Medium Frequency Currents

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Objectives

- Define interferential.
- Explain the main principles of IF.
- Describe the parameters of IF and its modulation.
- Discuss indication and contra-indications of IF.
- Describe the steps of clinical application for IF.
- Define Russian current and identify its characteristics.
- Understand the theoretical basis for Russian current.
- Discuss the advantages of applying Russian current.
High frequency generators have a frequency of more than 10,000 Hz.

Stimulators are classified as low, medium, or high frequency generators.

- **Low frequency generators** range from 1-1000 Hz.
- **Medium-frequency generators** 1000 to 10,000 Hz.
- **High frequency generators** have a frequency of more than 10,000 Hz.

**PULSE FREQUENCY**

- Number of cycles per second.

- Stimulators are classified as low, medium, or high frequency generators.
INTERFERENTIAL THERAPY utilizes two medium frequency currents which are slightly out of phase, passed through the tissues simultaneously, where they interfere with each other.

This interference gives rise to an interference or Beat Frequency which has the characteristics of a low frequency stimulation.
• The exact frequency of the resultant beat frequency can be controlled by the input frequencies e.g., if one current was at 4000 HZ and its companion current at 3900 HZ, the resultant beat frequency would be at 100 HZ
The basic principle of Interferential Therapy is to utilize the strong physiological effects of Low Frequency electrical stimulation of muscle and nerve tissues at sufficient depth without the associated painful and somewhat unpleasant side effects of such stimulation.
PRINCIPLE OF INTERFERENTIAL THERAPY

Skin Impedance is inversely proportional to the Frequency of the stimulation.

- Skin impedance diminishes with increase of frequency according to the formula:
  \[ Z = \frac{1}{2FC} \]
- Where: \( Z \) = impedance in ohms
  \( F \) = frequency in Hz
  \( C \) = capacity of the skin in microfarads
Skin Impedance at 50Hz is approximately 3200 ohms while at 4000Hz it is reduced to 40 ohms.

The result of applying Medium Frequency currents is that it will pass more easily through the skin, requiring less electrical energy input to reach the deeper tissues & giving rise to less discomfort.

The resulting Interference Current (Low Frequency) allows effective stimulation of biological tissues.
PRODUCTION OF INTERFERENTIAL

IFC is produced by mixing two medium-frequency currents that are slightly out of phase, either by applying them so that they ‘interfere’ within tissues or mixing them within the stimulator prior to application.

One current is normally of fixed frequency, for example at 4000 Hz, and the other current is adjustable, for example between 4000 and 4200 Hz.
Two currents summate or cancel each other out in a predictable manner, producing the resultant amplitude-modulated ‘interferential current’.
The frequency of the resultant current will be equal to the mean of the two original currents, and will vary in amplitude at a frequency equal to the difference between these two currents.

This later frequency is known as the ‘amplitude-modulated frequency’ (AMF) or ‘beat frequency’.

**AREA OF INTERFERENCE**

- It is the area where interferential current is set-up.
- The pattern of the interferential area may be static or dynamic.
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**STATIC INTERFERENCE**

The area in which the produced interferential current remains stationary. This area of static interference gives an appearance of clove leaf and lies to $45^\circ$ angles to the perpendicular lines from each electrode.
DYNAMIC INTERFERENCE

The area in which interference current is developed is moving in a to and fro manner through 45°. It is obtained by varying the current intensity in suitable manner. This dynamic area of interference is also called as vector sweep, vector scan.
USES OF INTERFERENTIAL THERAPY

There are 5 main clinical uses for which IF appears to be beneficial:

- 1- Relief and management of acute and chronic pain.
- 2- Muscle stimulation
- 3- Increased blood flow
- 4- Reduction of edema
- 5- Stimulating of soft tissues healing and repair.
PAIN RELIEF

IF current is used management of acute and chronic pain of different origin specially;

- Post traumatic pain.

- Sympathetically maintained pain as in shoulder hand syndrome, reflex sympathetic dystrophy and Reynolds disease.
MECHANISMS OF PAIN CONTROL
BY INTERFERENTIAL THERAPY

- Stimulation with the higher frequencies about 100Hz at sensory level, stimulate the pain gate mechanisms & thereby mask the pain symptoms.

- Stimulation with lower frequencies up to 10Hz at motor level intensities can be used to activate the opioid mechanisms, again providing a degree of relief.

- Decrease activity of the sympathetic ganglion and sympathetic nerves in cases of sympathetically maintained pain.
MUSCLE CONTRACTION STIMULATION

- Stimulation of the motor nerves to induce contraction of muscle can be achieved with a wide range of frequencies (10-50Hz).

- Clearly, stimulation at low frequency (e.g. 1-10Hz) will result in a series of twitches, with stimulation at 50Hz will result in a tetanic contraction.

- The choice of treatment parameters will depend on the desired effect.
MUSCLE CONTRACTION STIMULATION

If IF is used as neuromuscular stimulation, it can be used for:

- Relaxation of muscle spasm.
- Prevention and retardation of disuse atrophy.
- Muscle re-education.
- Maintenance of range of motion.
INCREASE BLOOD FLOW

Increased vasodilatation is noticed following interferential current due to;

- Its effect on parasympathetic nerve fibers for increased blood flow. IC is used in treatment of circulatory disorders.

- Depressing the activity of certain cervical and lumbo-sacral sympathetic ganglia in patients with increased arterial constrictor tone so increased circulation a in Reynaud's disease.
REDUCTION OF EDEMA

- Chronic post-traumatic edema can be reduced by the use of IF. This effect is attributed to milking of the venous and lymphatic return through electrically evoked contraction.

- The beat frequency of approximately 15 Hz or a sweep of 10-25 Hz is often used.
STIMULATING SOFT TISSUES
HEALING AND REPAIR

- IF improve accelerate ossification and is used to enhance fracture healing.

- IF current also is used to accelerate wound healing by improving cellular function and increasing cell proliferation.
By careful manipulation of the input currents it is possible to achieve any beat frequency that you might wish to use clinically.

Modern machines usually offer frequencies of 1-150Hz, though some offer a choice of up to 250 Hz or more.
ELECTRODES PLACEMENT

- Electrode positioning should ensure adequate coverage of the area for stimulation.

- Placement of the electrodes should be such that a crossover effect is achieved in the desired area. When the electrodes are properly positioned, the stimulation should be felt only between the electrodes, not under the electrodes.

- If the electrodes are not placed so that a crossover is achieved, the physiological effects of I/F can not be achieved.
TECHNIQUES OF APPLICATION
QUADRIPOlar TECHNIQUE

- The four electrodes are positioned around the target treated area so that each channel runs perpendicular to the other and the current crosses at a midpoint.

- The interference effect branch off at 45° angles from the center of the treated. Tissues within this area receive the maximal treatment effect.

- The electrodes are positioned in a coplanar arrangement to treat a flat surface.
In bipolar technique, the mixing of the two channels occurs within the generator rather than in the tissue.

This technique does not penetrate the tissues as deeply as quadripolar application and there tend to be more sensory sensation than with four pole technique.

In some circumstances, a bipolar technique is preferable if a longitudinal zone requires stimulation.

When muscle contraction are the goal of the treatment, bipolar electrode placements are used.
TYPES OF ELECTRODES

- **Metal plate and pads**
  
  Current is applied by metal electrode with water-soaked sponges.

- **Carbon rubber electrodes**
  
  Current is applied by Carbon rubber electrodes are used with conducting gel.

- **Suction cup electrodes**
  
  Suction unit can be connected to the interferential machine. The electrodes are applied to the patient through flexible rubber cups.
TREATMENT PARAMETERS

INTENSITY

The intensity of the current is dependent on the desired physiological effect and the tissue to be stimulated.

In general the current could be administered at sensory level, motor level, or noxious level.
TREATMENT PARAMETERS

Frequency

Different tissues will have an optimal stimulation band,

- Sympathetic Nerve 1-5Hz
- Parasympathetic Nerve 10-150Hz
- Motor Nerve 10-50Hz
- Sensory Nerve 90-100Hz
- Nociceptive fibers 90-150Hz
- Smooth Muscle 0-10Hz
SWEEP FREQUENCY

- Nerves will accommodate to a constant signal & a sweep (or gradually changing frequency) is often used to overcome this problem.

- The most common application is the 6 second rise and fall between the pre-set frequencies.

- For example, if a 10-25 Hz range has been selected, the machine will deliver a changing frequency, starting at 10 Hz, rising to 25 Hz over a 6 second period.
Once this upper limit has been achieved, the frequency will once again fall, over a 6 second period to its starting point at 10Hz. This pattern is repeated throughout the treatment session.
TREATMENT DURATION

Vary widely according to the usual clinical parameters of acute/chronic conditions & the type of physiological effect desired.

- Acute conditions  5-10 minutes
- Chronic conditions  20-30 minutes.
INDICATIONS

- Pain
- Muscle spasm
- Edema
- Hematoma
- Chronic ligamentous lesion
- Trigger spots in myofascial syndromes
- Stress incontinence
- Delayed union and Sudek’s atrophy
RUSSIAN CURRENT
Russian current generators were developed in Canada and the United States after the Russian scientist Yakov in 1977 A.D.

It can help athletes to gain up to 40% in muscle strength and torque production.

These stimulators deliver a medium frequency pulsed symmetric biphasic waveform.

Russian current was utilized by the Russian Olympic team in an attempt to develop muscle mass.
PARAMETERS OF RUSSIAN CURRENT

WAVEFORM
Symmetric biphasic waveform, either sine wave or square wave.

PULSE DURATION
Ranging from 50-250 μsec
**FREQUENCY**

It is usually conducted in 2500 Hz, delivered in form of bursts (50 bursts/second) each burst is of 10 msec. duration with an interburst interval of 10 msec.

**DUTY CYCLE**

Duty cycle of the Russian current is 50%.

**INTENSITY**

Intensity used should be sufficient to produce maximum electrically induced muscle contraction.
ADVANTAGES OF RUSSIAN CURRENT

It is better tolerated by the patient than other kinds of electrical stimulations.

It faces lower skin impedance, as the higher-frequency currents reduce the resistance to current flow.

It is a fast-oscillating biphasic current, so that, as soon as the nerve repolarizes it is stimulated again.

Thought to depolarize both sensory and motor nerves concomitantly Thus simulating muscle training.
The main effect of Russian current is electrically induced increase in muscle torque production.

It is not used in rehabilitation, but rather in strength training protocols as it produces a more forceful muscle contraction than most electrical stimulation units.

Medium frequency currents are characterized by deeper penetration of stimulation and a stronger muscle contraction production.
Russian current stimulation regimen might increase muscle force and maximum voluntary contraction (MVC) of athletes by up to 40%.

Russian current stimulation should be combined with voluntary exercise regimen, as the commonly used exercise programs build muscle bulk and muscle force but ignore the role of skill and fine motor control in athletic performance.

Electrical stimulation preferentially recruits the fast twitch, motor units associated with sudden, rapid movement and precise motor control of movement.
INDICATIONS OF RUSSIAN CURRENT

- Muscle strengthening.
- Facilitation of muscle contraction and muscle control.
- Prevent muscle atrophy.