. It is used in treatment of pain

without muscle spasm.

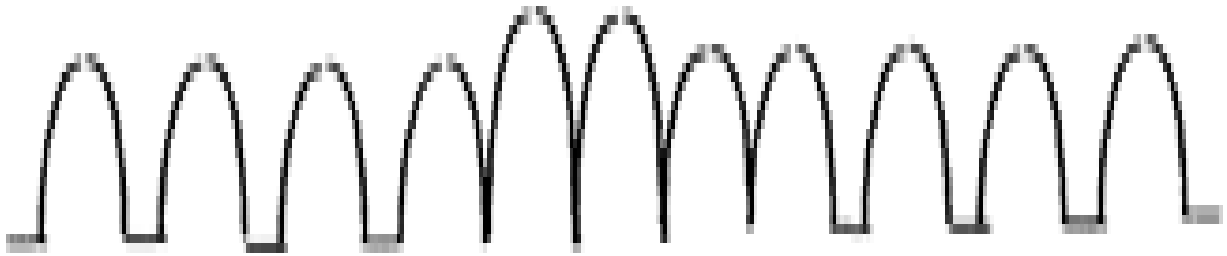


Physical properties of DD:

3. CP (Short periods):

Equal phases of DF and MF, alternating without interval pauses.

4. LP (Long periods):



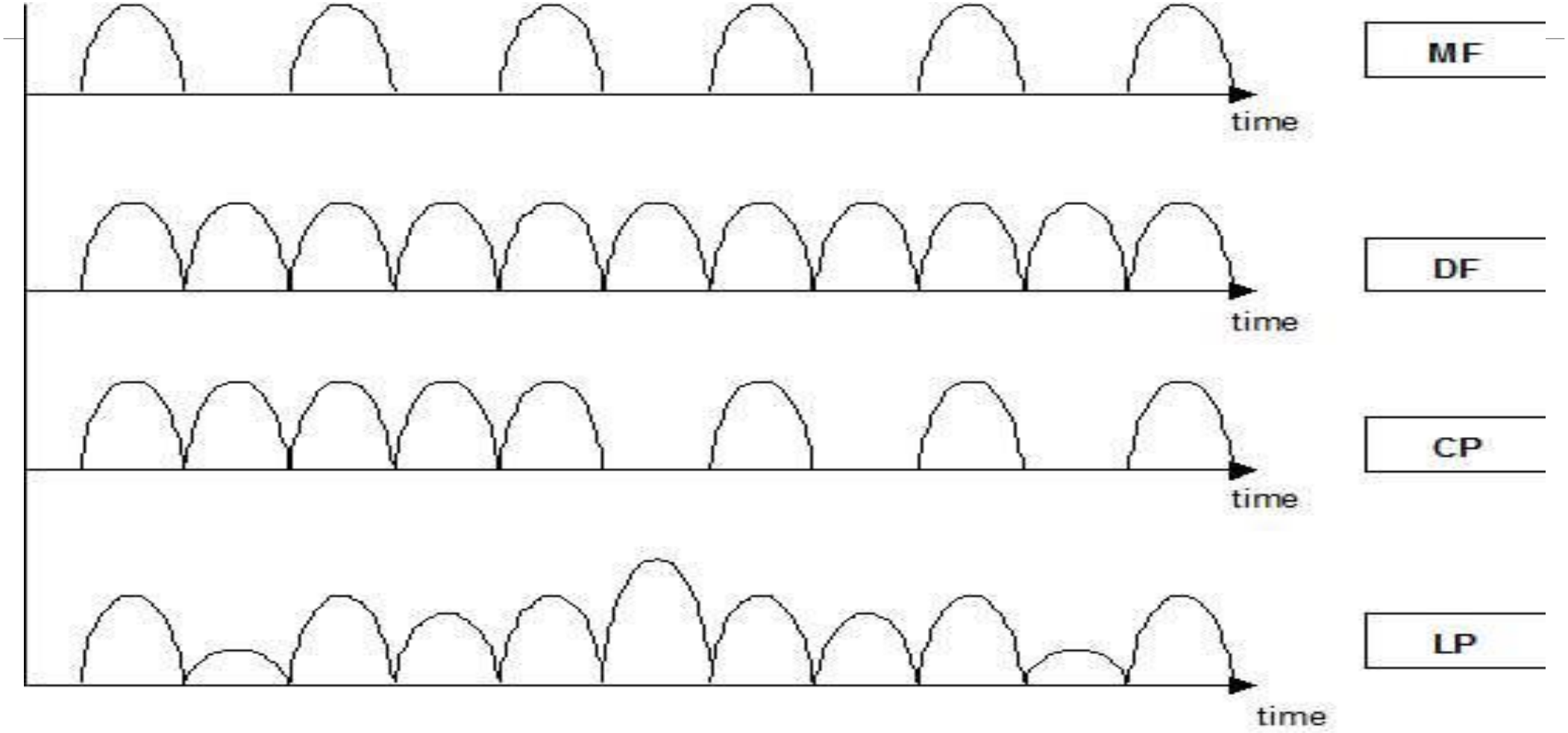
slow alternation between six seconds of MF current and a six-second DF phase.

Cont.

5. RS (Syncopal Rhythm):

It comprises 1-sec phase of MF, followed by a 1-sec rest phase.

Diadynamic currents



Clinical application of Electricity: minimizing the resistance

Reduce the skin-electrode resistance

- **Minimize air-electrode interface**
- **Keep electrode clean of oils, etc.**
- **Clean the skill on oils, etc.**

Use the shortest pathway for energy flow

Use the largest electrode that will selectively stimulate the target tissues

If resistance increases, more voltage will be needed to get the same current flow

Stimulation Parameter:

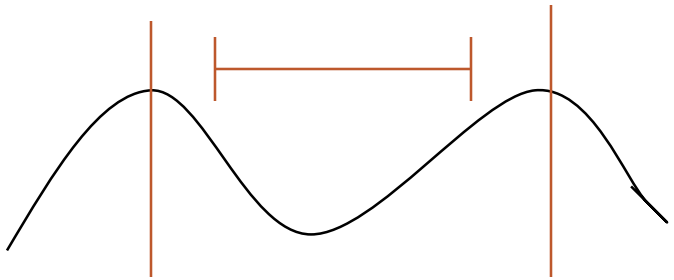
Amplitude: the intensity of the current, the magnitude of the charge. The amplitude is associated with the depth of penetration.

- **The deeper the penetration the more muscle fiber recruitment possible**
- **remember the all or none response and the Arndt-Schultz Principle**

Simulation Parameter

Pulse duration: the length of time the electrical flow is "on" also known as the pulse width. It is the time of 1 cycle to take place (will be both phases in a biphasic current)

- **phase duration important factor in determining which tissue stimulated: if too short there will be no action potential**



Stimulation Parameter:

Pulse rise time: the time to peak intensity of the pulse (ramp)

- rapid rising pulses cause nerve depolarization
- Slow rise: the nerve accommodates to stimulus and a action potential is not elicited
  - Good for muscle reeducation with assisted contraction - ramping (shock of current is reduced)

Stimulation Parameters

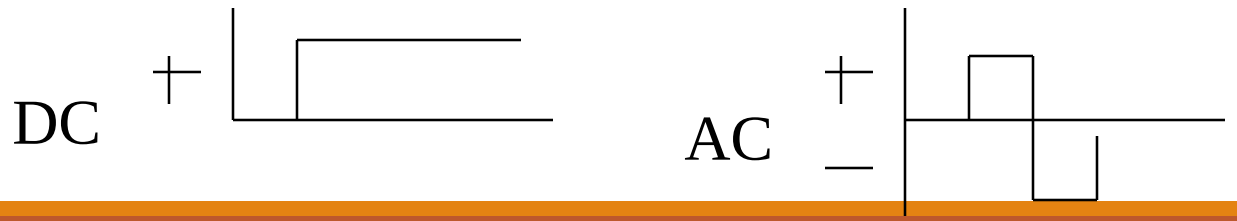
Pulse Frequency: (PPS=Hertz) How many pulses occur in a unit of time

- ***the lower the frequency the longer the pulse duration***
- **Low Frequency: 1K Hz and below (MENS .1-1K Hz), muscle stim units)**
- **Medium frequency: 1K ot 100K Hz (Interferential, Russian stim LVGS)**
- **High Frequency: above 100K Hz (diathermies)**

Stimulation Parameter:

Current types: alternating or Direct Current (AC or DC)

- AC indicates that the energy travels in a positive and negative direction. The wave form which occurs will be replicated on both sides of the isoelectric line
- DC indicated that the energy travels only in the positive or on in the negative direction

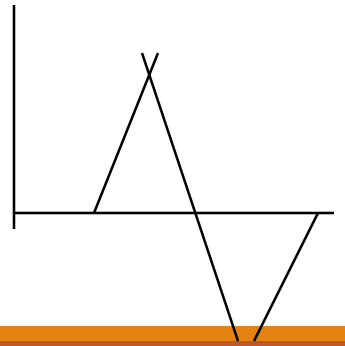


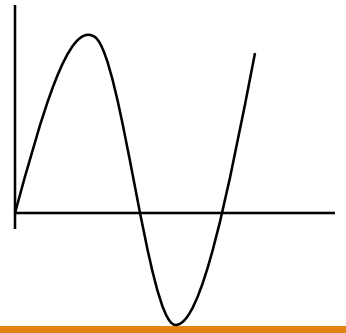
Stimulation Parameter:

Waveforms; the path of the energy. May be smooth (sine) spiked, square,, continuous etc.

Method to direct current

- Peaked - sharper
- Sign - smoother





Stimulation Parameter:

Duty cycles: on-off time. May also be called inter-pulse interval which is the time between pulses. The more rest of “off” time, the less muscle fatigue will occur

- 1:1 Raito fatigues muscle rapidly
- 1:5 ratio less fatigue
- 1:7 no fatigue (passive muscle exercise)

Stimulation Parameter:

- Average current (also called Root Mean Square)
  - the “average” intensity
  - Factors effective the average current:
    - pulse amplitude
    - pulse duration
    - waveform (DC has more net charge over time thus causing a thermal effect. AC has a zero net charge (ZNC). The DC may have long term adverse physiological effects)

Stimulation Parameter:

Current Density

- The amount of charge per unit area. This is usually relative to the size of the electrode. Density will be greater with a small electrode, but also the small electrode offers more resistance.

Direct Current

Description:

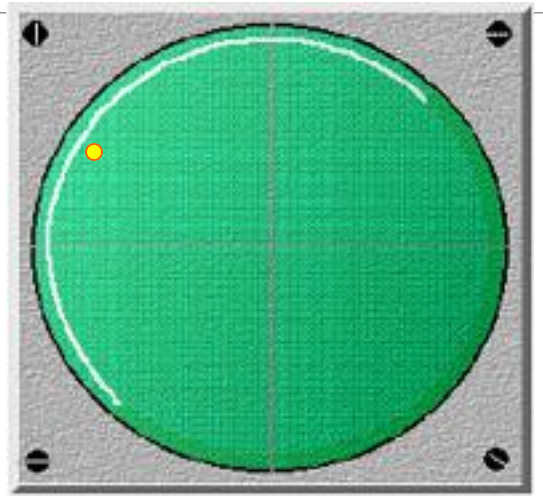
One-directional flow of electrons

Constant positive and negative poles

Use:

Iontophoresis

Low-voltage stimulation



Alternating Current

Description:

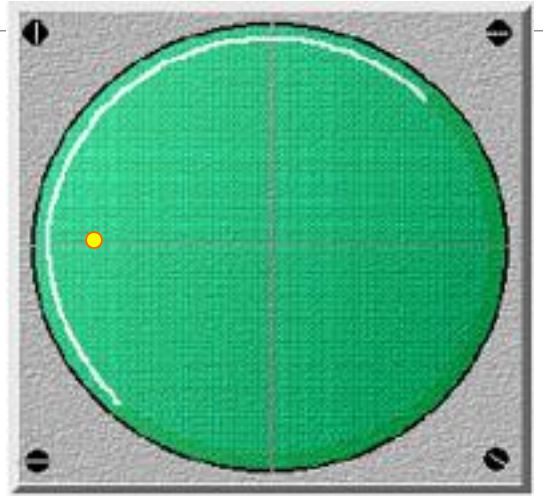
bidirectional flow of electrons

No true positive and negative poles

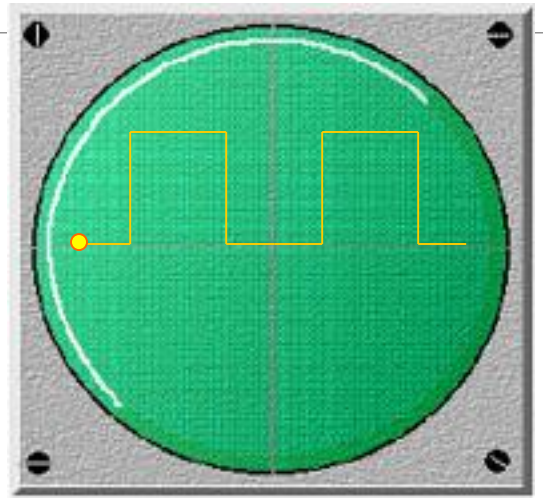
Use:

Interferential stimulation

Premodulated currents



Pulsed Currents



MONOPHASIC

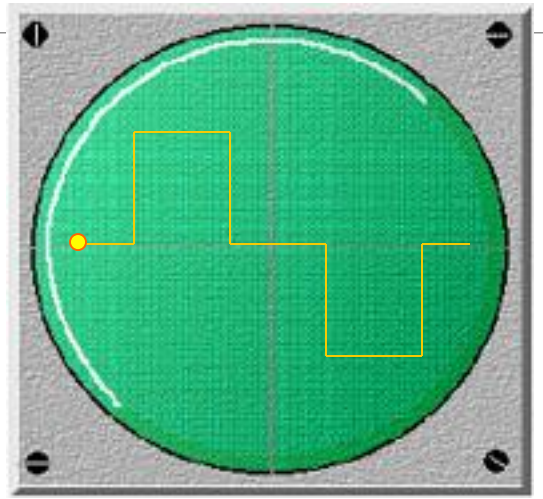
Description:

One-directional flow marked by periods of non-current flow

Electrons stay on one side of the baseline or the other

Use:

High voltage pulsed stimulation



BIPHASIC

Description:

Bidirectional flow of electrons marked by periods of non-current flow

Electrons flow on both sides of the baseline (positive and negative)

Use:

Neuromuscular electrical stimulation

Three types of biphasic currents

Biphasic Current Types

Symmetrical

- Mirror images on each side of the baseline
- No net positive or negative charges under the electrodes

Balanced Asymmetrical

- The shape of the pulse allows for anodal (positive) or cathodal (negative) effects
- No net positive or negative charge

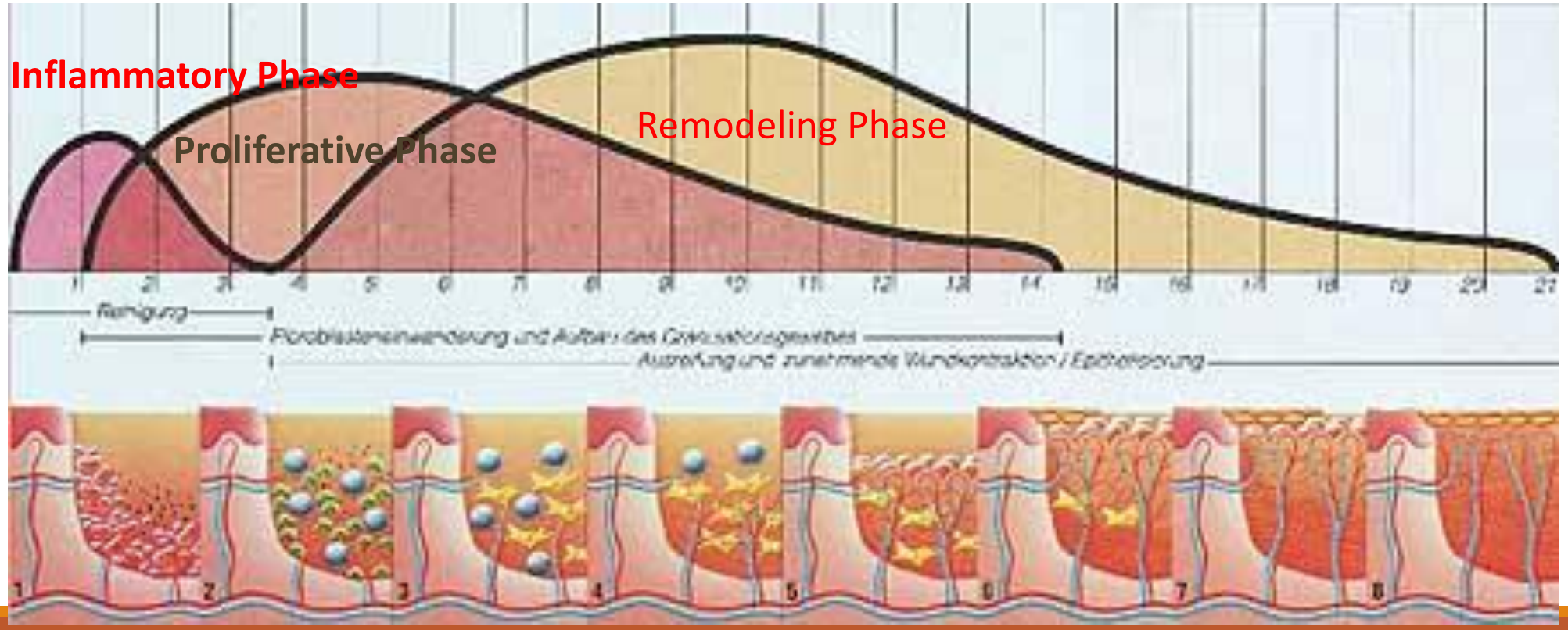
Unbalanced Asymmetrical

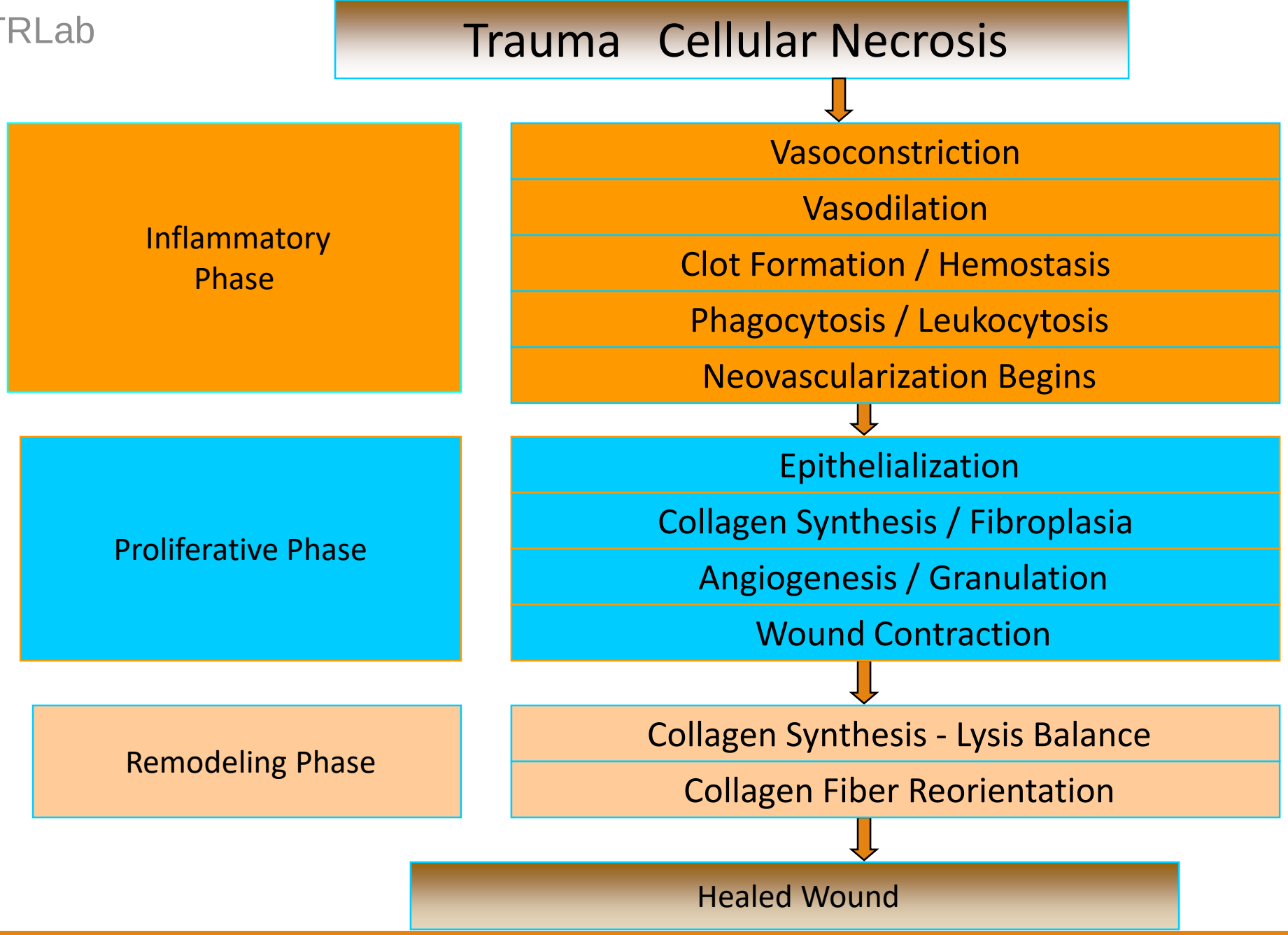
- Positive or negative effects
- The imbalance in positive and negative charges results in a net change over time. Can cause skin irritation if used for long durations

COURSE OF WOUND HEALING

3 Phase of the Wound Healing

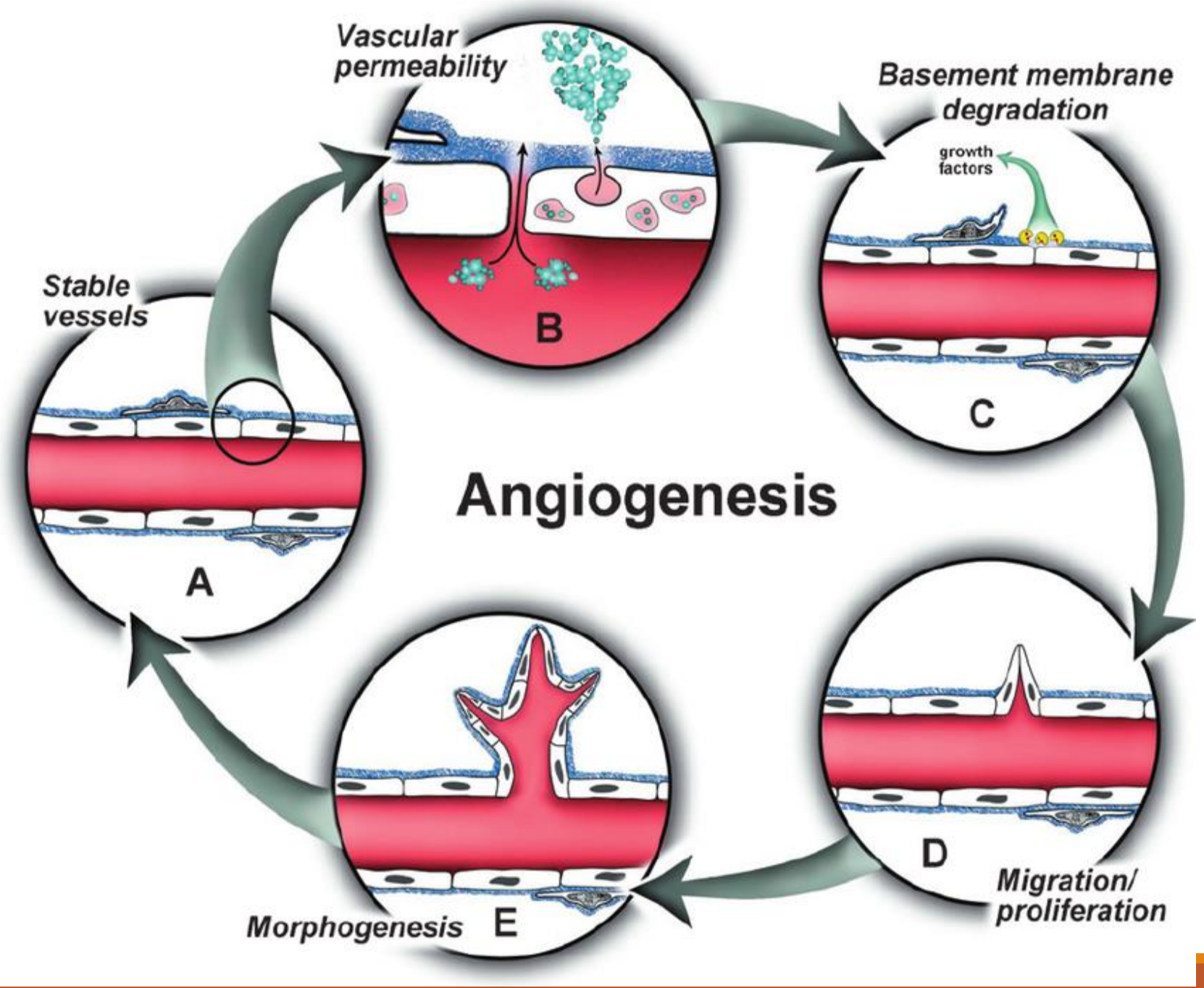
1. Inflammatory Phase : at the moment of injury – 3 (2-5) days
2. Proliferative Phase : 3 (2-5) day to 20 days
3. Remodeling Phase





Flow Chart of Wound Healing

Angiogenesis is the formation of new blood vessels. This process involves the migration, growth, and differentiation of endothelial cells, which line the inside wall of blood vessels. The process of **angiogenesis** is controlled by chemical signals in the body



Major Components of Hemostasis

Vascular Injury

Collagen

Tissue factor

Vasoconstriction

Platelet Activation

Coagulation Cascade

Antithrombotic Control Mechanisms

vWF, fibrinogen

Thrombin

Platelet Plug

Fibrinogen → *Fibrin*

Blood Clot

Plasmin

Fibrinolysis & Clot Degradation

Primary Hemostasis

Secondary Hemostasis

A)Synthesis lysis balance:

Means the balance between the new collagen production process and the break down process of old collagen .New collagen formation = old collagen breakdown (under normal condition). If collagen formation is higher than old collagen breakdown this will lead to hypertrophic scar & Keloid formation. Collagen destruction or breakdown is occurred by the action of the collegians enzyme. Collegians enzyme is capable of cleaving strong cross-links or of the tropo- collagen molecule. Breaking these bonds causes the molecule to become soluble and excreted from the body as waste products.

BIOLOGICAL EFFECTS OF ESTR

Table 4. Summary of Biological Effects of ES in Wound Repair Process

1. Inflammatory Phase

Initiates the wound repair process by its effect on the current of injury

- Increases blood flow
- Promotes phagocytosis
- Enhances tissue oxygenation
- Reduces edema perhaps from reduced microvascular leakage
- Attracts and stimulates fibroblasts and epithelial cells
- Stimulates DNA synthesis
- Controls infection
- Solubilizes blood prod

2. Proliferation phase

Stimulates fibroblasts and protein synthesis

- Stimulates DNA synthesis
- Increases ATP generation
- Improves membrane transport
- Produces better collagen matrix organization,
- Stimulates wound contraction

3. Epithelialization phase

- Stimulates keratinocytes reproduction and migration
- Produces a smoother, thinner scar

Thank you