specific current intensities. The intensity should be slowly turned up until the patient signals that the required sensation has been reached. Periodic adjustment of intensity is recommended to compensate for any adaptation.

Treatment Duration

Treatment times vary widely according to the usual clinical parameters of acute/chronic conditions and the type of physiological effect desired. In acute conditions, shorter treatment times of 5-10 minutes may be sufficient to achieve the effect; 10–15 minutes of treatment, not exceeding 20 minutes to one area, has been suggested (Savage 1984) though other authors have recommended 10 minutes for most painful conditions (Wadsworth and Chanmugam 1980). In certain circumstances, it may be necessary to stimulate the tissues for 20-30 minutes.

Physiological Effects of Interferential Currents

The current flowing between each pair of electrodes is insufficient to stimulate nerve and muscle directly, until the amplitude of the current is modulated by interference. This method of therapy thus reduces the stimulation of cutaneous sensory nerves near the electrodes, while promoting the effect upon the deep tissues.

The physiological effect of this amplitude modulated current depends upon frequency. Neurons exhibit a maximum rate at which action potentials are conducted and this is a function of the degree of myelination and diameter of the axon. Repetitive stimulation at any frequency up to its maximum (1 kHz for a large motor neuron) will cause action potentials to flow in the axon at the same rate. As the rate of stimulation increases, successive stimuli fall within the relative and eventually the absolute refractory period of the preceding action potential. A larger than normal flow of current will be necessary to stimulate a refractory neuronal membrane, and thus the sensitivity of the nerve decreases. This effect is called Wedensky inhibition. Thus, a prolong stimulation at a supramaximal frequency causes the axon to cease conducting current. Accommodation of the neuron is responsible for this effect, caused by an increased threshold and synaptic fatigue. Some sources report that these effects occur in large neurons stimulated at frequencies as low as 40 Hz. Small or unmyelinated neurons have a slower conduction velocity and longer refractory period than large neurons, and will show a stimulus induced block to conduction at a lower frequency.

The physiological effects vary with the factors such as the magnitude of the current, mode (constant/sweep), frequency range used, and the accuracy with which the electrodes are placed. The common effects produced are as follows:

i. **Stimulation of muscle:** Rapid stimulation of a motor nerve with large comfortable interferential currents results in asynchronous depolarization of individual motor units (Gildemeister effect). This mimics the pattern of muscle contraction observed during a normal voluntary contraction. Motor excitation using interferential currents is considered as an advanced method compared to other low frequency electrical stimulation. The most effective motor nerve stimulation range with IFT appears to lie between approximately 10 Hz and 25 Hz. Stimulation below 10 Hz results in a series of coarse twitches which may be of clinical benefit. Stimulation at higher frequencies than that needed to bring about a partial tetany (usually around 20 Hz or 25 Hz) can generate a strong tetanic contraction, which might be considered beneficial to assist patient appreciation of the required muscle work.
Muscle contraction is produced with little sensory stimulation and can be of deeply placed muscles, e.g., pelvic floor. Due to the effect of the interferential currents on both the voluntary and smooth muscle fibers, this current can restore the tone in the pelvic floor muscles compared to the faradic currents.

ii. **Relief of pain:** The analgesic effect of interferential therapy can be explained in part by Wedensky inhibition of type C nociceptive fibers. The pain gate theory and other mechanisms also contribute significantly for the reduction of pain by interferential currents.

The pain gate theory: Based on the pain gate theory developed by Melzack and Wall in 1965, it is theorized that the short duration pulses at a frequency of 100 Hz may stimulate the large diameter Aβ fibers, which have an effect on the pain gate in the posterior horn, that inhibit transmission of small diameter nociceptive traffic (C and Aδ fibers), which effectively closes the gait to painful impulses. A frequency of 80–100 Hz rhythmic is usually chosen for this effect as the problem of accommodation is minimized.

Descending pain suppression: This is another system that helps to reduce pain, which is mediated by the endogenous opiates. Nociceptive information that enters the spinal cord travels to the thalamus and interacts in the midbrain with structures such as PAG and raphe nucleus. Increased activity in the fibers descending from PAG and raphe nuclei to the spinal segment at which pain information enters releases inhibitory neurotransmitters that block further conduction of pain impulses. When interferential currents with a frequency of 15 Hz is applied, the stimulation of small diameter Aδ and C fibers increases activity of the descending fibers from the raphe nuclei, releasing inhibitory neurotransmitters (enkephalin and β endorphin) at the spinal level, neutralizing the pain, causing pain relief.

Increased circulation: Interferential current has been claimed to improve the circulation of blood and reduce swelling, which may wash away the chemicals that stimulate nociceptive nerve endings. Reduced swelling may concomitantly reduce tissue pressure. These phenomena are reported to occur because of mild muscle contraction or action on the autonomic nervous system, decreasing the tone of the blood vessels.

Placebo: Placebo response has been identified as one of the factors for relief of pain.

iii. **Control of circulation:** Evidence supports the beneficial effects of interferential currents in improving circulation. The current, when applied to the dorsal roots or spinal segment of origin of a peripheral nerve, causes peripheral vasodilatation in the structures innervated by it. Interferential therapy at a frequency of 100 Hz is used to promote vasodilatation. However, a frequency of 10 Hz which activates the musculoskeletal pump is used to promote venous and lymphatic return, which is utilized for the reduction of edema.

iv. **Effect on cell metabolism:** Interferential currents when applied alter the intra-cellular concentration of enzymes and other molecules that are important for many metabolic processes.

v. **Effects on autonomic nervous system:** The neurons that make the autonomic nervous system are small and poorly myelinated like the Aδ and C fibers of the peripheral nervous system. Evidence suggests that these small neurons of the peripheral nervous system fail to conduct at frequency exceeding 40 Hz and 15 Hz, respectively, suggesting that at lower frequencies interferential currents can stimulate the autonomic nervous system, which can be utilized for the increase of blood flow and control of incontinence.