

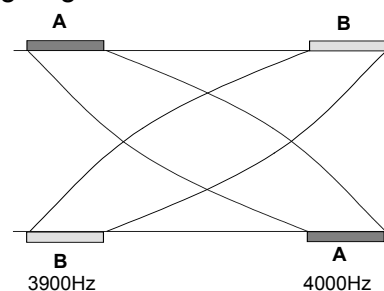
Interferential Therapy

The basic principle of Interferential Therapy (I/F) is to utilise the strong physiological effects of low frequency ($\cong < 250$ pps) electrical stimulation of muscle and nerve tissues without the associated painful and somewhat unpleasant side effects of such stimulation.

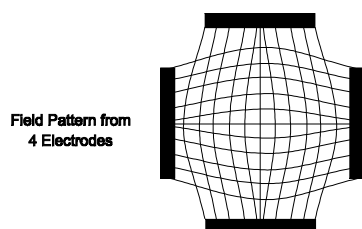
To produce low frequency effects at sufficient intensity at depth, most patients experience considerable discomfort in the superficial tissues (i.e. the skin). This is due to the resistance (impedance) of the skin being inversely proportional to the frequency of the stimulation. In other words, the lower the stimulation frequency, the greater the resistance to the passage of the current & so, more discomfort is experienced. The skin impedance at 50Hz is approximately 3200Ω whilst at 4000Hz it is reduced to approximately 40Ω . The result of applying this latter frequency 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 effects of tissue stimulation with these 'medium frequency' currents (Medium frequency in electromedical terms is usually considered to be 1KHz-100KHz) is unknown. It is unlikely to be innocuous, but in terms of current practice, little is known of its physiological effects. It is not capable of direct stimulation of nerve in the common context of such stimulation.

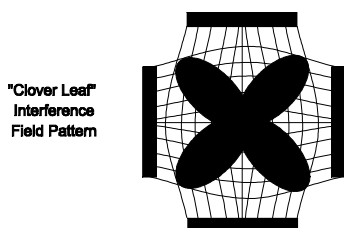
Interferential therapy utilises two of these medium frequency currents, passed through the tissues simultaneously, where they are set up so that their paths cross & in simple terms they interfere with each other. This interference gives rise to an interference or beat frequency which has the characteristics of a low frequency stimulation.



If current A - A is at 4000Hz
And current B - B is at 3900Hz
then the interference current will
have a 'beat frequency' of 100Hz



Field Pattern from
4 Electrodes



"Clover Leaf"
Interference
Field Pattern

The exact frequency of the resultant beat frequency can be controlled by the input frequencies. If for example, one current was at 4000Hz and its companion current at 3900Hz, the resultant beat frequency would be at 100Hz, carried on a medium frequency 3950Hz amplitude modulated current.

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 250Hz or more. To a greater extent, the therapist does not have to concern themselves with the input frequencies, but simply with the appropriate beat frequency which is selected directly from the machine.

The use of 2 pole I/F stimulation, where there is clearly no interference within the body, is made possible by electronic manipulation of the currents - the interference occurs within the machine.

The magnitude of the low frequency interference current is approximately equivalent to the sum of the input amplitudes. In other words, the result of the interaction between the two input currents is a low frequency current, which has an amplitude greater than either of the individual input currents.

Physiological Effects:

Excitable tissues can be stimulated by low frequency alternating currents. Although to some extent, all tissues in this category will be affected by a broad range of stimulations, it is thought (Savage 1984) that different tissues will have an optimal stimulation band, which can be estimated by the conduction velocity of the tissue, its latency and refractory period. These are detailed below:

Sympathetic Nerve	1-5Hz
Parasympathetic Nerve	10-150Hz
Motor Nerve	10-50Hz
Sensory Nerve	90-100Hz
Nociceptive fibres	90-150Hz (?130Hz specific)
Smooth Muscle	0-10Hz

The clinical application of I/F therapy can be based logically on this data together with a knowledge of physiological behaviour of stimulated tissue. Selection of a wide treatment band can be considered less efficient than a smaller selective band in that by treating with a frequency range of say 1-100Hz, the appropriate treatment frequencies can be covered, but only for a relatively small percentage of the total treatment time. Additionally, some parts of the range might be counterproductive for the primary aims of the treatment.

There are 4 main clinical applications for which I/F appears to be used:

- Pain relief
- Muscle stimulation
- Increased blood flow
- Reduction of oedema

In addition, claims are made for its role in stimulating healing and repair.

As I/F acts primarily on the excitable tissues, the strongest effects are likely to be those which are a direct result of such stimulation (i.e. pain relief and muscle stimulation). The other effects are more likely to be secondary consequences of these.

Pain Relief:

Electrical stimulation for pain relief has widespread clinical use, though the direct research evidence for the use of I/F in this role is limited. Logically one could use the higher frequencies (90-150Hz) to stimulate the pain gate mechanisms & thereby mask the pain symptoms. Alternatively, stimulation with lower frequencies (1-5Hz) can be used to activate the opioid mechanisms, again providing a degree of relief. These two different modes of action can be explained physiologically & will have different latent periods & varying duration of effect. It remains possible that relief of pain may be achieved by stimulation of the reticular formation at frequencies of 10-25Hz or by blocking C fibre transmission at >50Hz.

Muscle Stimulation:

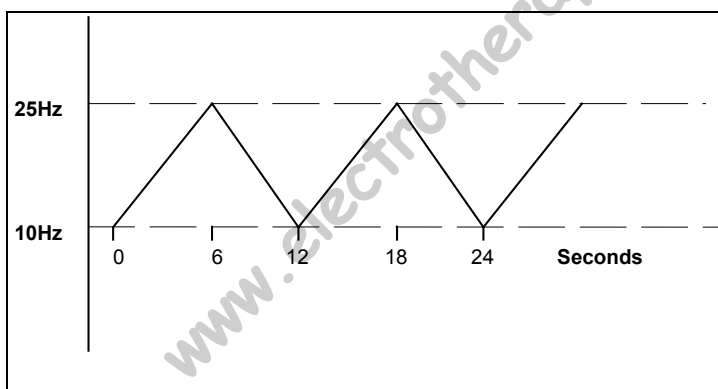
Stimulation of the motor nerves can be achieved with a wide range of frequencies. Clearly, stimulation at low frequency (e.g. 1Hz) will result in a series of twitches, whilst stimulation at 50Hz will result in a tetanic contraction. The choice of treatment parameters will depend on the desired effect, but to combine muscle stimulation with an increase in blood flow and a possible reduction in oedema, there is some logic in selecting a range which does not involve strong sustained tetanic contraction & a sweep of 10-25Hz is often used.

There is no primary nervous control of oedema reabsorption & the direct electrical stimulation of blood flow is limited in its effectiveness. It is suggested therefore that in order to achieve these effects, suitable combinations of muscle stimulation can be made.

Treatment Parameters:

Electrode positioning should ensure adequate coverage of the area for stimulation. In some circumstances, a bipolar method is preferable if a longitudinal zone requires stimulation rather than an isolated tissue area. Placement of the electrodes should be such that a crossover effect is achieved in the desired area. If the electrodes are not placed so that a crossover is achieved, the physiological effects of I/F can not be achieved.

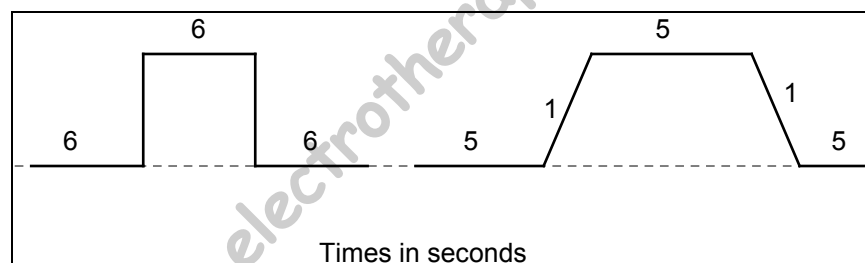
Nerves will accommodate to a constant signal & a sweep (or gradually changing frequency) is often used to overcome this problem (as well as generating a range of effects). The sweep (range) should be appropriate to the desired physiological effects, though again it is suggested that an excessive range may minimise the clinical effect.



The mode of delivery of the selected sweep varies with machines. The most common application is the 6 second rise and fall between the pre-set frequencies. For example, if a 10 - 25Hz range has been selected, the machine will deliver a changing frequency, starting at 10Hz, rising to 25Hz 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

Other patterns of sweep can be produced on many machines as illustrated:



Treatment times vary widely according to the usual clinical parameters of acute/chronic conditions & the type of physiological effect desired. In acute conditions, shorter treatment times of 5-10 minutes may be sufficient to achieve the effect. In other circumstances, it may be necessary to stimulate the tissues for 20-30 minutes. It is suggested that short treatment times are initially adopted especially with the acute case in case of symptom exacerbation. These can be progressed if the aim has not been achieved and no untoward side effects have been produced. There is no research evidence to support the continuous progression of a treatment dose in order to increase or maintain its effect.

References

- Adedoyin, R. A., et al. (2002). "Effect of interferential current stimulation in management of osteo-arthritic knee pain." Physiotherapy **88**(8): 493-9.
- Alves-Guerreiro, J., G. Noble, et al. (2001). "The effect of three electrotherapeutic modalities upon peripheral nerve conduction and mechanical pain threshold." Clinical Physiology **21**(6): 704-711.
- Bircan, C., O. Senocak, et al. (2002). "Efficacy of two forms of electrical stimulation in increasing quadriceps strength: a randomized controlled trial." Clin Rehabil **16**(2): 194-9.
- Hou, C. R., L. C. Tsai, et al. (2002). "Immediate effects of various physical therapeutic modalities on cervical myofascial pain and trigger-point sensitivity." Arch Phys Med Rehabil **83**(10): 1406-14.
- Hurley, D. A., P. M. Minder, et al. (2001). "Interferential therapy electrode placement technique in acute low back pain: a preliminary investigation." Arch Phys Med Rehabil **82**(4): 485-93.
- Johnson, M. I. and G. Tabasam (2003). "An investigation into the analgesic effects of different frequencies of the amplitude-modulated wave of interferential current therapy on cold-induced pain in normal subjects." Arch Phys Med Rehabil **84**(9): 1387-94.
- Johnson, M. I. and G. Tabasam (2003). "A single-blind investigation into the hypoalgesic effects of different swing patterns of interferential currents on cold-induced pain in healthy volunteers." Arch Phys Med Rehabil **84**(3): 350-7.
- Lambert, I., S. Tebbs, et al. (2000). "Interferential therapy machines as possible vehicles for cross infection." Journal of Hospital Infection **44**: 59-64.
- Noble, J. G., G. Henderson, et al. (2000). "The effect of interferential therapy upon cutaneous blood flow in humans." Clin Physiol **20**(1): 2-7.
- Palmer, S. T. et al. (2004). "Effects of electric stimulation on C and A delta fiber-mediated thermal perception thresholds." Arch Phys Med Rehabil **85**: 119-128.
- Philipp, A., et al. (2000). "Interferential current is effective in palmar psoriasis: an open prospective trial." Eur J Dermatol **10**(3): 195-8.
- Roche, P., H.-Y. Tan, et al. (2002). "Modification of induced ischaemic pain by placebo electrotherapy." Physiotherapy Theory and Practice **18**: 131-139.
- Sontag, W. (2000). "Modulation of cytokine production by interferential current in differentiated HL-60 cells." Bioelectromagnetics **21**(3): 238-44.
- Stephenson, R. and E. Walker (2003). "The analgesic effects of interferential (IF) current on cold-pressor pain in healthy subjects: a single blind trial of three IF currents against sham IF and control." Physiotherapy Theory and Practice **19**: 99-107.
- Ward, A. R., V. J. Robertson, et al. (2002). "Optimal frequencies for electric stimulation using medium-frequency alternating current." Arch Phys Med Rehabil **83**(7): 1024-7.
- Watson, T. (2000). "The role of electrotherapy in contemporary physiotherapy practice." Man Ther **5**(3): 132-41.

Interferential Contraindications

- Patients who do not comprehend the physiotherapist's instructions or are unable to co-operate should not be treated
- Patients who are taking anticoagulation therapy or have a history of pulmonary embolism or deep vein thrombosis should not be treated with the vacuum electrode applications
- Similarly, patients whose skin may be easily damaged or bruised
- Application over :
 - The trunk or pelvis during pregnancy
 - Active or suspected malignancy except in hospice care
 - The eyes
 - The anterior aspect of the neck
 - The carotid sinuses
- Patients with pacemakers
- Dermatological conditions e.g. dermatitis, broken skin
- Danger of haemorrhage or current tissue bleeding (e.g. recent soft tissue injury)
- Avoid active epiphyseal regions in children

Interferential Precautions

- Care should be taken to maintain the suction at a level below that which causes damage / discomfort to the patient
- If there is abnormal skin sensation, electrodes should be positioned in a site other than this area to ensure effective stimulation
- Patients who have (marked) abnormal circulation
- For patients who have febrile conditions, the outcome of the first treatment should be monitored
- Patients who have epilepsy, advanced cardiovascular conditions or cardiac arrhythmias should be treated at the discretion of the physiotherapist in consultation with the appropriate medical practitioner
- Treatment which involves placement of electrodes over the anterior chest wall