Intro NMS 460

a non-invasive pulsed radio frequency current
for pain relief and nerve regeneration

Pulsed RF
Neuromodulation
Device for
pain relief and
nerve regeneration

Phyllis Berger

Manufacturer

Xavant Technology PTY (LTD)
Unit 102, The Tannery Industrial Park
309 Derdepoort Rd, Silverton
Pretoria, South Africa, 0184
Tel: +27 (0) 12 743 5959
Fax: +27 (0) 86 547 0026
E-mail: support@xavant.com
Web: www.xavant.com

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INTRODUCTION

There are many different electrical currents that have been used over the years for pain relief. It started in the earliest times, in fact in the Fifth Dynasty, Egypt when individuals with pain and various ailments were placed in water with an electric eel or fish. The 'patient' then received an electric shock/s from the fish and 'healing' apparently occurred. It was also known that contact with a lodestone (magnetite) had healing qualities. These magnetic effects were discovered in Asia Minor from the period between 3000 – 2500 BC. Magnets have been found to increase circulation and produce endorphins and it is known that an electric current is also produced by a magnetic field[1].

Science has investigated galvanic and faradic currents since the late 1700s and in recent times it has been proven that galvanic/direct current and magnetic fields influences both wound and bone healing, faradic current eases spasticity and increases strength in muscles and alternating low frequency currents (transcutaneous electrical nerve stimulation) release endorphins and relieves pain.

Transcutaneous electrical nerve stimulation (TENS) was explored in the 1960s and Melzack and Wall published their "Gate Control Theory" which helped to provide the neurophysiological basis for the understanding of endogenous pain control via the release of endorphins by specific low frequency devices[2]. Research into acupuncture and TENS developed concurrently and assisted with understanding the neuro-pharmacological basis of pain modulation.

Acupuncture was re-discovered by the West in the 1970s after the visit of Nixon to China although the earliest bronze needles were used in China in 1600 BCE and the Yellow Emperor's Classic of Internal Medicine was written in 403 BCE. Acupuncture an ancient practice of medicine has as indicated above been practiced for thousands of years. Even if on the surface Western scientists distrusted Chinese research much of the work on acupuncture neuroscience flowed easily into the mainstream of TENS research[1]. Most of the research on acupuncture validates its use for pain control despite acupuncture being used for many other medical conditions.

Since the 1980s, many different types of electric current have been developed. It became apparent that using different types of current had different effects on various conditions and the patients themselves. Certain patients have a nervous system that has either a low or high pain threshold necessitating treatment that is compatible with the patient, not irritating the low pain threshold patient and yet being of sufficient effect to assist the patient with the high pain threshold.

In patients who have had chronic pain over a prolonged period or have experienced severe acute pain, the nervous system of these individuals may become sensitized due to spontaneous and continuous firing of neurons. This condition indicates that there may be a lack of inhibition from higher centres (brain and/or spinal cord) therefore increasing pain and or producing inflammatory and other substances that increases activation of firing of peripheral neurons. This may cause hypersensitivity or hyperactivity in the nerves either or both peripherally and centrally due to the condition known as neuropathic pain.

It has become evident that the type of pain must be identified to facilitate the correct treatment. This may be nociceptive, neuropathic, neurogenic pain or a combination of these that may evolve from either different conditions and or areas of the body. It is noteworthy that if the correct current choice is made for a particular condition, remarkably both a change in the condition and relief of many different types of pain may occur.

Pharmacologically there are different types of analgesics and non-steroidal anti-inflammatories that have been used to mediate the above conditions. When the condition does not alleviate secondary analgesics such as anti-epileptics, anti-depressants, opioids and even cortisone, among others are then administered. Each patient is different and a trial of treatment is embarked upon to find the correct medication for that particular patient.

Sometimes even all of the above medication does not improve the situation, possibly just maintaining a tolerable level of pain control and often with the development of side effects that in some cases may be severe.

It is therefore worthwhile to explore other - electrical/mechanical non-invasive methods that may help to break the pain cycle, improve function and quality of life for many patients.

Often a combination of both medication and physical methods of pain control may be a positive consideration in mediating pain.

This manual does not include the valuable psychological methods of relaxation, breathing exercises, self-hypnosis and skills of understanding and acceptance of pain.

This manual contains information that will assist with the use of a newly developed device for ameliorating pain. Although the device is new and all the results of using NMS 460 may be considered anecdotal, in this particular context consistently observing results that are maintained for months, years and in many cases completely resolved, it should therefore be acknowledged as a valuable tool in the armamentarium of the treatment of severe pain conditions.

Research and publication is presently occurring and will be inserted in this manual where appropriate.

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Chapter One

Introduction to the STIMPOD NMS460

The STIMPOD NMS460 is a pulsed radio frequency device that has recently been developed and it has been discovered that it appears to have profound effects in the treatment of neuropathic disorders that may arise from many different aetiologies.

This may include:
complex regional pain syndromes, neuropathic pain, neuropathies and post surgical pain, to name but a few.

These symptoms may manifest with:
pain of a sharp, shooting, twingeing, burning, electrical quality with or without paraesthesia and these may include pins and needles, numbness or hyper or hypo-aesthesia and other unpleasant sensations.

There may also be loss of function and reduced mobility occurring with all or some of the above symptoms.

The treatment is an externally applied, non-interventional, pulsed radio frequency (PRF) device that delivers 133 kHz of power via a small probe to a nerve or region such as a joint or muscle that may be involved in either a neuropathic, neurogenic or nociceptive condition. The most commonly treated area is the peripheral nerve or even central nerve root that supplies the painful region.

The device is applied:
- for 5 mins to a nerve region
- often requires only 3 treatments (even once weekly) to dispel the above symptoms on a permanent basis

The probe that delivers the current easily identifies the nerve involved and may produce fasciculations along this nerve pathway.
- In fact this may be a method of identifying the nerve supply to the affected area.
- A patient may even report that stimulation of a nerve with NMS reproduces the painful sensation!
- Fasciculation may increase nerve and therefore muscle activity and if strength increases in the muscular support system this may improve pain relief.

By activating specific motor pathways (in a certain condition) to the brain that may have been dormant, reconnection to the injured area is established centrally. This may improve both proprioception and strength to the painful region.

In addition to pain relief, improvement in mobility and strength also occurs post treatment and this has encouraging effects for continuance of other/normal treatment modalities for nociceptive or other pain and also in the rehabilitation phase of a condition.

These effects have been remarkably visible in patients' who have had Bell's palsy and that have evidenced improvement in measurement scores with this treatment even after 6 months of poor to nil response with regular physical modalities.

In acute Bell's palsy there have been rapid improvements that suggest that this treatment may expedite the normal recuperative period (two weeks) in those patients that would achieve recovery spontaneously or even in those that may have had a slower recovery period.

Bell's palsy has devastating effects on the psyche of an individual due to discomfort, specifically to the eye and mouth and embarrassment to the individual to be in be seen in public with this affliction due to the alteration in facial expression and the inability to close the eye, eat without drooling and to be understood while speaking.

The STIMPOD treatment has also been applied to spinal regions that have developed neurogenic and neuropathic pain syndromes, with good effects.

It is believed that the current applied either to peripheral nerves or central nerve roots activates pain-blocking mechanisms at the **dorsal root ganglion** mimicking the effects of a DREZ (dorsal root entry zone) lesion yet without causing any injury or damage to the nerve.

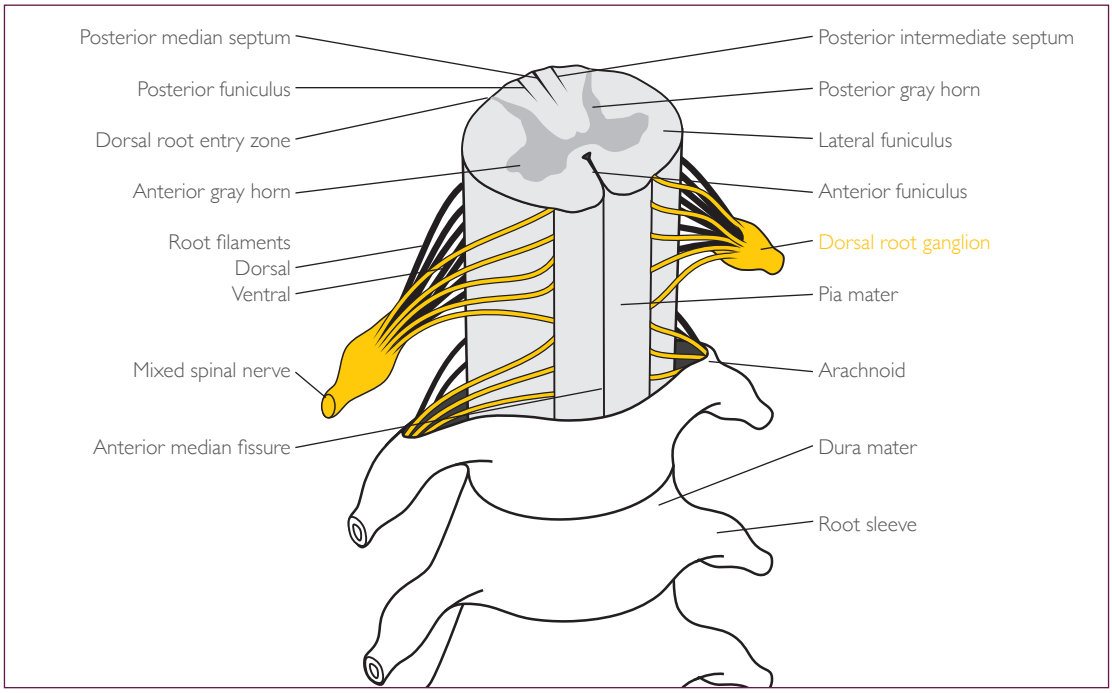


Figure 1: Dorsal root ganglion

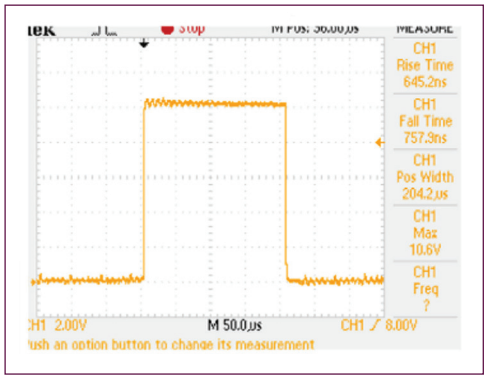
The **bioelectronic** effects occurring from the pulsed radio frequency aspect of the current is too fast for ionic flow effects and rather capitalizes on the semiconducting properties of soft tissue structures and magnetic effects similar to many other pulsed radio frequency devices.

There is also a bioelectric effect when applying this current. The current delivers a low frequency current between 1 – 10 Hz and has a square pulse wave with the PRF portion superimposed upon the direct current low frequency aspect of the wave. It is possible that the direct current square wave portion of the current may even be seen as a red flare that appears on the skin after the treatment has been delivered. This may affect the polarity of the tissues below the probe, influencing circulation and changes in action potentials.

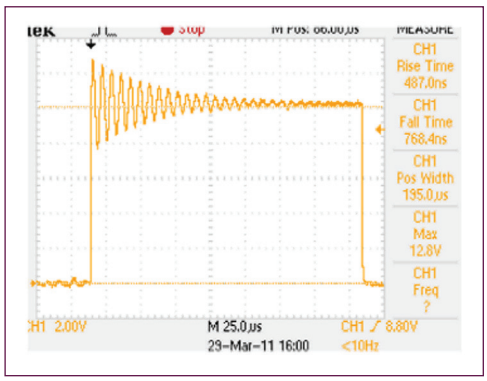
The effects of the low frequency component (1-10 Hz) are that the probe may be applied to the meridians or acupuncture points on the patient at higher intensities (above 4 Hz) than is normally delivered by electro-acupuncture devices. The effect of this increased intensity is that more neuronal fibres will be recruited and activated.

The current has a strong sensation that can be modified by reducing intensity, frequency or pulse width and even if low intensities are given, results are often still evidenced immediately post treatment. Some patients, depending on their condition may have increased pain post treatment and then complete resolution of pain and improved mobility may often occur even three weeks after treatment has ceased. No damage or localized injury occurs to any tissue.

The waveform before super-imposition of the PRF current.



The waveform with incorporation of PRF component



Chapter Two

The differences between STIMPOD NMS 460 and other pain modulating electrical currents

It has become apparent that using different current waveforms and procedures that produce electrical stimulation on the body have beneficial and different effects on various conditions and symptoms.

Various currents waveforms will now be described with both their **efficacy and their LIMITATIONS** that may affect both pain or function.

It is important to understand different current waveforms and frequencies as each has differing effects on the human body and it becomes a constant challenge to use the correct current for a specific condition. Not all devices available are hereby described however the principal of these devices is apparent in many of those used for similar purposes.

The main differences between most transcutaneous electrical currents depends on the frequency, waveform, pulse width and the intensity. These factors influence pain, inflammation, circulation and nerve conduction.

In the diagram below STIMPOD NMS460 treatment has been included. The device that was used was the NMS300 which is the prototype of the model used presently, the NMS460.

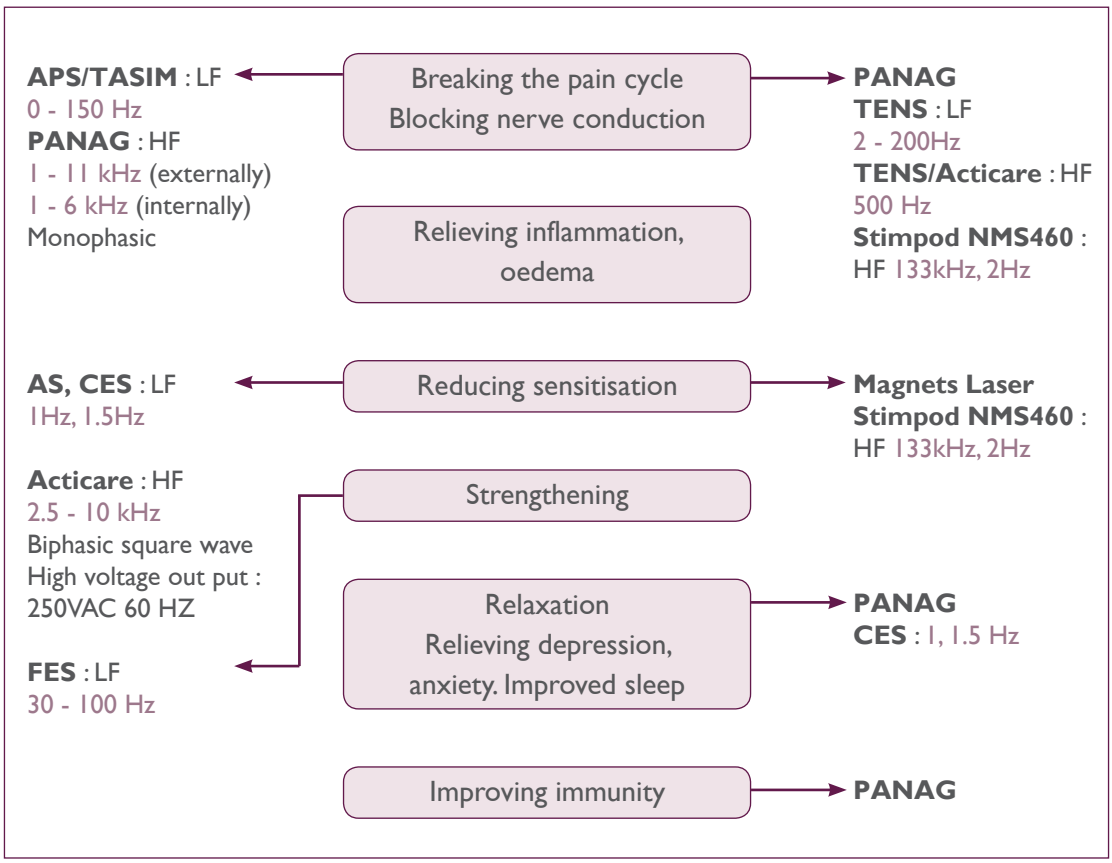


Figure 2: Diagram to illustrate uses and types of different currents

1. The most commonly known device that has been used since the 1960's for pain management is transcutaneous electrical nerve stimulation (TENS). This current waveform is a low frequency device (0 – 200 Hz) that may be used with different modes such as continuous, modulated or burst. It has an intensity that ranges from 1 – 10 mA, can be applied via electrodes to the body for many diverse pain states and can be worn by the patient as they perform their daily activities. It was found that stimulation of large diameter neuronal fibres reduces the pain perception transmitted through the small fibres via the 'gating mechanism' proposed by Melzack and Wall (1965) – this stimulation modulates the intensity of ascending transmission (*bottom up* in the neural system) and also influences the descending mechanisms (*top down* in the neural mechanisms) thus this type of electrical pain modulation occurs through sensory modulation (through the skin) of both peripheral and central nerve impulses.

The rationale is based on the concept of a 'gating mechanism' in the dorsal horn of the spinal cord where small diameter, unmyelinated C and thinly myelinated A delta fibre activity can be modulated (suppressed) by the larger diameter myelinated A beta fibre activity, thus reducing pain. Studies have identified endogenously produced opioid substances that are activated by different frequencies of TENS such as enkephalin and endorphin that have potent opioid agonist activity. High frequency (75 – 200 Hz), low intensity TENS stimulation involves the spinal segmental inhibitory GABAergic (GABA an acronym meaning gamma aminobutyric acid that is an amino acid found in the CNS and acts as an inhibitory neurotransmitter) interneuron in the spinal cord and activates delta opioid receptors in both the spinal cord and rostroventral medulla. Low frequency (1-4 Hz), high intensity TENS affects the opioid pathways through the mu opioid receptors and these affect central mechanisms at both spinal cord and brainstem sites that exert inhibitory effects through descending mechanisms[1]. Other studies have demonstrated that low frequency also activates peripherally located alpha 2A adrenergic receptors that may impact on sympathetically mediated pain[2,3].

Most of the present devices used for pain modulation are based on the above mechanisms as most currents are delivered transcutaneouly and therefore it is important to understand what has recently been available for treatment.

In fact one component of the STIMPOD NMS 460 involves a low frequency as previously described in chapter ONE.

Limitations:

The negative aspect of TENS that may arise for some types of patients with neuropathic pain is that it may irritate nerve endings and increase pain (Latrimoliere, Woolf 2009)[4]. If pain is increased specifically in complex regional pain or in neuropathic pain conditions (specifically if in a sympathetically maintained pain) then pain remains and or worsens. This is due to

the fact that the large diameter A beta fibres have become sensitized due to persistent pain and activation of these fibres by stroking, touching or massage which then up-regulates pain reactions.

- Therefore TENS cannot be relied upon to assist with severe neuropathic pain
- Tens does not activate regenerative nerve processes

2. Another type of device is one that delivers a sub-liminal current that is usually imperceptible to normal sensory fibres unless the nerve fibres[5] are severely sensitized then even this type of current may be detected by the patient or even irritate the condition.

These devices are:
Alpha-stim (1 – 1.5 Hz) a low frequency, device (with bipolar asymmetric rectangular waves with net current) applied in a cross fire technique surrounding the local painful peripheral region but not on the painful site, or spinally used in the same manner or a similar device with this same low frequency that delivers current cranially[6,7] via clips on the ears. The effects of this treatment when used transcutaneously are found to reduce local hypersensitivity and increase central endorphins, and when used trans-cranially, induces relaxation, improves insomnia and reduces anxiety.

Acticare (2.5 – 10 kHz) is a high frequency biphasic square wave high voltage alternating current delivered at a rate of 60 Hz and may produce warmth but very minimal sensation[8]. This treatment is usually applied trans-spinally for pain anywhere in the body and in some patients it may produce pain relief, although not consistently in all patients.

Limitations:

- The alpha-stim only relieves hypersensitivity in some patients, it may also increase pain in others
- There are no further effects from this treatment
- All of the above treatment is sub-liminal and usually has no sensation

3. A high frequency device that has been known to improve the anti-inflammatory response by influencing the immune system is Panag.

Panag (6 – 11 kHz, monophasic, high frequency) – this device is also delivered transcutaneously with local electrodes or viscerally via a probe into internal orifaces (vagina, anus, mouth). The visceral current has nil sensation but the transcutaneous current has a tingling sensation that may cause fasciculation depending on the area – e.g. nerve site. Usually the tingling sensation disappears after at least 15 mins with nerve accommodation and higher intensities may then be delivered. Changes have now been made to this device to reduce the sensation from the external electrodes to enable a higher current to be administered but with nil sensation. This may increase the effects of the

current without increasing discomfort. This current has been found to improve nerve root pain due to its anti-inflammatory effects. The results are often not observed immediately. Prolonged use often has positive results, documented with improved CD 4 and 8 factors and reduced viral loads in AIDs patients according to a pilot study (unpublished) and reduces endometriosis according to a large randomized and controlled trial[9] (unpublished presently).

Limitations:

- There are no evident effects on neuropathic pain except for pain relief in the inflamed region either locally or centrally or both depending where the electrodes are placed
- Results are not immediate
- There may be improvement in strength but only over considerable time with the use of the device

4. Direct currents are another type of electrical current that has been used for many years with profound effects on inflammation, bruising, wound healing[10], fractures, muscle strengthening, neurogenic pain from compressed nerves and nociceptive pain in joint inflammation[10], (OA, RA) and even in complex regional pain conditions. Modified direct current is one of the most restorative electrical currents that have been used to date. All electrical interactions in our bodies that drive physiological processes are direct current, and the human body is highly responsive to weak electrical and magnetic signals. Application of modified direct current can reduce inflammation and improve circulation thereby relieving pain. Trans-cranial direct current stimulation (a non-invasive procedure) is demonstrating considerable efficacy in Parkinson's and psychological disorders to name a few[11].

Not all neuropathic or neurogenic conditions are responsive to this treatment. Perhaps the reason for this is due to the current being mainly tolerated with a low intensity (maximum 4 mA) and therefore this may not be strong enough to reach or activate deeper nerve tissue.

STIMPOD NMS 460 has a direct current component (square wave) that also may improve local tissue changes.

Limitations:

- Neuropathic pain conditions may be irritated by direct current, specifically if the skin is sensitive
- There are no immediate regenerative effects on nerve conduction

5. Western medical acupuncture is a treatment used for pain relief in all pain conditions[1]. It also has effects on mobility – increasing range of movement. It is however not in the ambit of this manual to discuss this vast subject.

Limitations:

- Acupuncture cannot be relied upon to change neuropathic pain immediately
- Many patients do not respond to acupuncture
- Many patients are afraid of needle treatments
- Many patients do not respond to acupuncture specifically those with high anxiety

An algorithm has been devised and used to relieve chronic pain. P Berger (1999)[12].

The diagram below demonstrates the process of using the abovementioned types of current and acupuncture to break the pain cycle. It is possible that 10% of patients respond with complete pain relief only to TENS or a series of treatments of electro-acupuncture (complete responders) or a combination thereof. This may occur after 3 treatments with only TENS and is most often demonstrated when the patient is able to use the TENS at home for work and recreational activities for at least 8 hours per day (pilot study, 1999). Responders may require 6 treatments of a combination of TENS and or electro-acupuncture treatment to alleviate the condition.

If there is an incomplete response (incomplete responders) with some pain relief (above 30% and possibly reaching 60-80%), then more treatment will be required. Some of the other modalities as described previously and annotated below may be used to break the pain cycle and/or improve circulation and improve mobility. These patients may revert to less than 30% response or remain at 60-80% relief or even reach 100% resolution however this may then take 12 or more treatments and treatment may need to persist for many months or even years with some recalcitrant patient conditions.

If the patient has had less than 30% response (non-responders), then usually non-physiotherapeutic treatment is applied such as pharmacology, psychotherapy and interventional medicine. If the patient stabilizes they may be able to return for continuing treatment then becoming partial responders.

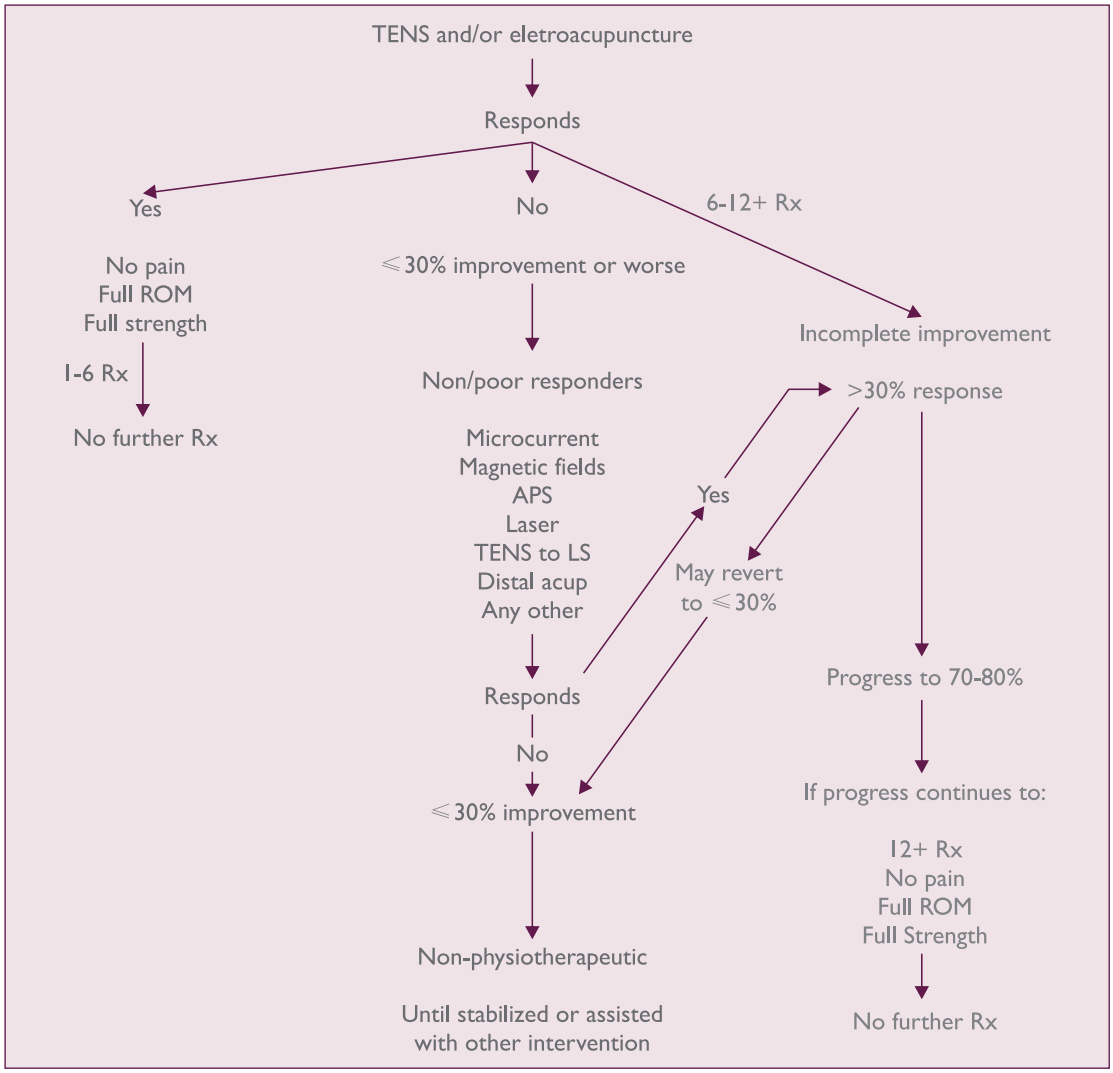


Figure 3: Physiotherapy algorithm for CRPS in an extremity. TENS: transcutaneous electrical nerve stimulation; ROM: range of movement; Rx: treatment(s); APS: action potential simulation; LS: lumbar spine
Pain Reviews 1999; 6: 211-232

Possibility: STIMPOD NMS460
It is possible that the NMS therapy can/should be used at the inception of any pain treatment to expedite responses?

6. Radiofrequency devices

Pulsed radiofrequency fields are an emerging technology used in the medical field for the treatment of tumors, cardiac arrhythmias, chronic and post-operative pain, bone fracture, and soft tissue wounds. There are two general categories of pulsed radiofrequency field therapies based on their mechanism of action: thermal and non-thermal (athermal).

While thermal radiofrequency ablation for tumors and cardiac arrhythmia has been used for over 25 years, non-thermal pulsed radio frequency is currently being developed for the ablation of cardiac arrhythmias and tumors. The technique uses **pulsed radio frequency** energy delivered via catheter at **frequencies of 300–750 kHz for 30 to 60 seconds.**

Thermal pulsed radio frequency takes advantage of high current delivered focally by an electrode to ablate the tissue of interest. Generally the tissue/electrode temperature reached is 60 to 75 °C **resulting in focal tissue destruction**.

Thermal pulsed radio frequency ablation has also been used for lesioning of peripheral nerves to reduce chronic pain.

Non-thermal therapeutic uses of pulsed radio frequency are also currently being used to treat pain and oedema, chronic wounds, and bone repair. Pulsed radiofrequency therapy technologies are described by the acronyms EMF (electromagnetic field), PEM (pulsed electromagnetic fields), PRF (pulsed radiofrequency fields), and PRE (pulsed radiofrequency energy). These technologies have been varied in terms of their electric and magnetic field energies as well as in the pulse length, duty cycle, treatment time and mode of delivery. Although pulsed radiofrequency has been used for medical treatment purposes for decades, peer reviewed publications accessing the efficacy and physiological mechanism(s) are now starting to appear addressing this technology[13].

Limitations of invasive PRF:

- There may not be immediate effects on neuropathic pain, this may be evidenced only after a few weeks post procedure
- There are no immediate specific effects on neuropathic symptoms
- There may initially be local oedema and scarring at the site of the above treatment whether peripheral or central
- The condition may require ongoing radio frequency treatment to control but often not completely alleviate the pain

7. The STIMPOD NMS460 delivers a pulsed radio frequency current waveform that is superimposed upon the direct and low frequency components of the current.

- This current is non-invasive and non-injurious
- Complete resolution of pain conditions specifically neuropathic pain may occur after 3 or less treatments
- Treatment time is short – 5 mins
- Treatment may be given at a distance from the offending region – nerve root instead of nerve branch
- This treatment improves nerve conduction and relieves neuropraxia e.g. Bell's palsy
- The current may have restorative effects on other nerve conditions

Limitations:

- At this point in the use of STIMPOD NMS460 therapy there appears to be more possibilities than limits!

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Chapter Three

Principles of treatment with the STIMPOD NMS460

Neurogenic or neuropathic pain

The NMS 460 targets the nerve responsible for the pain and it is specifically the neuropathic component of pain where the most demonstrable and profound effects occur.

Initially a diagnosis must be made establishing the nerve responsible for supplying the affected area – there may be one nerve or several nerves that could be treated to curtail the symptoms. (See chapter FOUR on diagnosing neuropathic symptoms).

If the condition is highly sensitive and local treatment may cause aggravation of pain then it may be necessary to target the nerve root or the main nerve supply e.g. femoral nerve at the groin/inguinal region (proximal treatment) or even centrally at L3/4 facet joint region, to block the pain in the foot if the problem emanates from the L3/4 region or the hip joint.

Local stimulation of the affected nerve should be avoided in many conditions until resolution starts to occur to prevent irritation of the nerve fibres.

As improvement occurs - then treatment of the smaller branches supplying the region e.g. upper, mid or lower saphenous nerves for pain in the medial region of the foot, ankle, leg, knee or thigh. If the pain is in the lateral aspect of the leg then the sciatic nerve and its lateral branches in the thigh, lateral cutaneous nerve of the thigh, common, deeper and or superficial peroneal nerve/s may be treated depending on the condition and the area being treated.

Local regions of a scar may also be treated both immediately and at any stage post-operatively if a persistent post-operative pain syndrome occurs. It is thought that preventative measures may be helpful in preempting chronic pain conditions in post operative or any pain condition.

Case histories have demonstrated that even central regions such as spinal or facial pain may respond to NMS 460 treatment.

Treating the spine may include:

- the cervical, thoracic and lumbar-sacral regions

Treatment of the cervical spine areas may target:

- both local and referred pains
- neurogenic pain from headaches
- trigeminal neuralgia (TN)
- temporomandibular joint
- facial pain
- vestibulitis causing dizziness and nausea

Treating vestibulitis:

The vestibular system, which contributes to balance in most mammals and to the sense of spatial orientation, is the sensory system that provides the leading contribution to movement and sense of balance. Together with the cochlea, a part of the auditory system, it constitutes the labyrinth of the inner ear in most mammals, situated in the vestibulum in the inner ear[1].

The region that may be accessed therefore by the Stimpod NMS 460 for the areas mentioned above are occipital nerve, inferior to both the mastoid process and to the outer ear behind the pinna. it is known that among the various projection pathways from the vestibular system, conduction also occurs to the spinal cord allowing for quick reflex reactions to both limbs and trunk to regain balance. Targeting the neural system (spinal cord and brain) nearest will elicit effects in reducing dizziness and nausea resulting from this condition as noted in treating many patients with this condition using the Stimpod NMS 460.

The nerve supply of the previously mentioned areas can then be treated:

- occipital branches for C2 and temporal regions
- TN – posterior, superior and even inferior to the temporomandibular joint
- Bell's palsy - facial nerve at the external auditory meatus, the facial nerve as it exits the parotid gland on the face and along its branches on the face – temporal, zygomatic, mandibular and buccal nerve branches.

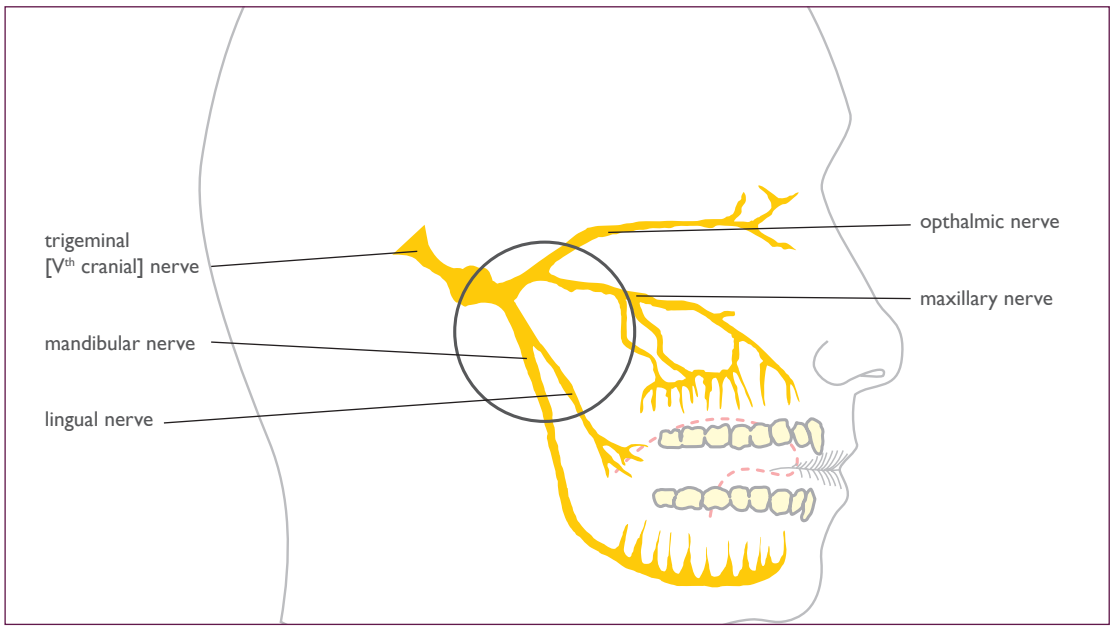


Figure 4: Example of position of trigeminal nerve

Figure 5: Example of bony landmarks for the accessing the trigeminal nerve, above the zygomatic bone

When treating the spinal region in any area – treatment could target the nerve nearest the facet joint – this may relieve referred nerve root pain.

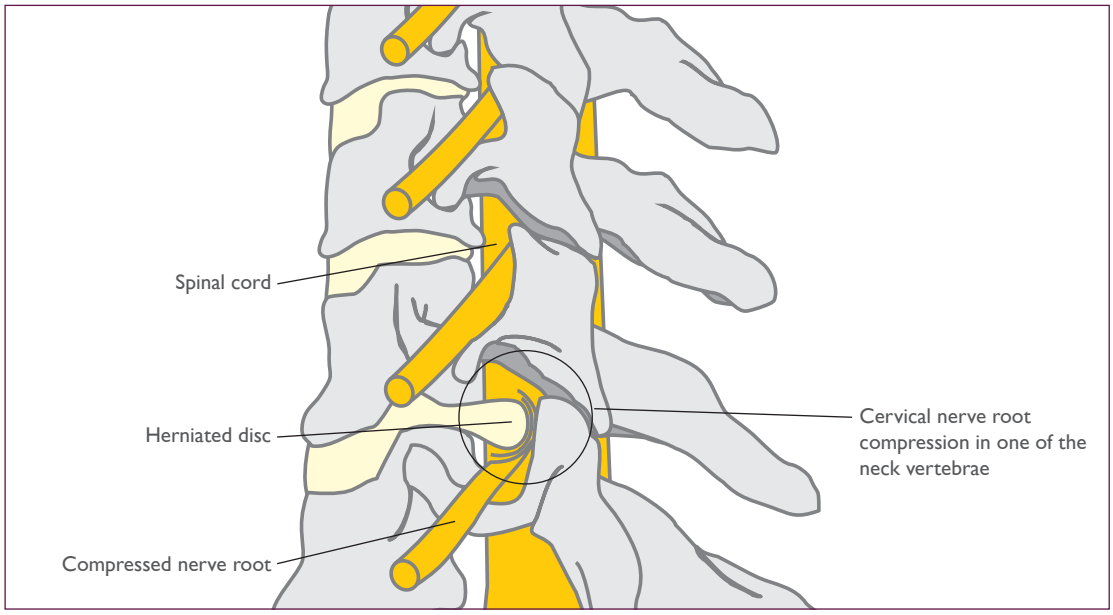


Figure 6: Herniated cervical disc pressing on nerve root and spinal cord

Treatment to the brachial plexus above or below the clavicle will relieve:

- neck pain

- nerve root compression referring into the arm and hand
- neuropathic pain in any region in the arm and hand

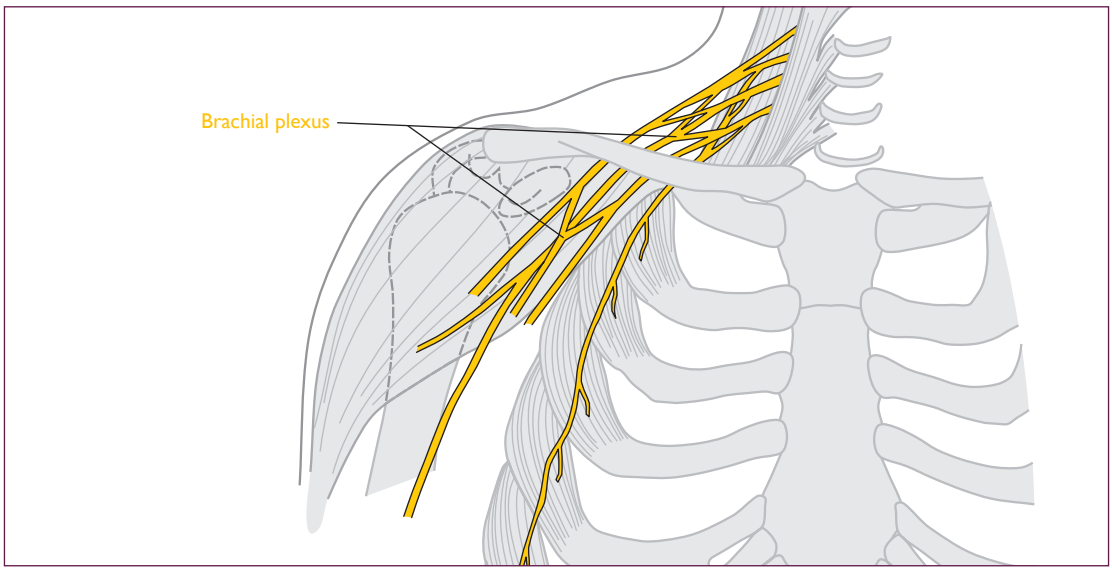


Figure 7: Brachial plexus

Treating sciatica

Sciatica (**sciatic neuritis**) is a set of symptoms including pain that may be caused by general compression or irritation of one of five spinal nerve roots that give rise to each sciatic nerve, or by compression or irritation of the left or right or both sciatic nerves. The pain is felt in either the lower back or buttock, or various parts of the leg and foot. In addition to pain, which is sometimes severe, there may be numbness, muscular weakness, pins and needles or tingling and difficulty in moving or controlling the leg. Typically, the symptoms are only felt on one side of the body. Pain can be severe in prolonged exposure to cold weather.

Treating the sciatic nerve situated beneath the gluteus muscles will relieve back pain, gluteal, thigh and leg pain either from a neurogenic source or well defined neuropathic symptoms/ syndromes e.g. meralgia paraesthetica or complex regional pain syndromes, among others.

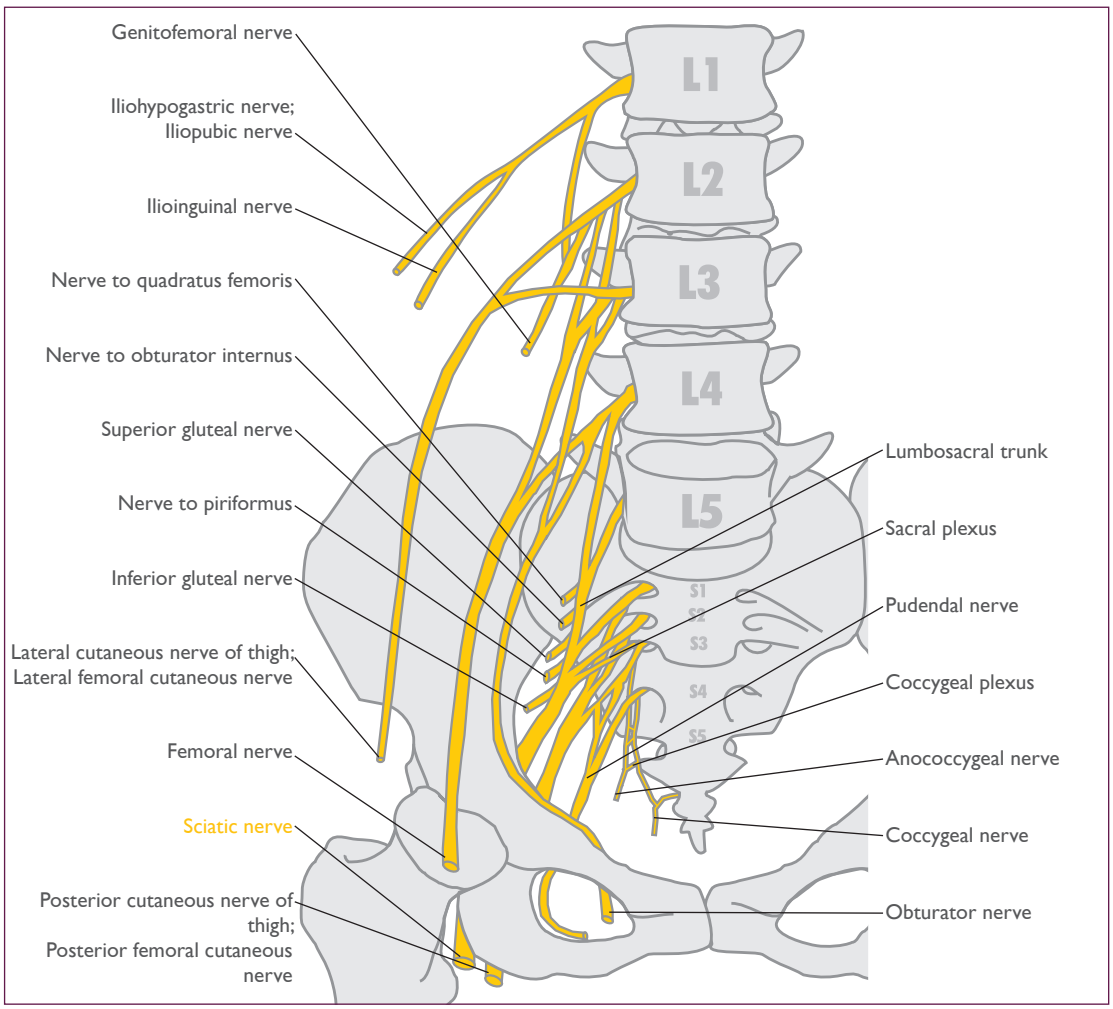


Figure 8: Treatment may be given on a tender area in the vicinity of the sciatic nerve.

Many painful conditions are sourced from either a neuropathic or nociceptive pain or both. It has been noted that when the neuropathic symptoms recede – even in the low back area – muscle spasm eases/ceases and this then enables the nociceptive pain that may be limited by spasm, joint stiffness and muscle weakness to be treated with conventional physiotherapy or other medical treatment approaches, more easily and successfully. It may not require further treatment as often all symptoms such as muscle spasm and joint stiffness recede.

Muscle spasm may limit muscle power at the site of the injury or degenerative region. It is often found that movement improves after this treatment. Movement may improve due to disinhibition at the nerve site or possible nerve regeneration/stimulation.

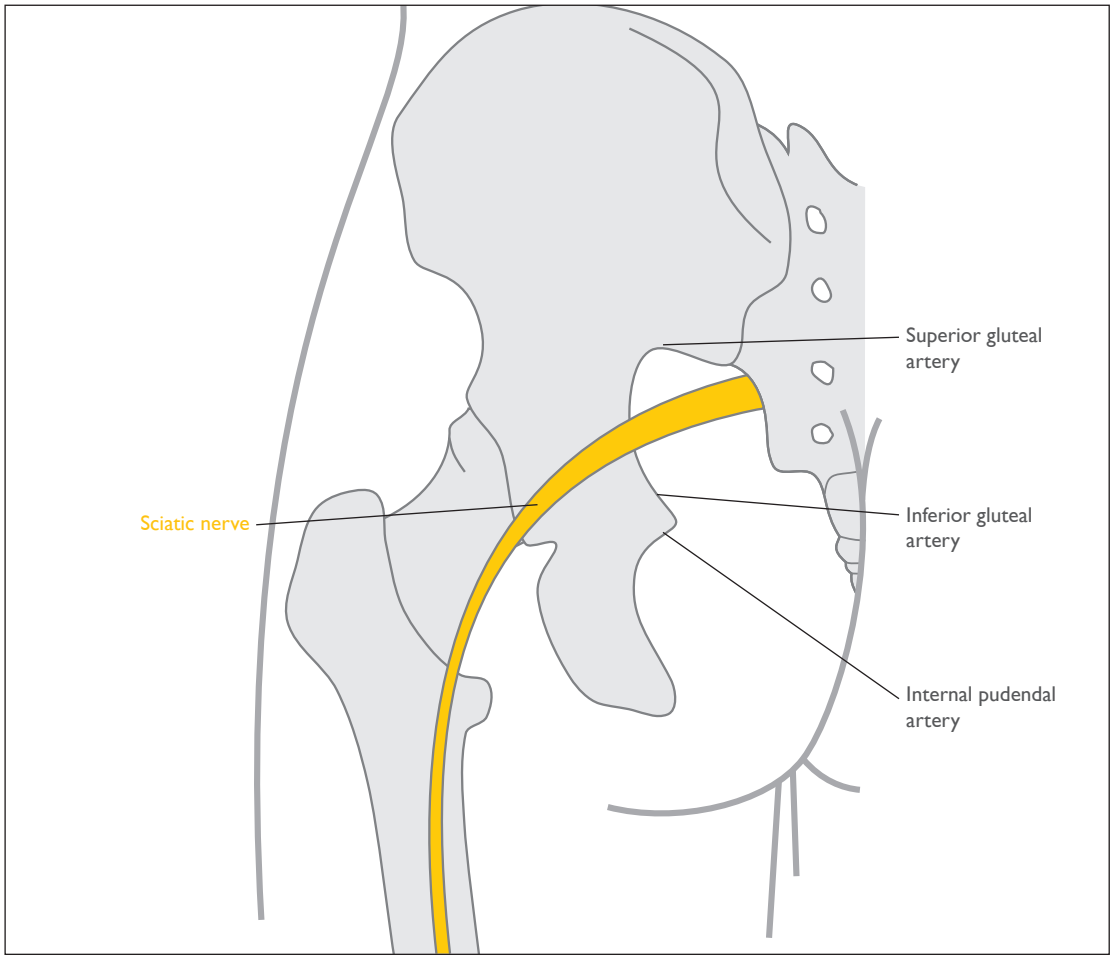


Figure 9

Sciatic nerve and its anatomical relationships[2]

A remarkable example of improvement in strength is demonstrated in a Bell's palsy patient with nil response to a muscle strength evaluation scale after six months after having had the conventional medication and physiotherapy (exercises, ultrasound, TENS and electrical muscle stimulation). The muscle strength was restored from 0 to 3 – 5/5 with STIMPOD NMS 460 treatment applied daily to the facial nerve branches for 5 mins on each branch for one month (case history, D A Muller, 2010).

In complex regional pain patients that are unable to mobilize their joints e.g. foot, changes occur post NMS 460 treatment that often enables foot movements to be restored in many patients even if the condition has been chronic.

Movement and strength have improved in the limbs and spine post STIMPOD NMS 460 treatment – possibly due to a pain blocking mechanism and nerve regeneration or stimulation.

Pain relief without restoring function is useless and it appears that this device is capable of achieving both pain relief in certain conditions and improved mobility.

The principal of the pain blocking mechanism is that the pulsed radio frequency at 133 kHz power is capable of travelling along the deeper nerves and may reach the **dorsal root ganglion (DRG) or nerve root.** This then appears to produce a comparable effect to the interventional PRF without any injury or trauma to the tissues and possibly even a greater improvement in nerve conduction.

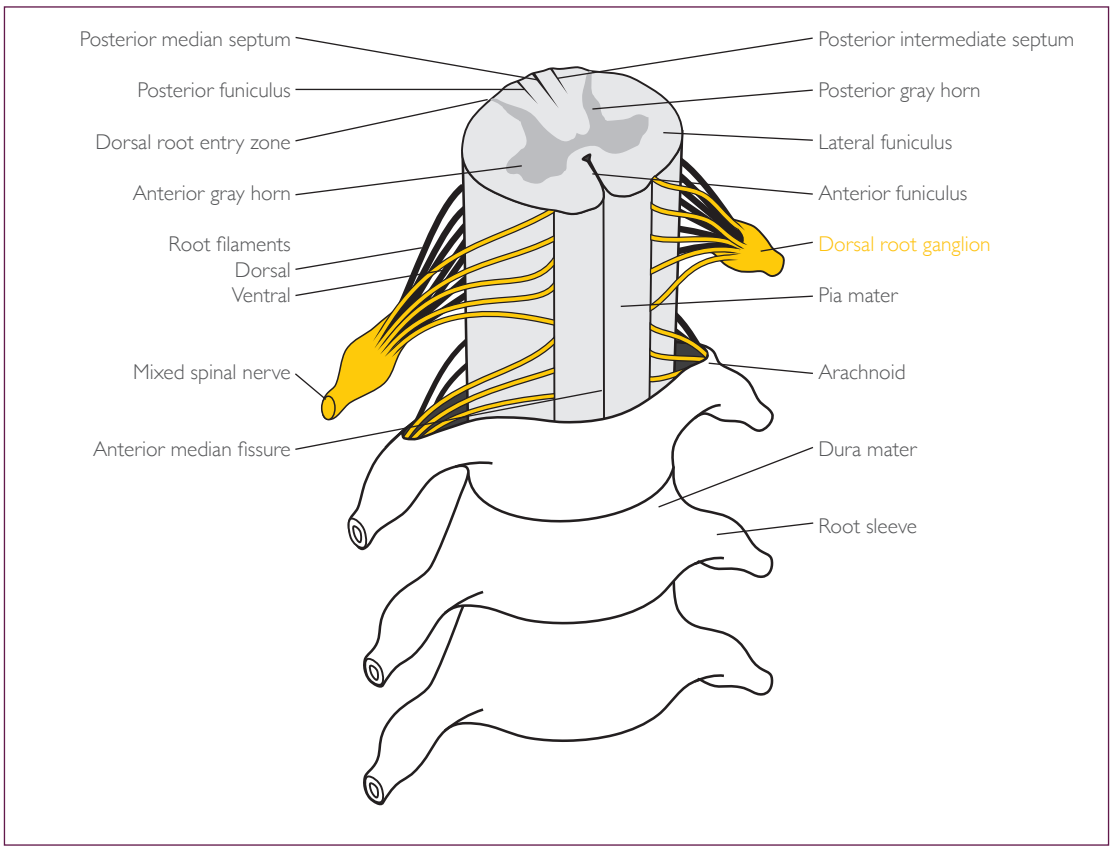


Figure 10

Normal invasive procedures in the above-mentioned area/s may cause local injury to the surrounding nerve area (root) whereas non-invasive current applied as close to these underlying regions demonstrates significant changes in pain *without injury*. If regeneration does occur within the nerve it may affect gene expression and normal conduction and strength may then return.

References

1. *http://en.wikipedia.org/wiki/Vestibular_system*
2. *Sciatic nerve and its anatomical relationships*
   http://upload.wikimedia.org/wikipedia/commons/3/3a/Gray1244.png

Chapter Four

How to recognise neuropathic pain or conditions

When a patient complains of a nociceptive type of pain the pain usually emanates from a specific known cause e.g. osteoarthritis of the knee or trauma as in a sprained ankle. The patient is usually able to define the area and understand the cause.

Nociception is defined as the neural processes of encoding and processing noxious stimuli. It is the afferent activity produced in the peripheral and central nervous system by stimuli that have the potential to damage tissue. This activity is initiated by nociceptors, (also called pain receptors), that can detect mechanical, thermal or chemical changes above a set threshold. Once stimulated, a nociceptor transmits a signal along the spinal cord, to the brain[1].

However with neuropathic pain – a nerve is activated and often the patient is unable to accurately detect the actual source of the pain. The nerve may be oedematous/swollen or compressed and bruised/damaged (as in a neuropraxia that may emanate from a viral/bacterial source) or even have recovered from these disturbances and yet may continue to produce signals that activate receptor sites in many areas of the nervous system.

The pain may occur spontaneously with nil appearing to stimulate the nerve or be irritated/provoked by even the lightest touch, such as pressure of the bedclothes, cold air, water, vibration or any other. The type of pain may be continuous, or intermittent/come and go of its own volition (patients often comment: "it has a life of its own"). Pain may be elicited by a stimulus that does not normally produce pain, either by mechanical, thermal or even cold and there may be increased responsiveness to pain – the patient feels more pain than is seemingly normal for a particular injury.

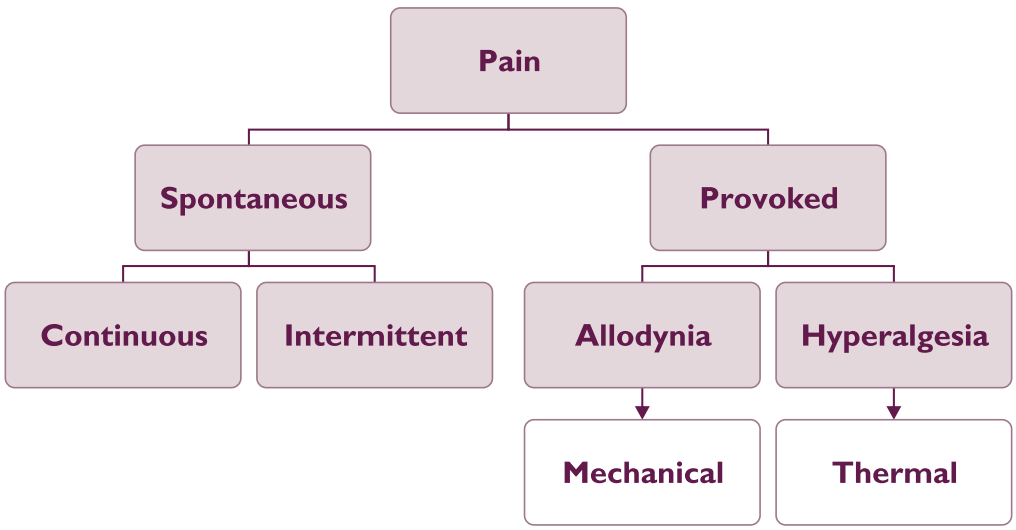


Figure 11: Components of neuropathic pain

Allodynia – pain due to a stimulus that does not normally provoke pain

Bennett MI, Attal N, Backonja MM, Baron R, Bouhassira D, et al. (2007) Using screening tools to identify neuropathic pain. Pain 127: 199–203. A review that brings together the main authors of all the modern screening tools for neuropathic pain and provides a pros-and-cons analysis[2].

The patient may also complain of a numb pain – the area feels numb yet is very painful (e.g. meralgia paraesthetica). There may also be very unpleasant sensations (dysaesthesia) such as electric shocks, shooting and burning types of pain, to name a few. *Burning pain is a common signal that the nerve is disturbed by neuropathic pain.*

Neuropathic pain results from lesions or diseases affecting the somatosensory system. It may be associated with abnormal sensations called dysaesthesia, that occur spontaneously and allodynia that occurs in response to external stimuli. Neuropathic pain may have continuous and/or episodic (paroxysmal) components. The latter are likened to electric shocks. Common qualities include burning or coldness, "pins and needles" sensations, numbness and itching. Nociceptive pain, by contrast, is more commonly described as aching[3].

Up to 7% to 8% of the European population is affected and in 5% of persons it may be severe. Neuropathic pain may result from disorders of the peripheral nervous system or the central nervous system (brain and spinal cord). Thus, neuropathic pain may be divided into peripheral neuropathic pain, central neuropathic pain, or mixed (peripheral and central) neuropathic pain[3].

Patients are often not able to clearly localize the pain and the pain may spread to other regions of the limb or body that are not involved in the painful region (e.g. opposite leg) or further up the limb into areas that have not had an injury.

Sometimes stimulation of a painful neuropathic region may produce severe pain that comes on much later, producing after-sensations and shocks as if the nervous system has summated the impulses and "has a life of its own."

Sensory abnormalities found in patients with neuropathic pain			
Quantitative	Qualitative	Spatial	Temporal
Hypoaesthesia	Allodynia	Poor localization	Abnormal latency
Hyperaesthesia	Paraesthesia	Abnormal radiation	After sensation
Hypoalgesia	Dysaesthesia		Summation
Hyperalgesia			
Source: Modified from Hansson et al.			

Hansson P. **Neuropathic pain: clinical characteristics and diagnostic workup[4].**

A questionnaire has been developed that enables the researcher or therapist to analyse the condition in relation to neuropathic pain.

Over recent years, several screening tools for distinguishing neuropathic from nociceptive pain have been validated. Some of them, i.e., the Neuropathic Pain Questionnaire (NPQ), ID Pain, and PainDETECT, rely only on interview questions. PainDETECT was designed to detect neuropathic pain components in patients with low back pain; it has been validated in about 8,000 patients with low back pain, and reaches about 80% sensitivity and specificity.

The Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) scale and *Douleur Neuropathique en 4 Questions* (DN4) questionnaire use both interview questions and physical tests (pinprick and tactile hypoesthesia, pain to light touch), and achieve higher sensitivity and specificity than the screening tools that use only interview questions. The higher diagnostic accuracy achieved by the LANSS scale and DN4 questionnaire is hardly surprising given that their scores also reflect physical tests, and emphasizes the importance of clinical examination[5,6].

The following will provide an assessment of the patient to determine if neuropathic pain is indeed present.

DN4 Questionnaire *(Answer yes or no for the following 4 questions)*

Interview of the patient

Question 1: Does the pain have one or more of the following characteristics?

	YES	NO
Burning	☐	☐
Painful cold	☐	☐
Electric shocks	☐	☐

Question 2: Is the pain associated with one or more of the following symptoms in the same area?

	YES	NO
Tingling	☐	☐
Pins and needles	☐	☐
Numbness	☐	☐
Itching	☐	☐

Examination of the patient

Question 3: Is the pain located in an area where the physical examination may reveal one or more of the following characteristics?

	YES	NO
Hypoaesthesia to touch	☐	☐
Hypoaesthesia to pinprick	☐	☐

Question 4: In the painful area, can the pain be caused by

	YES	NO
Brushing?	☐	☐

YES = 1 Points **NO** = 0 Points

More than 4 points out of 10 indicate neuropathic pain

Patient's score: TOTAL

The investigator may then find it useful to continue with the above-mentioned analysis of neuropathic pain, the treatment protocols and the post treatment charts on an ongoing basis for the same and or additional patients.

References

1. *http://en.wikipedia.org/wiki/Nociception*
2. *Bennett MI, Attal N, Backonja MM, Baron R, Bouhassira D, et al. 2007 Using screening tools to identify neuropathic pain. Pain 127: 199–203.*
3. *http://en.wikipedia.org/wiki/Neuropathic_pain*
4. *Hansson P. 2002 Neuropathic pain: clinical characteristics and diagnostic workup. Eur J Pain 6:47–50*
5. *Unal-Cevik I, Sarioglu-Ay S, Evcik D. 2010 A comparison of the DN4 and LANSS questionnaires in the assessment of neuropathic pain: validity and reliability of the Turkish Version of DN4. J Pain. 11:1129–1135*
6. *Harifi G, Ouilki I, El Bouchti I, Ait Ouazar M, Belkhou A, Younsi R, et al. 2010 Validity and Reliability of the Arabic Adapted Version of the DN4 Questionnaire (Douleur Neuropathique 4 Questions) for Differential Diagnosis of Pain Syndromes with a Neuropathic or Somatic Component. Pain Pract.*

Chapter Five

Case histories using STIMPOD NMS460 pulsed radiofrequency

My first encounter with NMS 460 treatment was an introduction to a report by a group of researchers that was performed in the United Kingdom. The device used at that time, the NMS 300 was a prototype of the model in use today (as previously mentioned), the NMS 460.

Study Title: "External Stimulation: Simplistic Solution to intractable pain?"
Researchers: T. Goroszeniuk, S Kothari
Facility: Pain Management Centre, St. Thomas' Hospital, London

Methodology:

- *NMS300 (Neurotrace III) stimulating for 5 minutes, at 2Hz, intensity from 1-15mA.*
- *35 Eligible patients – Peripheral Neuropathic Pain.*

Results:

- *In 19 cases VAS reduced to 0 (100% improvement).*
- *In 4 cases, 90% improvement.*
- *Another 4 cases, 63% improvement.*
- *Another 4 cases, 50% improvement.*
- *Last 3 cases, 25%, 20%, 15% respectively.*

Discussion: The fact that the patients selected for the above study had excellent results is remarkable as these patients had experienced intractable pain that had previously not responded to other therapies. In most studies if there is between 30 – 50% improvement in pain, it is considered a worthy treatment. In the above situation to have a little more than half the patients experiencing 100% improvement, the NMS therapy could be considered a breakthrough treatment.

Another study that provides a shift in a treatment regimen is the result obtained in a patient that had Bell's palsy for six months with no previous effects from conventional physiotherapy. In fact the neurologist had diagnosed that there would be no further progress for this patient.

Researcher: D A Muller
Facility: Private Practice
Patient Condition: Bells Palsy, advised by the Neurologist that the condition is permanent Physiotherapy was not prescribed.

Methodology:

- *Treatment initiated on 26/02/2010, including:*

Ultrasound, Laser, Facial exercises
Electrical modalities were given to facilitate the stimulation of the facial muscles and nerve fibers. Treatment was given every 2-3 days.

Results: Before 13/05/2011

- *No noticeable change*

Commencing with NMS therapy

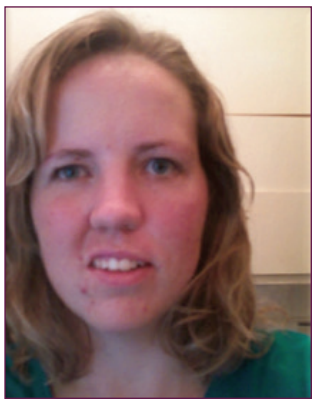
- *13/05/2011, NMS treatment*
- *Treatment was performed once daily for 5-10 minutes*
  The patient was given a device to use at home daily

Results: End June 2011

- *Muscle grading scale:*
- *Most facial muscles 3/5 – 4/5.*
- *Orbicularis Oculi 2/5*
- *Left eye could not close completely.*

Discussion:

This patient had a remarkable result as she had experienced an attack of Bell's palsy two years previously on the left (same) side of the face that had not resolved completely and then a new attack at the end of 2009. Perhaps this indicates that even six months or longer after nil spontaneous recovery or the usual facilitated improvement with exercises, massage and electrical stimulation, the NMS may be considered a new concept in neural stimulation of a neuropaxia or possible axonotmesis in the condition of Bell's palsy.



Before

After

Does this then encourage or imply STIMPOD NMS 460 use with other neuropraxic conditions?

I then proceeded to evaluate the NMS 460 treatment on neural (involving nerve tissue) pain conditions and Bell's palsy patients in my own Pain Management Practice in Johannesburg South Africa.

The first few patients with nerve pain that were evaluated demonstrated resolution of the neuropathic aspects of their pain and I considered this to be a breakthrough treatment for these particular patients with chronic and severe pain. This treatment enabled me to change the condition far more rapidly than with any other previous treatments and should be considered FIRST in any line of defensive treatment against pain.

1. The first patient that I evaluated was a female dentist of 39 years of age, who demonstrated symptoms of neuropathic pain in the left buttock, posterior thigh and calf.

- The symptoms appeared in 2008 – with intermittent pain, and then with the pain returning more intensely – the pain was in the left low back area and sacroiliac joint area.
- Many dentists suffer back pain and this patient even changed her chair, but the stabbing, sharp pain in the lumbar spine and gluteal area remained
- The pain was severe at times ranging from 3 – 10/10 on the visual analogue scale (VAS)
- On the objective examination (O/E): There was pain on lumbar extension and end of range of the straight leg raise test in lying, left spinal rotation produced pain in the left mid-thoracic region
- However the patient also experienced ***unusual pain on localized pressure to the medial side of the calf that then referred from the medial into the lateral side of the calf***

In February 2010, 4 conventional treatments (Rx) of mobilizations (mobs), ultrasound (US), massage, Traction, Electro-acupuncture, High Frequency current (Panag) were given – there was improvement in the low back and sacroiliac joint ***BUT the unusual referred pain continued.***

Two months later on 16 April 2010, the patient returned for further treatment to try to eradicate the strange referred pain in the calf that had subsequently been diagnosed as a neuropathic pain **and only the NMS 460 was used.**

The acupuncture points stimulated were Sp 9, Sp 6 (saphenous nerve branches) and GB 34, GB 39 (the common and lower peroneal nerve) at 20mA for 5mins each.

The acupuncture points and the nerve sites are similarly situated and treatment may therefore be given on nerve sites or acupuncture points.

The unusual pain referral was completely relieved and the low back and leg pain was also much improved.

On 8 September 2010 the patient returned with only the *slightest sensation* apparent from the medial referral region to the lateral calf area.

The same treatment was given as before with only NMS 460 stimulation.

The condition has completely resolved when the NMS 460 was used as a stand-alone treatment and by November 2011 (2 months after the last treatment given) the patient has remained pain free.

2. Another patient that had changes in the neuropathic pain condition post NMS 460 therapy was a female, 32 years old that had been injured in a motor vehicle accident 1 year previously. She had sustained a trapped nerve in the scar tissue where her leg had been crushed and 9 months previously had surgery to release the nerve. Although there was improvement she had been referred by the orthopaedic surgeon for unrelenting pain in the right lateral lower leg extending superiorly above her left ankle joint towards the knee and inferiorly into the soul of her foot.

The pain was a sharp, throbbing, bruised feeling and sometimes a muscular pain was experienced. She also had paraesthesia (pins and needles) from the lateral calf to the plantar surface of the foot. Walking even a few steps and standing aggravated the condition and night pain was present.

- VAS was 6/10
- The patient was eased by ice at times
- The objective examination revealed pain on plantar- and dorsi-flexion movements.

There was also a history of previous low back pain and stiffness throughout the whole spine including cervical regions with a possible diagnosis of fibromyalgia.

The medications prescribed for her condition were: neurontin, cortisone, vitamin B, panamor, ciprolex

The first treatment included a combination of direct current to the lower leg, electro-acupuncture and laser to the wound site and **NMS 460 to the common peroneal nerve site only**, for 10 mins.

The patient had relief for 10 days, and returned for further treatment with a pain VAS of 4-5/10.

She had 4 further treatments including electrical currents from the spinal region to the right foot with continuing NMS 460 therapy to peroneal nerve, sciatic nerve in the gluteal region and lumbar spine at L5/S1 at 5 mins at 3-4 mA per session

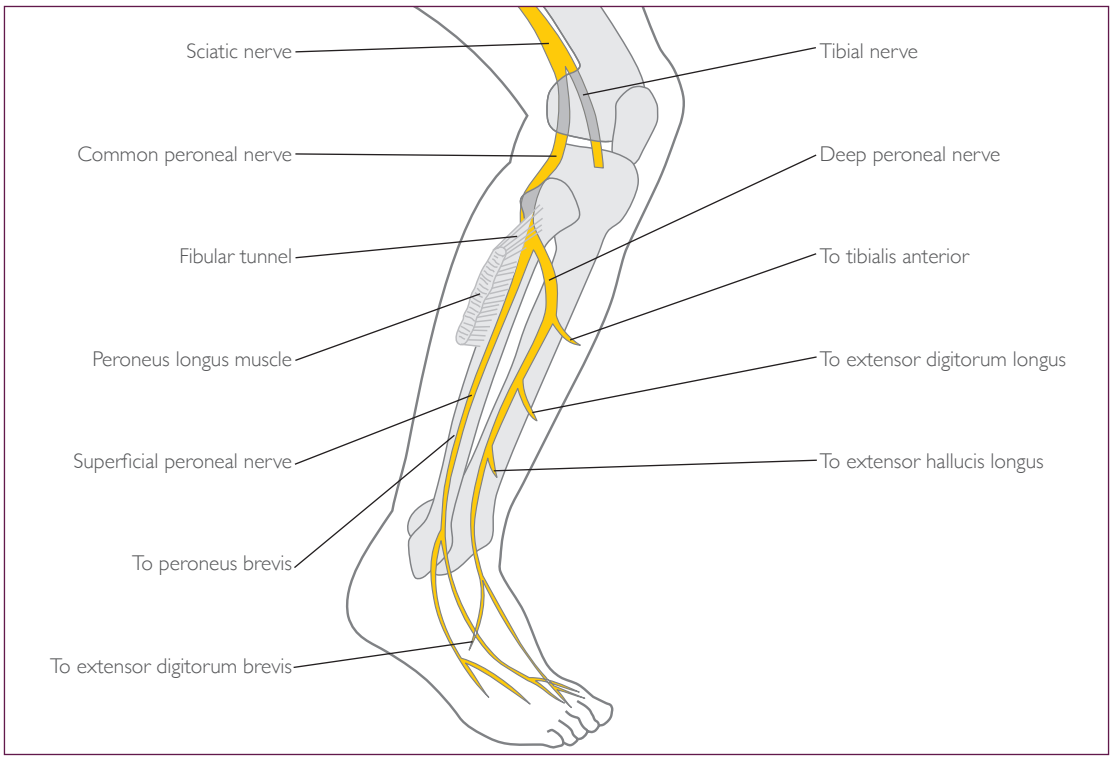


Figure 12

Pain was then reduced to 3/4 - 0/10

She was able to walk (for many hours including travelling overseas) and stand with ease with no further treatment required.

This patient returned 13 months later having had no pain since the last treatment. She recently travelled to London in mid winter and after much walking in the freezing weather, only the burning pain returned with VAS 6/10 and some stiffness around the ankle joint and slight oedema present in the area adjacent to the scar. She was given three treatments of a combination as before of ultrasound, direct current, laser for the oedematous area adjacent to the wound, muscle strengthening electrical current and NMS 460 at the sciatic nerve in the popliteal fossa (acupuncture point UB 40) and at the common peroneal nerve (acupuncture point GB 34) for 10mins each at a maximum intensity of 5 mA. She now has 0/10 pain.

If recurrence occurs only after a prolonged period and only three treatments are necessary to resolve the issue, then NMS 460 is a cost effective and successful treatment for neuropathic pain in this particular patient.

3. Another female patient, 70 years, post total hip replacement 6 years previously (2004) had severe pain and dysfunction in her left leg especially in the groin, referring medially into the anterior thigh and the ankle. Her ankle was also severely swollen. She limped and was unable to flex her left hip in sitting or standing beyond 10 degrees. She also complained of low back pain and her walking ability was limited.

After the total hip replacement she gradually developed the above pain and X rays revealed ectopic bone formation in the antero-medial pelvis/pubic bone that was creating pressure on the hip flexor muscles and causing nerve compression. Surgery was not recommended due the danger of a haemorrhage into the pelvis.

She commenced treatment on 29 January 2010.

The treatments consisted of spinal mobilisation, electro-acupuncture to spine, hip and ankle, direct current therapy, high frequency current and faradic current. This patient lived 70 kilometres from the practice and received her treatment:
January: 29
February: 3,15, 22
March: 1, 7, 13, 19
May: 27 May
June: 2 June
Total 10 treatments.

Progress was made but the patient still complained of pain, swelling in the ankle and limited hip movements causing limping.

Additional treatment of NMS 300 (including the above treatments) to the groin, sciatic nerve and lumbar spine were given on:
June: 9, 17, 23, 30
July: 28
August: 13, 26
September: 16
Total 8 treatments

Phenomenal improvements were achieved since June (with her pain into the antero-medial thigh and ankle being elicited during the treatment stimulation of the femoral nerve with the NMS 460 device indicating that the correct nerve that caused her pain had been targeted), and which ***pain then disappeared in the ankle and antero-medial thigh after 2 treatments.***

This patient has now been discharged with minimal low back pain still remaining due to degenerative arthritic changes, nil pain in the hip and excellent function of the hip joint with full flexion of the hip in sitting and 75 degrees of straight leg raise in lying before limitation but not pain. She has no pain or swelling in the ankle.

The patient is now walking normally and on telephonic feedback remains pain free one year later.

Discussion:
In the above three patients – there was definitely a neuropathic component in the first two patients due to degenerative neurogenic compression in the first patient and trauma (causalgia) in the second patient and a neurogenic compression of the femoral nerve due to the ectopic bone formation in the third patient.

It appears that the aetiology of the disorder is not as important for determining the treatment of choice, as is the importance of targeting the nerve supply to an affected area.

After these major improvements in difficult pain conditions, I then continued to treat many patients who had both neuropathic and nociceptive pain since June 2010 with excellent results with most patients.

However not all patients respond completely or at all as in all types of treatment.

It is thought that some patients may stop treatment before full resolution could occur as it may take additional treatments to determine the correct nerve area that will resolve the pain for these particular patients.

Possibly once the neuropathic component is relieved, other treatment should be continued to resolve all the issues involved.

I have selected various case histories to illustrate the effects that occurred in patients that had either a combination of treatment with the NMS 460 and other modalities or stand-alone NMS 460 therapy depending on the condition presenting itself.

A combination of modalities were selected as it is known that direct currents reduces swelling and improves wound healing, electroacupuncture and laser improves wounds and scars and other modalities are valuable in reducing certain aspects of the patient's condition. It was not the intention to permit any patient to have treatment that would not be conducive or necessary for improving the total condition.

1. A female patient, 69 years, was referred for complex regional pain syndrome post bunionectomy surgery 6 months previously in September 2010.

The first consultation was in May 2011, with the patient complaining of electric shocks, shooting pain, ants crawling around the foot, burning sensations and a cold pain spreading all over the dorsum of the foot and laterally up the leg.

- Pain VAS = 6 – 9/10, with touch allodynia due to the pressure of the bed sheets on the feet at night being unbearable
- the pain moved around constantly
- oedema in the foot was present
- pain was also present in the first metatarsophalangeal (MP) joints and the patient experienced an inability to wear any shoes except slippers
- the right foot was worse than the left

Diagnosis: neuropathic pain, stiffness in the first metatarsophalangeal joints of the big toes due to the bunionectomy and an indurated state of the wounds.

The previous treatment prior to our first consultation consisted of:
Lymph drainage, exercises, acupuncture, homeopathic injections into the toes, nerve creams, lyrica, duragesic patches.

At the objective examination: The feet were swollen, with the surgical scars of the bunionectomy being thickened and indurated. There was minimal movement at the MP joints of the big toes.

7 treatments were given of a combination of:
electro-acupuncture and infra-red laser for the wounds,
NMS 460 to the peroneal (GB 34) nerve and saphenous (Sp 9) nerve for 5 mins each at 20 mA.

After the 1st treatment VAS = 3.5/10, neuropathic pain and allodynia was reduced, with mainly joint pain remaining in the MP joints of the big toes
The treatment continued adding direct current and HF current from spinal region to feet

After the **3rd treatment** neuropathic pain and the allodynic symptoms were VAS = 0/10

3 further treatments were given of regular physiotherapy modalities including exercises to relieve the MP joint pain. The patient was able to wear normal shoes and the oedema reduced completely.

The patient is now discharged and she was examined in November 2011 – with nil complaints of pain and wearing normal (high heel) shoes.

Discussion:
If the neuropathic component of this patient's pain had not been reduced, the regular physiotherapy modalities that includes touching and handling of the foot and digits would not have been permissible. In fact the regular physiotherapy is contra-indicated in complex regional pain conditions as increasing pain in certain circumstances increases the severity of this condition. There was evidence of this from the previous treatments that this patient had received where no progress could be made and the pain levels had become intolerable, were continuing to escalate and depression had set in due to the exogenous circumstances.

2. A female patient, 54 years old was diagnosed at the Donald Gordon Witwatersrand University Pain Clinic, Johannesburg South Africa, with neuropathic pain in the lumbar spine and meralgia pareasthetica in the right thigh due to lumbar degeneration of L2, 3, 4, 5, and a low lumbar scoliosis with congenital stenosis.

The problem started 8 years previously with the patient being unable to stand from sitting, severe pain with walking or rolling over in bed with pain from 4 - 8/10 on the VAS at times.

- Severe numbness and burning in right thigh developed extending to the knee, with brush allodynia present.
- There were electric shocks and sharp pains in lumbar spine and sacroiliac joints bilaterally.
- Walking particularly aggravated the burning thigh pain and the patient was unable to walk by 5pm each day due to this pain.

Diagnosis: neuropathic pain was present in the spinal region and the lateral thigh combined with muscle spasm due to severe scoliosis, joint dysfunction due to the degeneration and spinal stenosis and core muscle weakness due to the inability to move normally.

Objective examination:

- There was nil lumbar extension or lateral flexion, however the patient was able to flex her lumbar spine.
- Muscle spasm extended from the lumbar region specifically into the right upper thoracic spine due to the lower lumbar scoliosis.
- Treatment: only 3 treatments of NMS 460 was given at the sciatic nerves in the gluteal muscles bilaterally, at L4/5 and L5/S1 centrally, at the facet joint region of this area and on the lateral cutaneous nerve of the right thigh.
- High current intensity of the NMS of 20 – 30 mA was given for 5 minutes each in the above-mentioned areas.
- The pain was reduced to VAS = 2-3/10, but there was still a numb sensation in the meralgic area of the lateral thigh but nil burning.

After 7 treatments there was nil pain on lumbar extension and lateral flexion with no muscle spasm evident on mobilization of the thoracic and lumbar spine. The numbness is receding – and is now only present in the lower 1/3 of the thigh.

The patient is coping much better and is highly mobile and active and walks long distances quite freely, being a Vice Principal of a large private school.

The 7 treatments extended from 13 June to 19 July 2011 and on telephonic communication in November 2011, the patient continues to remain pain free and active.

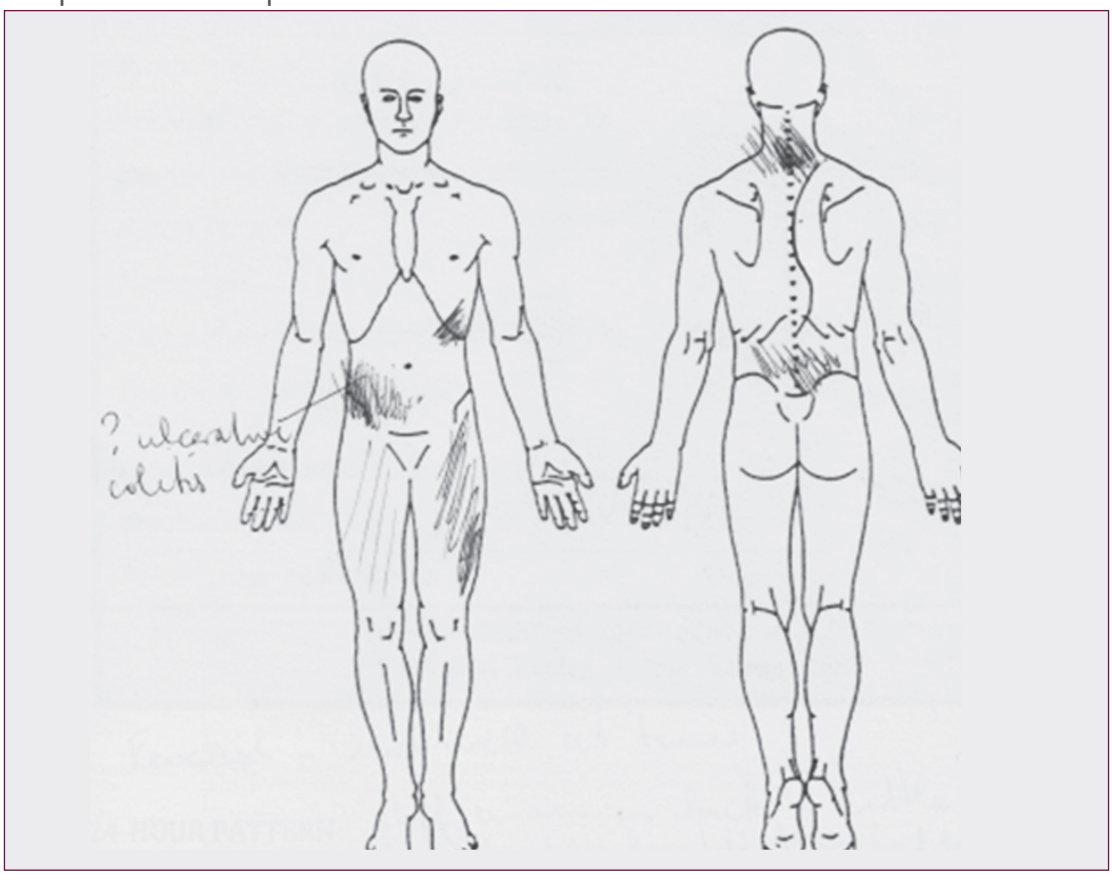
Discussion:
Many patients with muscle spasm are treated in the area of the spasm and at the segmental joint level of the degenerative condition. Often if manual treatment is given irritation in the condition could occur. In this patient the muscle spasm disappeared after relieving the neuropathic components of the pain in the lumbar-thoracic regions indicating that neuropathic pain interrupts the normal activity in muscles. The neuropathic pain in this patient compromised her mobility and particularly her walking ability. Once this aspect was relieved she was able to ambulate normally and receive treatment that strengthened her core musculature and reduced inflammation in her spine.

Perhaps there are many more patients that have a neuropathic component to their pain in many areas of the body and if this situation were to be relieved initially, improvement would be evident more rapidly than could normally be expected.

3. Another remarkable patient! A female of 63 yrs was diagnosed with ankylosing spondylitis (ossification of the anterior paravertebral ligaments), marked degenerative spondylosis, a pronounced thoracic kyphoscoliosis, severe spondylosis in the lumbar spine with a rotational scoliosis and sacro-iliiitis. VAS pain = 8/10, with sharp, aching pain, pricking, tingling sensations, brush allodynia, the vibration of driving being unbearable, there was almost nil mobility of both the lumbar and thoracic spine.

Medication: salazapyren, soliglobin, actosec, multivitamin, celebrex, tramacet, B cal D, vitamin C, stopayne, gastrone, angelique.

The patient drew her pain as marked in the chart below.



Diagnosis: This patient had severe functional changes throughout her spine due to the ankylosing spondylitis that only occurred much later in life compared to the normal manifestation of this condition. She obviously also had neuropathic components to her condition that made her pain intolerable and reduced her quality of life.

3 treatments of NMS 460 alone were given with the VAS = 5-6/10, it appeared that the pain was reduced and yet still became severe but also eased completely at times and this had never occurred previously.

The patient returned 6 months later for further treatment indicating that after at least a month she was very much better, she had now nil pain in legs and most of her pain was evident only in the right pelvis and L3/4 centrally, with the right lateral flexion, forward flexion of her lumbar spine and the left thoracic rotation greatly improved. Her husband, a dentist reported that she was walking well and had even participated in and managed a holiday that included walking and driving.

We continue to treat her condition for 3 treatments (only when necessary/when she requests it) and then rest for one month and then re-evaluate the effects of the treatment.

After this second session of 3 treatments the patient reported significant pain relief.

Discussion:
The relief that this patient achieved was remarkable considering her functional disabilities. It also improved her responses to her medications that are necessary to control her condition. If this treatment could ameliorate the patient's pain even if only for a few months, it is indeed a valuable adjunct to her other treatments. The results achieved with this patient provide encouragement to apply a treatment that blocks neuropathic pain in the treatment of many different and difficult conditions including inflammatory joint pain.

4. The following patient, a male of 67 years had lower back pain with sciatica due to a diagnosis of spinal stenosis. This patient had suffered with back pain for many years – initially he had an injury to his back in a parachute jump. Prior to our first consultation, he had previous physiotherapy and epidural injections to help relieve this pain. Six months ago the patient had felt a strain in his low back with shooting pain referring down into the left leg alternating into the right leg with right gluteal pain. Pain rated VAS = 8/10. The patient also suffers with high cholesterol, is a heavy smoker and has pain with coughing.

Diagnosis: The patient did not appear to have any components of neuropathic pain but more evidence of neurogenic pain creating a nerve root compression augmented by the spinal stenosis.

Objective examination: The patient first presented on 1 August 2011 as being in severe pain, having to use a crutch to support himself in the upright posture and he was unable to extend and laterally flex to the left with movements of the lumbar spine. Sciatic pain was present to the knee and appeared to move from the left to the right side or both.

Treatment 1: Side lying, NMS 460 at right and left sciatic nerve in the gluteal region (GB30), at the central lumbar and sacral spine L5/S1 and at the level of L3/L4, followed by a direct current for inflammation.

Treatment 2: There was improvement in left lateral flexion of the lumbar spine, sleep improved and general movements were easier. Pain rated VAS = 7/10. Side-lying: Ultrasound, APS, NMS 460 (GB 30 on the left for 20mins), L5 centrally (10mins)

Treatment 3: There was further improvement in left lateral flexion and extension of the lumbar spine. The patient was now able to lie prone: Acupuncture, sacral mobilisation, NMS 460 GB 30 right and left (10 min each)

Treatment 4: Improvement in walking. Pain not as severe when coughing. No crutch was used. Pain minimal. Prone: gentle spinal mobs, massage, ultrasound, NMS 460 GB30 right and left (10 min each)

Treatment 5: Sciatic pain and general movement much improved. Is able to extend and laterally flex lumbar spine fully. Prone: ultrasound, massage, spinal mobs, APS, NMS 460 L4/5 (10 min), GB 30 left (10mins)

Patient felt major improvement in the condition with nil pain and treatment continues with maintenance only when requested.

The patient has not requested treatment since October 2011 as telephonically he states he has no pain.

Discussion:
Initially the patient had no extension of his lumbar spine due to the severe swelling and inflammation in his spine and sciatic nerves preventing him from lying prone or from walking upright. The NMS 460 treatment provides evidence that possibly many neural compression conditions creating neurogenic pains can be treated successfully with the PRF device. As this condition is highly prevalent in degenerative disease – it could be considered the first choice of treatment in these conditions and it would then enable other aspects of the patients' condition to be treated with regular physiotherapy or exercises. It is notable that if conventional/ compressive type treatment is given to a nerve that is oedematous and inflamed irritation of the condition and increased pain may occur.

5. **Patient:** Female, 60 years old post left mastectomy with resultant spider-web syndrome which is a feeling of something light or web-like on the skin in a specific area – this is a neuropathic disturbance of superficial skin nerves.

History: On the 12 September 2011, the patient had a left mastectomy with lymph node removal for a stage 1 cancer. No physiotherapy treatment was given either in or out of the hospital.

Diagnosis: Post surgical sequelae of neuropathic pain evidenced by numbness in the axilla and arm and discomfort in the breast and axilla due to thickening and scarring of the wound areas.

Objective examination: The patient presented with a limited shoulder range of flexion (100 degrees), abduction and external rotation (90 degrees).

She also complained of numbness in the inner/medial part of both the upper arm and the forearm, there was a great deal of scarring and scar tissue present in both the regions of the breast and axilla.

Treatment 1: Massage, electro-acupuncture across scar, APS and NMS 460 at the brachial plexus (5 min) and axilla (10 min)

Treatment 2: Improvement in the range of arm flexion (130 degrees) abduction (120 degrees) but numbness was still present but according to the patient it had improved slightly. Massage, APS, electro-acupuncture through the scar, scapular and shoulder mobs, NMS 460 to the brachial plexus and axilla, the 2 regions were stimulated at 5 min each.

Treatment 3: There was further improvement in the range of shoulder movements, numbness had resolved significantly (only slight numbness and mainly in armpit).

Treatment was given as above.

The patient was very pleased with the progress and the appearance of the breast tissue and discharged herself after the third treatment.

Discussion:
Post surgical pain often becomes a chronic, severe and debilitating condition (CPSP) and is one of the most common and serious complications after surgery. There is no universally agreed definition of CPSP; however, the working definition proposed by Macrae is commonly used. CPSP is associated with increased analgesic use, restriction of activities of daily living, significant effects on quality of life, and increased health-care utilization. More than 4 million people undergo surgery every year in the UK, so CPSP poses a significant economic and health-care burden. Not all studies are consistent about the incidence of CPSP as there are wide variations between different surgical procedures[1].

Many medical interventions either before or at surgery have been applied to preempt or prevent this post surgical pain condition with few studies demonstrating efficacy. Therefore NMS 460 therapy is a useful treatment to reduce the symptoms (numbness in this patient) and improve the surgical wound site and allows additional treatments to be applied that assist the condition of the wound and surrounding areas (breast in this patient). In the case of breast surgery the patient often becomes depressed and loses self-esteem when the breast tissue does not appear normal and if the breast assumes a more natural appearance this does much to improve the general mindset of the patient.

6. A young female, 16 years of age, a professional dancer, had a tear in the labrum of her right hip that was repaired by the orthopaedic surgeon with a thermal probe to shrink the ligament on 28 September 2011. She was not permitted to dance for the next 8 months post surgery. She had limited internal, external rotation and adduction of her hip but all other movements were within normal limits.

The patient also had an aching low back pain in the L5 and right sacroiliac region with VAS = 6-7/10 and also a sharp pain in the right groin with VAS = 6-7/10. Most of her pain occurred after exercise. There were four small scars, keyloidal in appearance and sensitive to touch, from the arthroscopic surgery.

Diagnosis: The sharp pain in her hip could have been associated with a neuropathic component preventing internal, external rotation and adduction of the hip. There was also joint tenderness in the lumbar and right sacroiliac- spine that was probably a nociceptive adaptation to the lack of hip movement during her periods of dancing.

Treatment 1: The patient commenced treatment 11 November 2011. Electroacupuncture was given to the scars, direct current therapy to the hip joint, NMS 460 to the right (GB 30) sciatic nerve at 8 mA for 5minutes, right femoral nerve (St 30) at 8 mA for 10minutes.

Treatment 2: The lumbar and hip pain were greatly improved, the wounds had almost disappeared with a change occurring in their colour and the thickness. The external hip rotation was now full but the internal rotation and adduction were still limited and painful and the L5 and right sacroiliac still ached.

Treatment as before plus hip acupuncture points (UB 36, GB 31, 34).

Treatment 3: There was now nil pain nor limit of lumbar or hip movements. There was still some tenderness on pressure on the L5 with tightness in the right tensor fascia latae area. Treatment was then given to the lumbar thoracic and tensor fascia latae musculature of massage, elecroacupuncture and NMS 460 to GB 34, 30.

Only 3 treatments were given to relieve the pain and limitation of movement in the hip.

On telephonic report in January 2012, the patient reported nil pain and the right leg is now stronger than the left leg! The orthopaedic surgeon is now permitting biokinetic strengthening of her leg before the dancing commences. It appears this is earlier than would have normally been expected for this patient, as she was originally to have commenced dancing only in May 2012!

Discussion:
This patient had a combination of post surgical pain, nociceptive pain and some neuropathic elements to her condition. It appears that NMS 460 therapy may contribute to alleviating all or some of these aspects of the patient's pain enabling other treatments to be more successful. There was previous physiotherapy given to this patient but the physiotherapist concerned

was unable to work on the hip area in case aggravation of the condition occurred. NMS 460 therapy does not aggravate the condition and enables the patient to become more functional and thus also improves the quality of life.

7. Another patient, a male aged 57, was diagnosed with a cervical disc protrusion at C6 confirmed by MRI scan. The MRI showed a disc extrusion with central canal stenosis and marked spinal cord compression on the C5/ C6 nerve root.

History: 6 weeks previously the patient felt a stabbing pain in right upper thoracic region near the scapula with some referred pain in the right forearm. Pain VAS = 7/10, and was worse with sitting and relieved with lying. The patient had previous physiotherapy and anti- inflammatories but there was no improvement.

Objective examination: There was limitation in cervical rotation to the right and a marked crease across the neck posteriorly at the level C5/6

Treatment 1: NMS 460 treatment was given at C6 centrally and unilaterally on the right, including a painful area on the scapular region. (10mins and 5mins respectively)
Traction: 4kg for 30 minutes

Treatment 2: Pain VAS = 6/10, NMS 460 was given at C5 and C6 centrally and unilaterally on the right as well as on scapular region (5mins each)
Followed by: US, massage, APS, electroacupuncture
Traction: 5 kg for 30 minutes.

Treatment 3: Pain was markedly reduced VAS = 2/10, NMS was given at C5 and C6 unilaterally (7mins) and scapular region (5mins)
Followed by: US, massage, Panag/HF
Traction: 5kg for 30 mins.

This patient has ceased treatment due to time constraints however on telephonic evaluation he continues to feel improved and says he now just has an awareness of some mild discomfort only in the right scapular region.

Discussion:
This patient had a confirmed diagnosis of nerve root compression due to a disc protrusion. It is unusual to see a marked response in pain relief within 3 conservative and physical therapy treatments in this particular condition. It is believed that the NMS 460 influenced the improvement in the condition. The NMS 460 therapy is therefore to be recommended with nerve compressive conditions in all areas of the spine.

8. A young female aged 16 years was referred for treatment for idiopathic bilateral leg pain.

History: The patient is a dancer and she developed leg pain that persisted for one and a half years with no clear diagnosis although it was thought that the problem may possibly have been due to fibromyalgia.

The pain was constant mainly in the quadriceps, calves and hamstring musculature. The pain occurs with walking dancing, extension as in 'back bends'. Pain VAS can range from 5-10/10.

Objective examination: The patient has a good range with all movements, although the pain does occur in the lower back with extension movements.

Treatment 1: NMS at St 30 bilaterally (10 mins each). Panag/HF electrodes placed in the lumbar spine at L4/5 and connected to both feet, mobilisation of the lumbar spine.

Treatment 2: Had some relief of pain whilst dancing. NMS at St 30 bilaterally as before. Panag/HF from L4/5 to both feet, electroacupuncture and faradic stimulation on the quadriceps muscles bilaterally.

Treatment 3: Pain returned but the patient reported having had more strength to dance. NMS on quadriceps bilaterally for 10mins each. Panag/HF from hamstrings to feet, spinal mobilisation and acupuncture, US, massage and APS to quadriceps and electroacupuncture from St 30 to GB 34

Treatment 4: Pain reduced to 3/10. NMS sciatic nerve (5 mins each) and St 30 (10 mins each). Massage, local acupuncture points in the quadriceps muscles, US, APS

Treatment 5: Major improvement as the patient is able to dance without pain. Treatment was given of spinal mobilisation, Panag/HF from the lumbar spine to the calves, US, massage, acupuncture and APS.

Discussion:
This patient probably had a repetitive strain injury of her quadriceps muscles with accommodation in the hamstrings and calves to support her strained and therefore weakened quadriceps muscles. The condition was present for a long period of time causing the muscles to become indurated/thickened and fibrous thus reducing the circulation to these muscles. The effects of the NMS therapy controlled and blocked the pain, stimulated the nerve supply to the musculature enabling circulation to improve, strength to return and dancing to continue after only 5 treatments.

9. A female patient of 59 years had a total knee replacement on 30 November 2011. After one month she developed a burning pain and sensitivity from the groin to the medial and anterior knee joint and sharp shooting burning pain especially on walking in the lateral knee joint and referring into the lateral aspect of the lower leg to the ankle. She also complained of sensitivity and numbness in the above areas and stiffness in her knee with flexion at 90 degrees and five degrees off full extension. Pain levels VAS 8-10/10. The patient could not find a comfortable position to place her knee at night and consequently was sleeping poorly.

The patient commenced treatment on 30 January 2012. The patient therefore had a diagnosis of neuropathic pain according to the DN4 assessment of 8/10 points.

Two treatments were given of NMS at the groin (acupuncture point St30), direct current around the knee for swelling and inflammation and acupuncture points to decrease distress in this deeply depressed woman and improve mobility in the knee.

Treatment 3: Before treatment the VAS was 3/10 with no pain experienced medially and most of the remaining pain was in the lateral aspect of the leg. The knee stiffness had improved by 10 degrees and sleeping had also improved. The treatment was similar to the above but NMS therapy was then applied to both the medial and lateral knee joint at acupuncture points (Sp9, GB34).

After this treatment flexion had improved further (105 degrees) and there was no pain (VAS = 0/10) present in any area. The numbness also had decreased and the patient walked with ease.

Discussion

This patient has demonstrated confirmation that one can expect that three treatments of NMS will relieve the neuropathic aspects of the condition. Muscle strengthening, ultrasound, direct currents and acupuncture will then improve the swelling and mobility but fewer treatments will be necessary to achieve this effect.

It is notable that application of the NMS current commences at the main nerve supply to the medial knee and if the condition is still present albeit reduced, treatment can then be applied locally without fear of exacerbation.

General evaluation of NMS therapy: In the evaluation of the patients treated with NMS therapy and other modalities, it seems clear that the inclusion of the NMS therapy has brought about changes in the condition that would not have occurred without this addition. Many of the symptoms of neuropathic pain - the sharp, electric and burning pains, among other sensations, are relieved by targeting the nerve supplying the area involved.

This is an unusual approach to the normal treatment meted out by the physiotherapist. It seems logical however to target a nerve root and or nerve branches that supply a damaged or diseased region – in this way aggravation of the condition (centralization) can be prevented by treating a peripheral area centrally as in neuropathic pain. It has also been noted that when local nerves are stimulated/activated by the NMS therapy improvement in nerve conduction may occur – this may assist in neuropraxia (as in Bell's palsy) or improve nerve conduction in general where there is lack of inhibition centrally or inhibition of conduction in any weakened muscular state.

The original manual was written in 2012,1 and my colleagues at my Pain Management Practice and others who have the device in their practices have continued to use the NMS 460 on a majority of patients - either as a stand alone or in combination with regular physiotherapy. The results have been unequivocal and the conclusions reached in this chapter remain unchanged and confirm its value in physiotherapy practice.

References

1. *Chronic pain after surgery*
W. A. Macrae 2001 Chronic pain after surgery Br J Anaesth 87: 88-98.

Chapter Six

Bell's Palsy

This chapter is dedicated to the use of NMS 460 in Bell's palsy in both the acute and chronic states of this condition.

Bell's palsy is a form of temporary facial paralysis resulting from damage or trauma to one of the facial nerves due to irritation in the VIIth cranial nerve. This excludes facial paralysis associated with known causes such as infection or stroke. Cranial nerve VII controls most facial muscles, including those needed to smile, blink, and wrinkle the forehead. The nerve also controls the function of certain salivary glands, lacrimal (tear) glands as well as the tiny muscles inside the ear that dampen loud noises. The description of Bell's palsy, named after the 19th-century Scottish surgeon Sir Charles Bell, afflicts about 20,000 Americans each year.

The nerve becomes inflamed and swollen within a bony tunnel in the skull that opens just beneath the ear. It is important to remember that facial paralysis does not always mean an individual has Bell's palsy. Other diagnoses should be considered, especially stroke, Lyme disease, and varicella zoster (Ramsey Hunt syndrome). Less common causes include HIV infection, sarcoidosis, Sjögren's syndrome, amyloidosis, and tumors. Only a physician can distinguish among these possibilities by performing a careful examination. Diagnostic studies such as Lyme titers and neuroimaging may be indicated depending on the individual case.

Bell's palsy is the most common cause of facial paralysis and generally it affects only one of the paired facial nerves and one side of the face, however, in rare cases, it can affect both sides. Symptoms of Bell's palsy usually begin suddenly and reach their peak within 48 hours. Symptoms vary from person to person and can range in severity from mild weakness to total paralysis. These symptoms include twitching, weakness, or paralysis, drooping eyelid or corner of the mouth, drooling, dry eye or mouth, impairment of taste, and excessive tearing in the eye. Bell's palsy often causes significant facial distortion. Most scientists believe that a viral infection such as viral meningitis or the common cold sore virus -- *herpes simplex*-- can cause the disorder when the facial nerve swells and becomes inflamed in reaction to the infection.

Is there any treatment?

Recent studies have shown that steroids such as prednisone -- used to reduce inflammation and swelling -- are an effective treatment for Bell's palsy. Other drugs such as **acyclovir --** used to fight viral herpes infections -- may also have some benefit in shortening the course of the disease. Analgesics such as aspirin, acetaminophen, or ibuprofen may relieve pain. Keeping the eye moist and protecting it from debris and injury, especially at night, is important. ***Physical therapy to stimulate the facial nerve and help maintain muscle tone may benefit some individuals[1].***

What is the prognosis?

The prognosis for individuals with Bell's palsy is generally very good. The extent of nerve damage determines the extent of recovery. With or without treatment, most individuals begin to get better within 2 weeks after the initial onset of symptoms and recover completely within 3 to 6 months.

What research is being done?

The National Institute of Neurological Disorders and Stroke (NINDS) conducts and supports an extensive research program of basic science to increase understanding of how the nervous system works and what causes the system to sometimes go awry, leading to dysfunction. Part of this research program focuses on learning more about the circumstances that lead to nerve damage and the conditions that cause injuries and damage to nerves. Knowledge gained from this research may help scientists find the definitive cause of Bell's palsy, leading to the discovery of new effective treatments for the disorder. **Other NINDS-supported research is aimed at developing methods to repair damaged nerves and restore full use and strength to injured areas, and finding ways to prevent nerve damage and injuries from occurring**[1]**.**

Physiotherapy treatment of Bell's palsy has been quite controversial with some neurologists believing that stimulation of the nerve in the acute phase may prolong or prevent the healing process and that physiotherapy at any stage even in recalcitrant cases may have little to no effect.

It was even thought that electrotherapy may cause an increase of residual effects (increasing synkinesis) and delay regeneration of the facial nerve (Diels 2000)[2]. Farragher (1987)[3] and Targan et al (2000)[4] contradict these reports similar to Byers et al (1998)[5] who reported that pulsed electromagnetic stimulation enhances early regeneration of the facial nerve.

A study on "The effects of Electrical Stimulation (TENS) in Early Bell's Palsy on the Facial Disability Index Scores" was performed in South Africa by Alakram and Puckree (2011)[6] and was published in the SA Journal of Physiotherapy with the following abstract:

Recovery following facial nerve palsy is variable. Physiotherapists try to restore function in patients with Bell's palsy. The choice of treatment modality depends on the stage of the condition. Although limited evidence exists for the effects of electrical stimulation in the acute stage of Bell's palsy some physiotherapists in South Africa have been applying this modality. The study mentioned above examines the effects of electrical stimulation on functional recovery from Bell's palsy using the Facial Disability Index (FDI)[7], a tool that documents recovery from the patient's perspective.

A two group pre-test post-test experimental design comprising of 16 patients with Bell's palsy of less than 30 days duration was utilized. Patients with a clinical diagnosis of Bell's palsy were systematically allocated to the control and experimental groups. Patients (n = 16) were pre- and post tested using the FDI. Both groups were treated with heat, massage, exercises and given a home programme. The experimental group also received electrical stimulation (TENS at a low frequency of 10 Hz). The FDI of the control group improved 17.8% and 95.4% with a mean of 52.8%. The improvement in the experimental group ranged between 14.8% and 126% with a mean of 49.8%. Certain clinical residuals persisted in a mild form in both groups on discharge from the study. The effects of electrical stimulation as used in this study during the acute phase of Bell's palsy, quantified by the FDI was clinically but not statistically significant. It was remarked that a larger sample size and longer stimulation time or both should be investigated.

Although studies by Kit-Lan used frequencies between 6 – 10 Hz (1991)[8] and Farragher (1987)[3] and Mann (2000)[9] used frequencies of stimulation between 10 Hz and 10 - 40 Hz respectively considered relatively low frequencies, both studies reported return of facial symmetry and facial muscle activity in the chronic Bell's palsy sufferer.

From the above studies it appears that both acute and chronic Bell's palsy sufferers may benefit from low frequency electrical stimulation of facial muscles without any negative effects. After examining the details of the treatment given by D Muller in 2010 to the chronic Bell's palsy patient mentioned previously, I therefore decided to investigate and evaluate the effects of NMS therapy on the Bell's palsy patients referred to the Pain Management Practice.

The diagram below demonstrates the regions of the facial nerve and its branches on the face. Treatment with NMS therapy for a facial palsy is given:

1. Below the mastoid process
2. At the point where the earlobe meets the face/skull inferiorly (external auditory meatus)
3. Main facial nerve as it enters the face anterior to the ear through the lobes of the parotid gland

Facial nerve branches:

4. temporal
5. zygomatic
6. mandibular
7. buccal

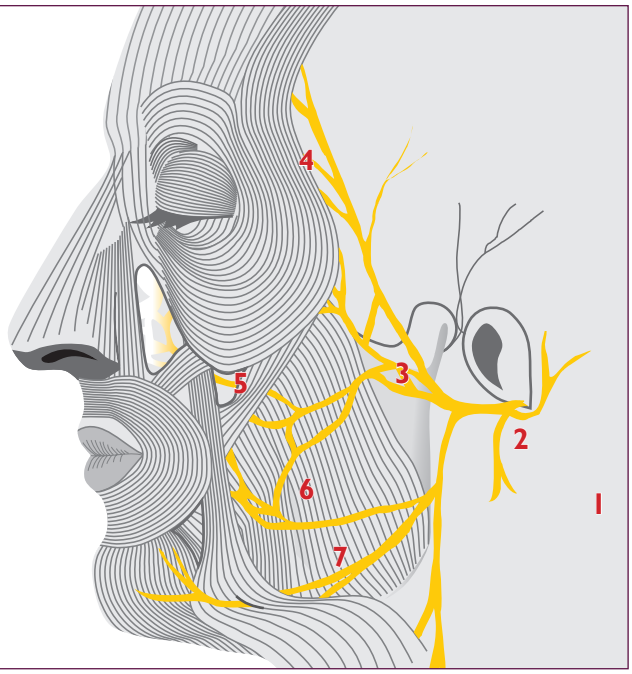


Figure 13

1. Our first patient was a female, aged 82years. She was diagnosed with right-sided Bell's palsy on 19 June 2011. *(Physiotherapist: A Theron)*

Her medical treatment was cortisone and she was given an eye patch, drops and ointment for her eye care. She did not have any pain in her ear of face.

The condition did NOT stabilize after 48 hours as could be expected.

Symptoms: *Our patient experienced*

- burning and tearing of her right eye
- complete paralysis of the right facial muscles 0/5
- she could not drink without a straw and taping of the right side of mouth was done to close and to hold the food in the mouth
- she could not speak clearly
- she was depressed and embarrassed and refused to go out

1st treatment: US and infrared laser (IRL) were used on the facial nerve at the level of the external auditory meatus to reduce swelling and inflammation in the nerve, NMS to all the facial nerve branches at a low current intensity for 5 mins on each nerve branch. Weak contractions

were visible with the current, however no active contractions were visible after the treatment.

3rd treatment: All treatments then continued as for the first two treatments with active exercises being encouraged. Active eye stimulation occurred with and during the NMS current, but nil active movements were visible after the treatment.

4th treatment: The eye was now closing actively without stimulation prior to the treatment.

5th treatment: Visible mouth and eye movements occurred on active exercise. Emotion had returned to the face.

9th treatment: There was lip movement with speech and the patient was able to use explosive consonants (b, p), eating improved, the eye was closing easily actively, the patient was wearing her patch intermittently, the eye was not burning, the face was more symmetrical, the patient was feeling very much better.

22 07 11 The patient has now had 16 treatments (3 per week, 6 weeks of treatment) with visible improvements in the orbicularis oris muscles in pursing the lips and smiling.

The patient continued with treatment intermittently as she had suffered a left cerebral haemorrhage (stroke) during the next few months creating difficulty with speech and weakness once again in the right facial muscles.

When a patient experiences a stroke, there is a block in circulation to the brain and some brain cells deprived of oxygen die within minutes. Others may take a few hours to die depending on the nature of the blockage or hemorrhage. The loss of physical and mental functions is often permanent and can include motor-function disability. The most effective treatment for stroke can be administered if it is within three hours of the onset of stroke. Although strokes can occur at any age, most stroke patients (two-thirds) are over the age of 65.

The patient resumed her treatment once she had stabilized but there was evidence of added weakness and speech deficits due to the stroke. She attended therapy as before once weekly or twice a month as often as she could manage.

By the 7 December 2011 she was able to control her lips in a grimace, was making continuing progress and was very much improved with 4/5 and 5/5 evident in the muscle grading scores in most muscles.

The patient now looks normal! Spontaneous recovery should have occurred within three months of the onset of the condition. The stroke added to the complications however by six

months this patient had returned to normality. If she had not suffered a stroke it seemed that normal facial mobility may have returned at approximately six weeks, less than three months.

The more commonly used House-Brackmann[10] score is a measure to grade the degree of nerve damage in facial nerve palsy. The measurement is determined by measuring the lifting (superior) movement of the mid-portion of the top of the eyebrow, and the outwards (lateral) movement of the angle of the mouth. Each reference point scores 1 point for each 0.25cm movement, up to a maximum of 1cm. The scores are then added together, to give a number out of 8.

Grade	Description	Measurement	Function %	Estimated Function %
I	Normal	8/8	100	100
II	Slight	7/8	76-99	80
III	Moderate	5/8-6/8	51-75	60
IV	Moderately Severe	3/8-4/8	26-50	40
V	Severe	1/8-2/8	1-25	20
VI	**Total**	**0/8**	**0**	**0**

House JW, Brackmann DE (1985). "Facial nerve grading system". Otolaryngol Head Neck Surg 93: 146–147. PMID 3921901.

Discussion:
Elderly patients do not often recover completely from a Bell's palsy and this patient was remarkable in that she also suffered a stroke and this made it even more difficult to return to normal facial function. Another interesting aspect of her progress was that by the third treatment she was able to actively contract muscles with the stimulation – this is a rarity at such an early phase of the condition and from the 3rd treatment active muscle action was present.

2. Another patient, a male, aged 56 years was diagnosed (14 October 2011) with left sided Bell's Palsy, there was nil pain *(Physiotherapist: J Jacks)*

Medical treatment: cortisone, antibiotics

Physiotherapy received: US, massage, exercises
The patient went away for 1 week and performed self-treatment with massage and exercises.

At the first consultation at the Pain Management Practice on 24 October 2011 the objective examination evaluated function according to the previous muscle grading tests (0-5) as follows:

Eye closure, lifting brow, frowning	=	Grade 2
Snarl and nasal flaring	=	Grade 0
Smile	=	Grade 1
Kiss	=	Grade 1-2
Chin crease	=	Grade 2-3

The patient was not able to seal his mouth around a bottle and had difficulty drinking from a cup - he was using a straw. There were no changes in his taste. There was overall asymmetry on the left side mainly by the nose, mouth and into the cheek.

Speech: the patient feels that the sounds he makes were slightly muffled and not as clear.

Treatment Day 1: NMS 5 mins each to the facial nerve at the external auditory meatus, front of ear on the facial nerve, temporal, zygomatic, buccal and mandibular branches.

Followed by: US, APS onto the facial nerve behind the ear and on the face, massage, revision of exersises previously given. *(It was noted that the patient was very sensitive to the NMS current, the range of intensity could only be applied between 3-6ma)*

Treatment Day 2: There was a noticeable change according to the patient. He was able to drink from a cup, was not using a straw, and the eye had more closure. There was improved symmetry in the face.

NMS as above: US, APS, Massage, Acupuncture was added at: GB 34, Li 4, St 44, Li 20, needles were also inserted into the facial muscles (no electrical stimulation was given to these muscles)

Treatment Day 3: There was further improvement noted by the patient. He found it easier to drink, he was also able to use a camera and close the eye shut, there was now a flicker of movement in the snarl.

Treatment was given as before and it was noted that when the NMS was applied behind the ear it produced a pulsatile feeling into the ear.

Treatment Day 4: The smile and snarl improved, the frown more defined, and the patient expressed that he felt a big improvement since the start of the treatment.

NMS: as above with the pulsatile feeling still present in the ear with stimulation. There was still sensitivity present on the face with the NMS current.

US, massage, APS, Acupuncture: Li 4, 11, GB 34, St 44, Liv 3. Revised exercises.

Treatment Day 5: Able to drink from bottle, symmetry further improved in face, able to snarl better, and smile appears more active.

NMS as above but extra sensitive to the current and the intensity could not be increased further than between 2-3 ma. APS, massage and US, electroacupuncture was given with contraction of muscles in face occurring with the stimulation Li 4, 11, GB 34, St 44, Liv 3

The patient was not treated over the weekend and the patient communicated telephonically on the Monday that he was very pleased with his progress and reported that the Bell's palsy had almost resolved completely.

Discussion:
This was another acute case history – with treatment commencing one week after the previous treatments had been given with nil response. It appears that as soon as the NMS stimulation is given, activation of muscles occurs. This is a notable response and it has also been observed in other patient's with Bell's palsy that as the nerve recovers, the sensitivity in the face increases.

3. Another patient, female, aged 71 years sustained a left sided Bell's palsy. She immediately went to her doctor after feeling that her mouth felt strange.

Medication: cortisone and anti-virals. Her eye was sensitive and she commenced using a tear gel and dark glasses.

Treatment 1: *(1 week only from the onset)*
The objective examination revealed:

Eyebrow raise	=	Grade 2-3
Eye closure, snarl, kiss, smile	=	Grade 2
Chin crease	=	Grade 2-3

NMS treatment was commenced on all the facial nerve branches as before. Acupuncture, APS, US

Treatment 2:

Eye closure	=	Grade 3
Smile	=	Grade 2-3.

The eye appeared less enlarged as seen below in the photographs.

NMS as above but the intensity level was less due to a greater sensitivity now occurring on the nerve branches

Treatment 2

Before

After

Treatment 3:

Snarl	=	Grade 2-3

Smile appeared less lop-sided, NMS treatment given as above and US

Treatment 4: *(2 weeks post diagnosis)*

Eyebrow raise	=	Grade 3-4
Eye closure	=	Grade 3
Snarl	=	Grade 3
Kiss	=	Grade 3
Smile	=	Grade 3

Treatment as above with NMS and US

The patient was discharged after the fourth treatment.

The patient requested that her photographs be shown to all patients with Bell's palsy to encourage them to have both the NMS therapy and to have hope that the condition could resolve speedily.

The patient also wanted doctors that have to make the diagnosis of Bell's palsy aware of the NMS treatment so that sufferers would get help for their condition as soon as possible.

Treatment 4

Before

After

Discussion:

Another acute case history is presented and treatment given daily. After a week of slow progress without the NMS therapy, the changes were evident after the first NMS treatment as there was an immediate improvement. There was no deterioration from the NMS current therapy once it commenced and the only noticeable change that was also present in the previous case history – is that sensitivity increased in the face as healing of the facial nerve progressed.

Therefore it appears that NMS therapy expedites nerve conduction in Bell's palsy in both acute and chronic states.

There is an immediate reaction (twitching, contracting muscles) to the pulsed radio frequency current in the facial muscles and this effect is not observed with conventional electrical current stimulation therapy in chronic conditions of Bell's palsy as well as often also in the acute phase. The conventional therapy sometimes takes weeks to either activate a contraction or maintain active movements post treatment.

More patients with Bell's palsy have now been treated with this device with the same results being achieved.

The questions that could be posed:

- Should NMS therapy be considered as a first line treatment in conjunction with the recommended medication of sterioids and anti-virals?
- Should treatment commence within 72 hours of the diagnosis to expedite improvement to days rather than within the two week to three months normal recovery period, and lastly
- Could NMS therapy prevent poor responses from those that would have become recalcitrant to progress (nil progress beyond six months)?

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Chapter Seven

The Guide to Treatment
How to use the NMS460

The NMS 460 therapy is a pulsed hybrid radiofrequency device of 133 kHz of treatment power with a novel waveform with a low frequency component from 1 – 10 Hz (1, 2, 5 and or 10 Hz may be selected) and a width between 0.1 – 0.2 ms (that may also be selected) according to the instructions that are included with the device.

The current waveform is therefore a square wave that has a low frequency and short pulse width with the RF waveform superimposed upon it.

STIMPOD NMS460: Hybrid RF Wave (Patented)

Superimposed RF Waveform:

Bioelectronic: Too fast for Ionic flow effects. Capatilizes on Semiconducting properties of soft tissue structures and magnetic effects, similar to interventional pulsed RF.

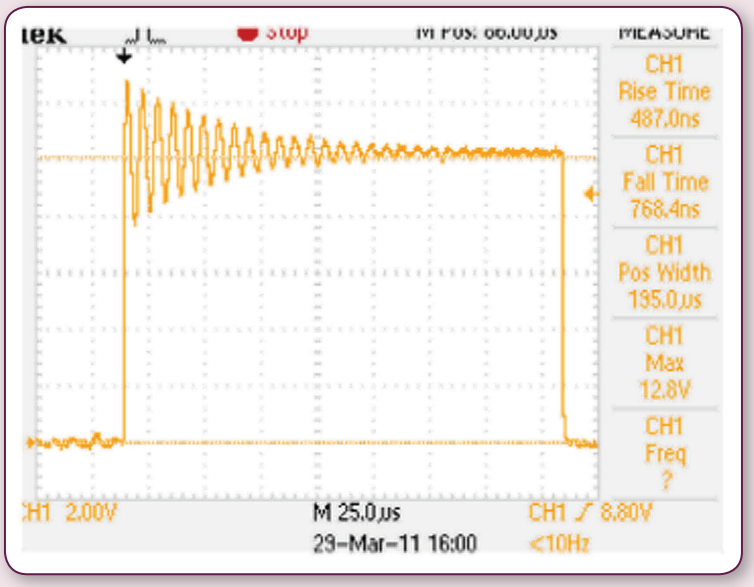
Results compare with PRF:

- Fast onset of effect - 5 minute treatments.
- Permanent changes brought about at DH.
- Seems to promote nerve regeneration.

"The first non-invasive Neuromodulation Device to employ pulsed RF principles."

Clinical Application:

- Intractable, Chronic Neuropathic Pain.
- Stimulate peripheral nerves responsible for pain.



How does NMS current therapy relieve pain?

The NMS current targets the nerve supply that may be involved or responsible for the pain. The conditions that may be relieved are pain conditions that may include neuropathic, neurogenic or nociceptive pain, or a combination of these whether peripherally or centrally maintained and OTHER conditions that may NOT be pain related.

Examples of various pain conditions are listed including the nerve sites for optimal stimulation.

Pain in any area of the musculoskeletal system – facial, head, cervical, thoracic, arms, legs, joints that may be treated by stimulating the following:

- The nerve supplying the area involved
- The muscle involved
- The joint involved
- Any condition that produces pain whether it is neuropathic, neurogenic or nociceptive in origin

1. If the nerve that produces the pain is in the **periphery**, then the nerve to stimulate is the main nerve branch that supplies the specific nerve or the area involved.

Pain in the medial ankle is treated by stimulating one or more of the following:

- The femoral nerve as it exits the groin
- The saphenous nerve – in either the medial thigh, knee or medial calf
- Any nerve that may be involved in the ankle region.

2. If the nerve that produces the pain is **central**, then the nerve to stimulate is the nearest nerve/s to the spine, the spinal region itself or any region of referral that may be identified as participating in the condition.

Pain in the cervical nerve region is treated by stimulating one or more of the following:

- The nerve site in the spinal cord at the segmental level either centrally or at the facet joint level of the nerve root (C3/4, C4/5, C5/6, C6/7, C7/T1) involved in producing the pain
- The brachial plexus anteriorly either immediately below the clavicle and or superior to the clavicle for any referred pain from the cervical, shoulder or arm region
- In the axilla for pain in this region, breast, upper thoracic region, shoulder or arm region

The pain in the thoracic spinal or joint region is treated by stimulating one or more of the following:

- At any central, facet or costovertebral joint level of the thoracic spine that may elicit symptoms of pain
- At any rib area (posterior, lateral or anterior) that may be involved in the condition
- At the brachial plexus both superior and inferior to the clavicle to treat the long thoracic nerve, upper thoracic nerves and their branches - anterior, posterior and lateral and any other nerve site involved in this region.
- The intercostobrachial nerve which is often damaged in the axilla during mastectomy with

resection of the lymph nodes.
- The sternum or xiphoid process for central pain in these regions

The pain in the upper lumbar nerve region is treated by stimulating one or more of the following:
- The nerve site in the spinal cord at the segmental lumbar level either centrally or at the facet joint level of the nerve root involved producing the pain
- The L2/3 or L3/4 nerve referral area into the hip, thigh, knee and or foot
- The femoral nerve at the level of the groin

The pain in the sciatic nerve region is treated by stimulating one or more of the following:
- The sciatic nerve in the gluteal area
- The branches of the sciatic nerve along the lateral aspect of the hip, thigh or lower leg
- The branches of the sciatic nerve that supplies the posterior aspect of the leg, at the gluteal crease, mid posterior thigh, mid popliteal fossa or mid posterior calf
- The nerve site in the spinal cord at the segmental lumbar level either centrally or at the facet joint level of the nerve root involved in producing the sciatic pain
  L4/5 (lateral referral)
  L5/S1 (posterior referral)

Pain in the lumbar spine is treated by stimulating the following:
- The nerve site in the spinal cord at the segmental lumbar level either centrally or lateral to this level at the facet joint
- The branches of the sciatic nerve in the hip and gluteal area that emanate from the segmental level involved

Pain in the sacral spine is treated by stimulating the following:
- The nerve site in the spinal cord at the segmental sacral level either centrally or lateral to this level (S1,2,3,4)
- The branches of the sciatic nerve in the gluteal area that emanate from the segmental level involved

Pain in any area emanating from the spine or nerve supply from the segmental level involved is treated by stimulating the following:
- Nerve pathways
- Acupuncture points
- (Acupuncture points are often situated close to nerve roots, a plexus – brachial or sacral, and or nerve branches)

Examples of conditions that are painful but do not necessarily relate to pain from the nervous system are listed.

3. Other conditions

Stimulation by NMS of joints may relieve pain in the following:

- Painful joints from arthritic conditions
- Trauma in painful joints or areas, including the sacrum and coccyx

Examples of non-painful conditions are listed.

4. Non-painful conditions such as a neuropraxia have been found to improve after the NMS stimulation

Nerve conduction will improve by stimulating the following:

- Facial nerve as in Bell's palsy
- Possibly other types of neuropraxia or an inflammatory condition in a nerve as in complex regional pain syndromes

Stimulation by NMS of nerves will improve the following:

- A condition that by its nature of being painful affects strength and therefore nerve conduction
- Poor muscular control as in an injury and therefore nerve conduction
- Muscle spasm due to nerve compression or joint pressure
- If it is evident that there is a disconnection from the periphery to the central control (spinal or brain) by inhibition in the muscular support system of any area

Two examples of the above are loss of core abdominal (mid-abdominals) and spinal (multifidus) muscular control due to back pain or wasting of the quadriceps due to osteoarthritis in the knee, to name two conditions.

How is the treatment applied?

The current is produced by a convenient hand-held device that is connected to a probe (the active electrode) that delivers the actual treatment current and an indifferent electrode that may be placed in any convenient area on the body. The indifferent electrode should not be situated too close to the active electrode probe as the current may then not penetrate the body but may only pass between the active and the indifferent electrode.

The range of the current intensity is between 0 and 30ma. Most low frequency devices (TENS), and depending on the devices available, deliver current between 0 and 10 ma with most

patients being comfortable with current between 4 – 6ma.

The higher current intensity that can be delivered by the NMS device is valuable in that it is known that higher current intensities recruit more nerve fibres, both sensory and motor fibres. The ability to provide higher intensities will activate the deeper nerves and fasciculation may occur in the muscles when the nerve supply is stimulated.

It is preferable to apply the probe firmly to the skin surface to permit the current to travel to the deeper tissue regions and to prevent sparking of current between the skin and the probe if pressure is too light on the skin.

It is also noted that when a gel is used on the area before the probe is applied to the skin, the treatment current becomes more comfortable and higher intensities are tolerated with greater ease.

Once the indifferent electrode is in place and the probe is applied to the specific site chosen, start with a fairly low intensity to allow the patient to get used to the sensation. The patient may experience the sensation of the current as needle-like (but not a sharp needle) with a pulsation of electrical pins and needles in a discrete (small) area.

Commence the treatment with the intensity between 1 and 3ma for the first minute (the timer on the device will indicate treatment time with a count down from 10 mins). If the patient is comfortable with the current sensation then increase the current if possible as high as could possibly be tolerated. In some patients this may reach 5ma and in others 30ma. The patient's threshold and the condition have to be taken into consideration when applying the current. If during treatment the intensity becomes uncomfortable reduce the current to the patient's comfort levels and increase intensity as and when it can be tolerated.

Higher intensities will activate the nerve supply to the muscles involved in the affected region. Fasciculation may be visible and perhaps it should be regarded as an optimum effect. It has been noted that when a condition is severe and muscle weakness is evident (wasting) and mobility in a limb reduced, the higher current intensity is not able to stimulate the nerve and therefore activate muscles optimally. As the condition improves even a lower current intensity is able to stimulate the affected muscles – this may be an indication that improvement has and is occurring.

If the sensation of the current is difficult for the patient to endure then change the frequency to 1 Hz and the width of the pulse to 0.1ms. The current is then delivered at a shorter rate and time to allow the sensation to be accommodated.

Diagnosis and treatment

- This is the most important aspect of the treatment.
- The type of pain must first be established and then the correct segmental level/s, nerve root/s or branch/s can be selected that will impact upon the symptoms of pain or improve nerve conduction.
- The physician or therapist must feel satisfied that the treatment will fit the diagnosis. It is important to compare the results before and after treatment.
- This may be done by analysis of some or all of the following:
    - The visual analogue scale (VAS) for changes in pain
    - Active muscle tests for mobility and strength
    - Other tests that may be relevant
    - Activities of daily living
    - State of mind of the individual

All of the above should demonstrate an improvement in the patients' quality of life to provide a raison d'etre for the NMS treatment.

The NMS treatment may enable other types of treatment to proceed when previously no progress could be made due to discomfort and weakness. This has an impact on severe pain and on rehabilitation. It is difficult to rehabilitate a patient who cannot bear to be touched or handled due to pain and difficult to strengthen a muscle that is inhibited due to pain.

Duration of treatment

The duration of treatment has been tried and evaluated in South Africa according to the original studies performed in the United Kingdom at the Pain Management Centre at St Thomas Hospital, London by T. Goroszeniuk, and S Kothari on 35 patients with peripheral intractable neuropathic pain as previously mentioned.

Duration has therefore been applied as follows:

- 5 mins to a nerve region
- Often requires only 3 treatments (even once weekly) to dispel the above symptoms on a permanent basis

In patients with chronic Bell's palsy according to a case history by D Muller in Pretoria, South Africa a patient was advised to use the device daily at home for one month.
The duration of this treatment was 5 mins on each nerve branch of the facial nerve. However this was for a chronic and non-responsive Bell's palsy.

Many patients have now been treated by a number of therapists/doctors with NMS therapy for chronic pain and smaller numbers with Bell's palsy in the acute or semi-acute phase due to the rarity of the condition. The results above have been confirmed in the case histories treated and duration parameters have been developed and appear advisable.

It appears that the duration of treatment is affected by:

- The condition either being acute or chronic
- The condition
- The tolerance of the patient

Acute pain conditions

- 5 – 10 mins
- In an acute presentation of a condition, 5 mins treatment may be sufficient.
- It may be necessary to treat more than one nerve site or area for 5 mins per site
- In an acute condition that requires only one nerve site or area to be treated, especially if at a distance from the region e.g. femoral nerve for a neuropathic pain in the medial ankle, then 10 mins treatment may be more effective, also taking into consideration that treatment may be given only once per week.
- If the patient is sensitive to the current sensation then 5 mins treatment would be sufficient or even less than 5 mins to assist in training the nerve area to accommodate to the current.

It is important to explain to the patient before treatment commences that the sensation of the probe and the resultant pulsation that may occur may initially feel a little uncomfortable, however certain effects may rapidly occur:

- The patient will accommodate to the current
- Some patients have a high threshold to the current and are not at all uncomfortable with it
- There may be immediate improvement in pain and mobility after the treatment
- The results will be sustained in many patients
- The pain may disappear completely and then return with less intensity or return after a few days at the same level as before but possibly with other changes such as improved mobility
- There may be no changes until after the 3 once weekly treatments are given
- Usually only 3 treatments are necessary to change the condition
- There may be increased pain and then complete resolution of the pain and other symptoms or the pain relief may last for months or longer with some return of symptoms, only to be resolved with usually minimal continuing treatment.
- Treatment may be given to nerve, muscle and or joint in the same treatment depending on the condition.

- Treatment may also be given daily, 3 or 2 times weekly depending on the condition, the individual and the individual requirements of the patient.
- If there is no exacerbation with treatment at a distance, then it may be advisable to treat the local nerve supply or region of the pain to achieve the best results.

Acute nerve pain or neuropraxia

Treatment could be given 5-10 mins on each nerve, daily for the first week, then 3 times and twice weekly until resolution and strength returns.

It appears that the patient with acute Bell's palsy may only require 4 to 5 treatments to settle the condition, ease all the discomfort in the eye and the mouth and restore normal facial function.

Chronic pain conditions

- 5 – 10 – 15 – 20 mins
- In conditions of pain that have been present for some time, there may be extreme sensitivity in the nerve or tissue involved and therefore treatment should be commenced at a distance from the local site.
- Longer duration of treatment may also be necessary to change a chronic nerve condition
- In some conditions local treatment may be the only area that will reduce pain and discomfort, despite sensitivity in the area.
- The therapist should be cautious with this approach.

Chronic non-painful conditions

- Intractable Bell's palsy (6 months with no changes in facial muscles evident) may respond as a stand-alone treatment with daily treatments of 5 mins on each nerve branch of the facial nerve involved.
- Treatment could persist for a month or many months to restore as much function as possible.

Perhaps this treatment would benefit other neuropathic conditions such as neuropathic pain and neuropathy (muscle weakness) from a disuse syndrome such as complex regional pain syndrome that may be spontaneous or traumatic (injury). Other neuropathies that should also be considered for treatment with NMS may be caused by metabolic (diabetic), viral and bacterial disorders or from any other aetiology.

TREATMENT CHART

Acute conditions:

Pain

Duration of treatment	Intensity of treatment	No of treatments
5 mins	Low and comfortable	1 - 3

Once weekly for three weeks
Three times a week
Daily for a week

Non-pain

Duration of treatment	Intensity of treatment	
5 – 10 mins	Medium to strong	3 - 6

Sub-acute conditions:

Pain

Duration of treatment	Intensity of treatment	No of treatments
5 mins	Low and comfortable	1 - 3

Once weekly for three weeks
Three times a week
Daily for a week

Non-pain

Duration of treatment	Intensity of treatment	
5 – 10 mins	Medium to strong	3 - 6

Once weekly for three weeks
Three times a week
Daily for a week

Chronic conditions – pain and non-pain

Duration of treatment	Intensity of treatment	No of treatments
5, 10, 20, 30 mins	Medium - strong – ->30 ma	3, 6, 12

Treat daily for one month, reducing to three times, twice or once a week over a prolonged period.

If pain diminishes to zero and then returns continue to treat as before however less treatment may be required to alleviate the condition.

If treatment intensity is uncomfortable then it should be reduced to comfort levels.

If the condition has been present for a long period of time then duration can be increased to 30 mins.

Discussion:
If possible stimulate until fasciculation (activation of the nerve supplying muscles that produces a muscle vibration rather than an individual muscle contraction) is observed to activate nerve conduction, this intensity can then be reduced to a non-fasciculation treatment current however as progress occurs in the condition then a lower intensity will create the initial nerve fasciculation.

When a condition is normal then lower intensity will produce these fasciculations however when a condition whether it be pain or a neuropraxia exists then nerve conduction is less active (it is still present) but requires greater intensity to activate. Activation of the nerve by NMS 460 (Stimpod) increases nerve conduction, this affects muscular activity and strength and improvement in mobility is evidence of the above effect. Relief of pain appears synonymous with this increase of mobility.

This is common for example in low back pain where it appears that 'muscles are weak' or less active contributing to reduced muscular support for the bones. It may take a prolonged period to build strength in a muscle that is deactivated due to pain. If NMS 460 is applied to the nerve root or branches then improvement in pain, mobility and activity regularly occurs.

Adaptation of application of treatment is continuous as progress occurs in the condition. When the condition improves less intensity is required to produce more activity.

The diagram below provides a visual of the most common nerves that may be involved in various conditions.

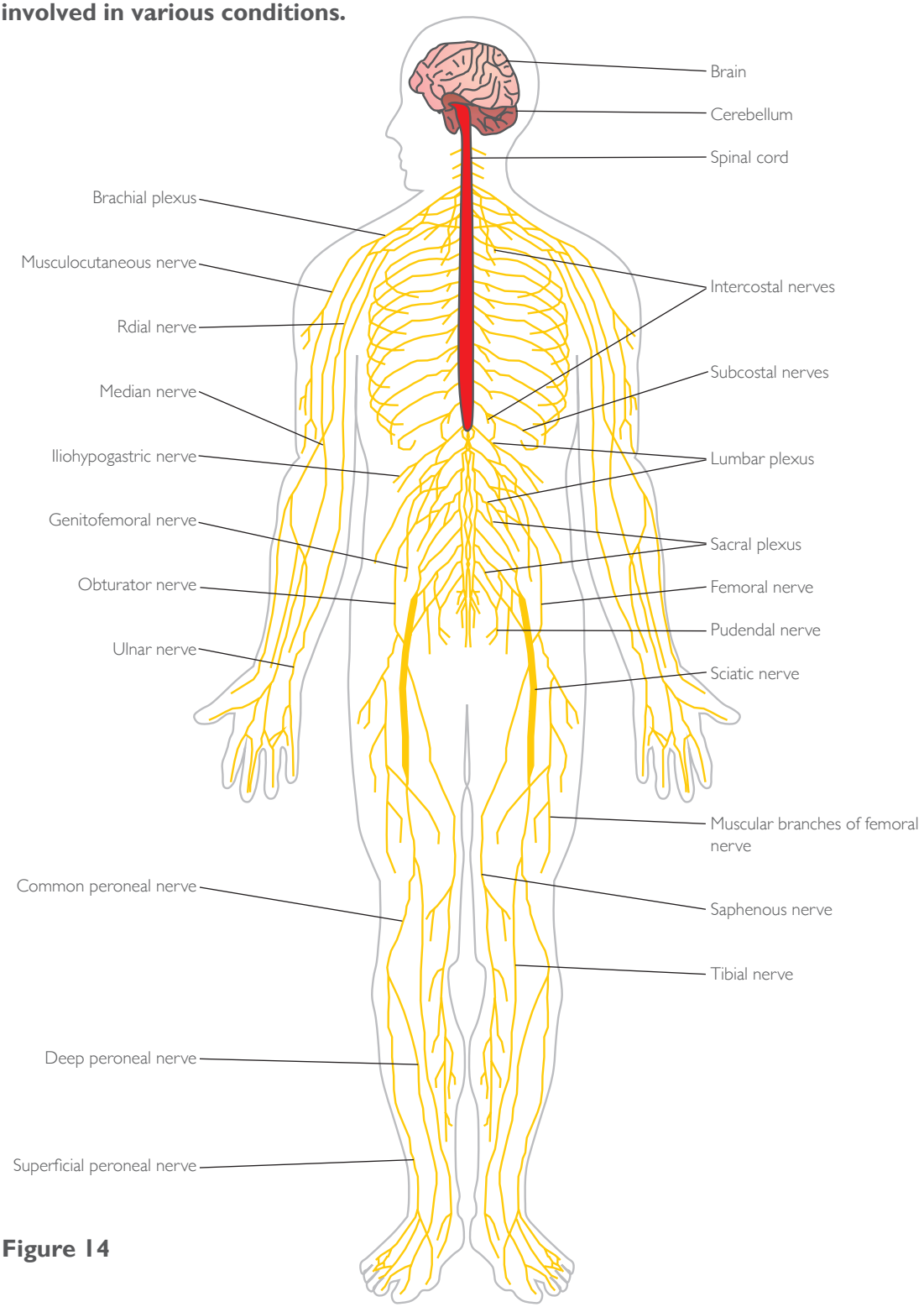


Figure 14

It is not the intention of this manual to provide diagrams of each treatment but three examples of treatment are given to enable the reader to have an understanding of the rationale of treatment when using NMS therapy.

The conditions that will demonstrate this treatment approach are:

- Tennis elbow, including post-operative tennis elbow repair

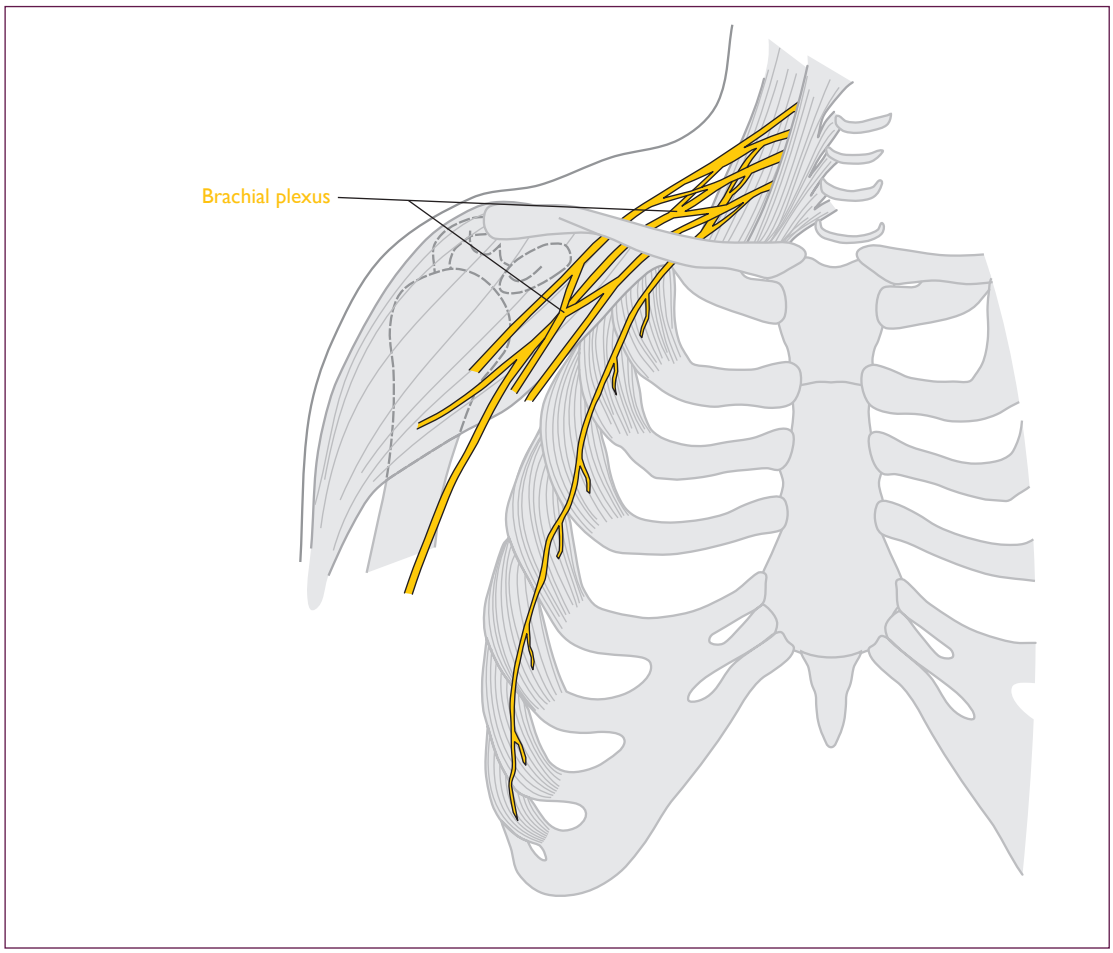


Figure 15: Brachial Plexus

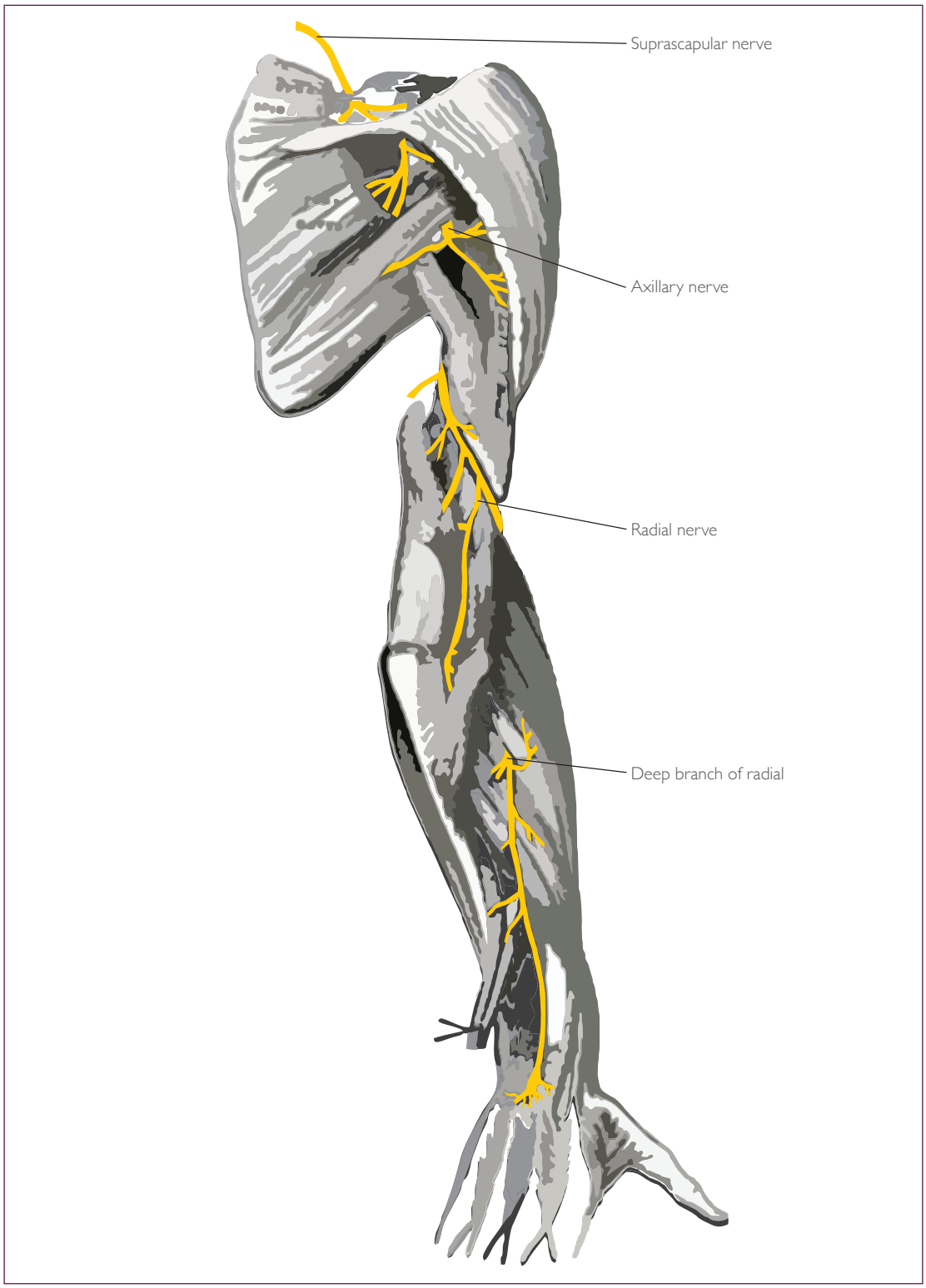


Figure 16: Posterior nerves of the arm

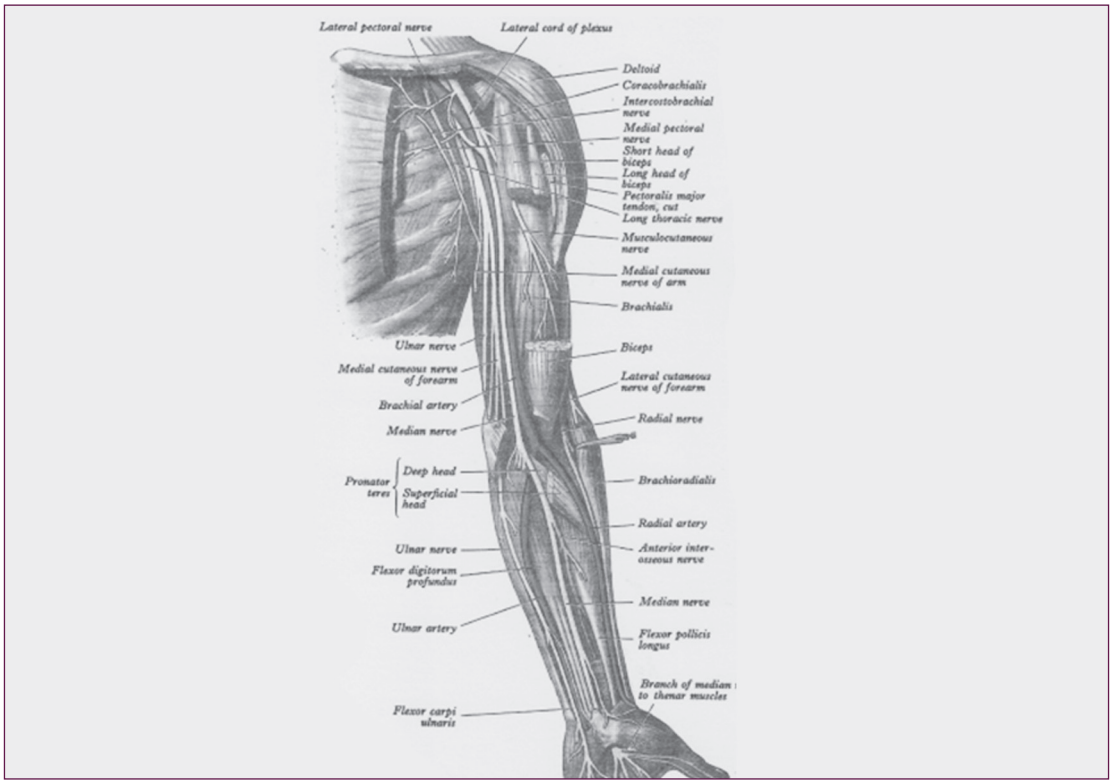


Figure 17: Anterior nerves of the arm

Place the indifferent electrode on the opposite side of the body, possibly on the left thoracic spine.

Position the probe on one or more of the following areas:

- On the radial nerve which is situated below the common extensor tendon (in the same position as the acupuncture point Li 10). *Once the current passes through this region, fasciculation may be observed in the forearm, even extending into the hand and fingers.*
- At the forearm crease on the Li 11 acupuncture point – an influential point for inflammation and for pain in the arm and hand
- On a painful site on the inferior humeral or radio/ulna joint
- On a painful site within the extensor muscles or tendons
- On either end of or on a painful site on the scar post surgical repair
- On the ulna nerve as it traverses over the medial epicondyle if necessary
- On the cervical facet joint that may be involved in the pain and allowing for a proximal treatment application
- On the brachial plexus allowing a proximal treatment application that may be delivered for a severe pain state in this area.

Each application may usually be given for 5 mins and if necessary a 10 minute application given for the most severe site e.g. local region or central nerve region area

- Sciatica from either a local nerve injury in the gluteus region and or a lumbar spinal degeneration producing sciatic pain in the gluteus muscle and referred into the posterior leg

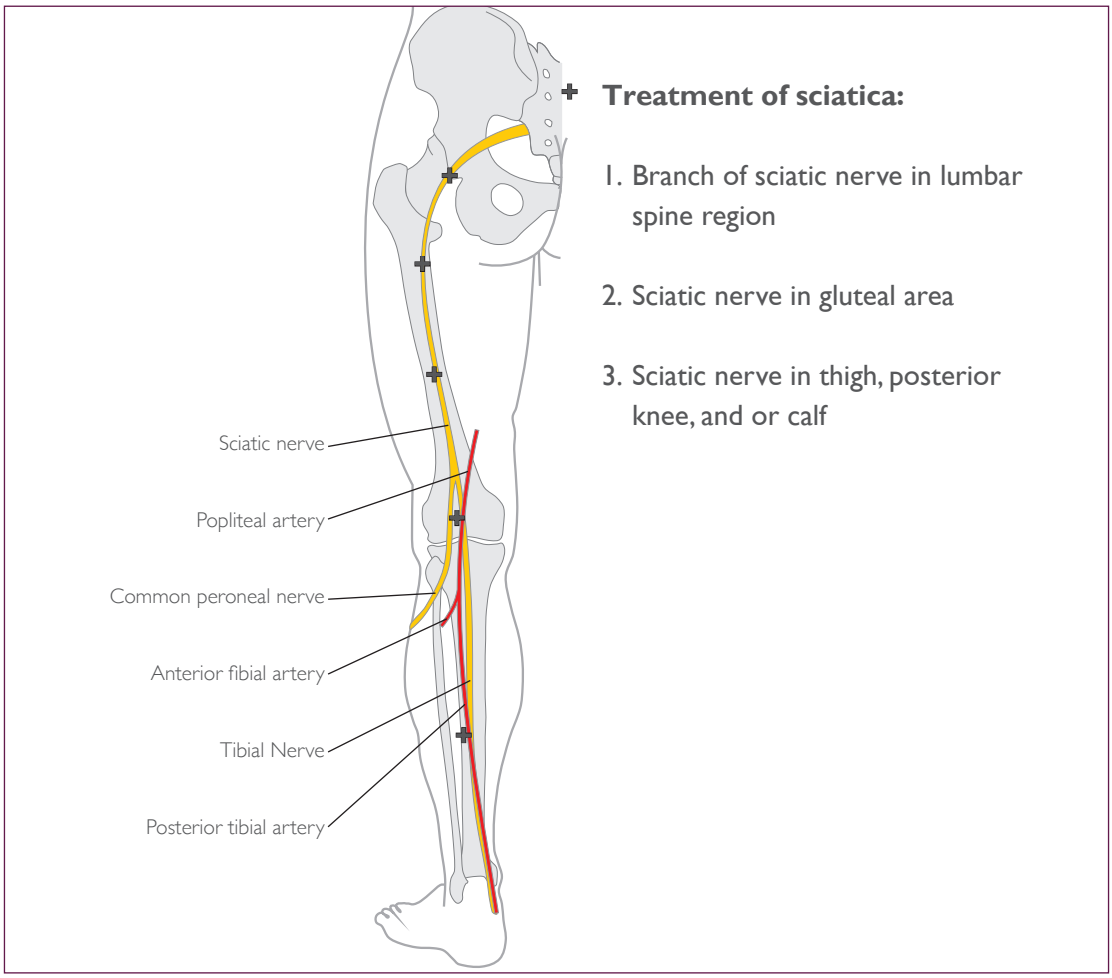


Figure 18

The indifferent electrode may be placed on the opposite side of the lumbar spine

Position the probe in one or more of the following areas:

- On the sciatic nerve site involved/tender area in the gluteal muscles
- On the leg in the path of the nerve involved (if posterior - at the mid gluteal crease, popliteal fossa and mid calf, if lateral - then on the lateral tender gluteal area, mid lateral thigh, common peroneal nerve, lower peroneal nerve)
- On the lumbar spine or facet region at the segmental level that may be causing the pain
- At the level representing the sympathetic region for the lumbar area – T10 to L2

Each application may be given for 5 mins and if necessary a 10 minute application given for the most severe site e.g. gluteal area or lumbar spine

- Anterior knee pain due to chondromalacia patella, medial to anterior knee pain in a complex regional pain syndrome of the infra-patella nerve branch and or osteoarthritis of the knee (medial or lateral) or any other knee condition

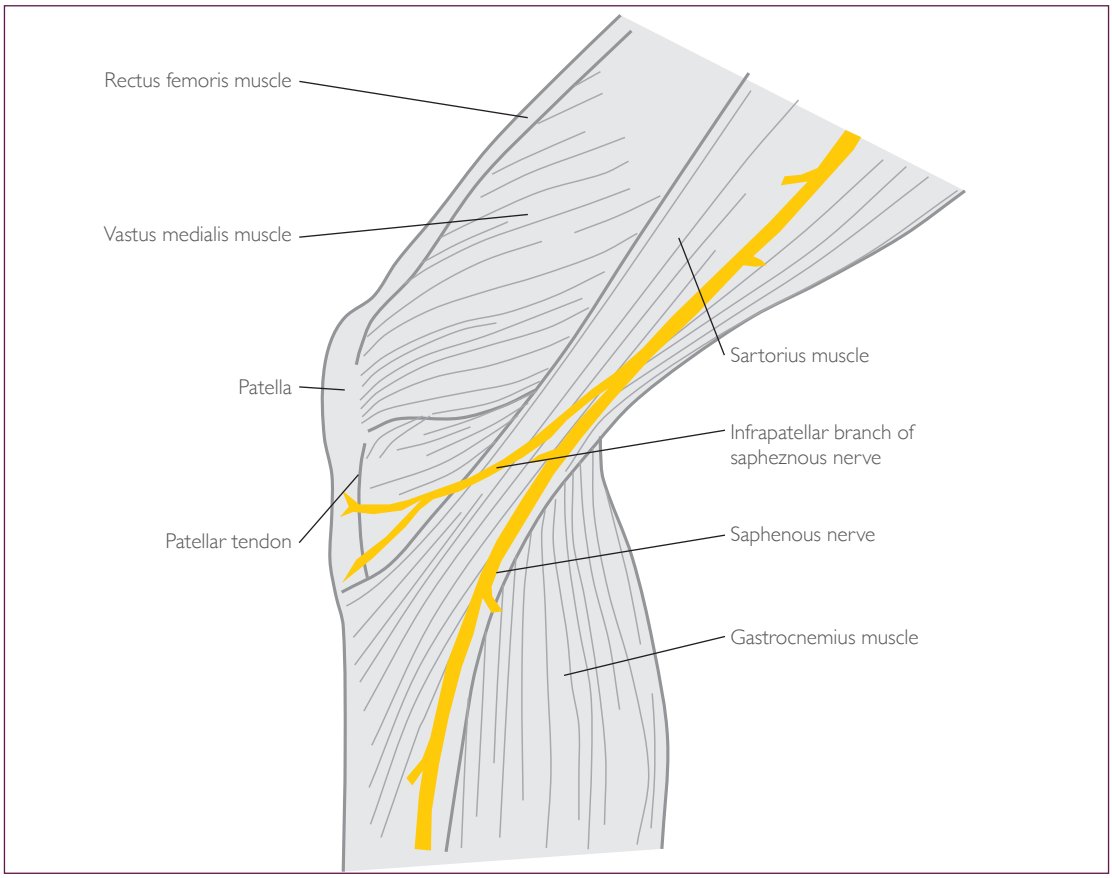


Figure 19

The indifferent electrode may be placed on the opposite side of the lumbar spine, posterior surface of the affected knee, or other.

Position the probe in one or more of the following areas:

- On the femoral nerve as it exits the groin region (acupuncture point St 30)
- On the saphenous nerve on any point as it traverses the medial thigh to the knee that is painful (acupuncture points, Sp 9, Sp 10, Kid 10, Liv 8)
- On the joint line – medial or lateral or both that is painful
- On the patella itself or infrapatella region if painful
- On either end or on a surgical scar that may be painful
- On the common peroneal nerve and its branches if painful laterally (acupuncture points GB 34, 39)
- Lateral cutaneous nerve of the thigh if painful (acupuncture points GB 31, GB 30)

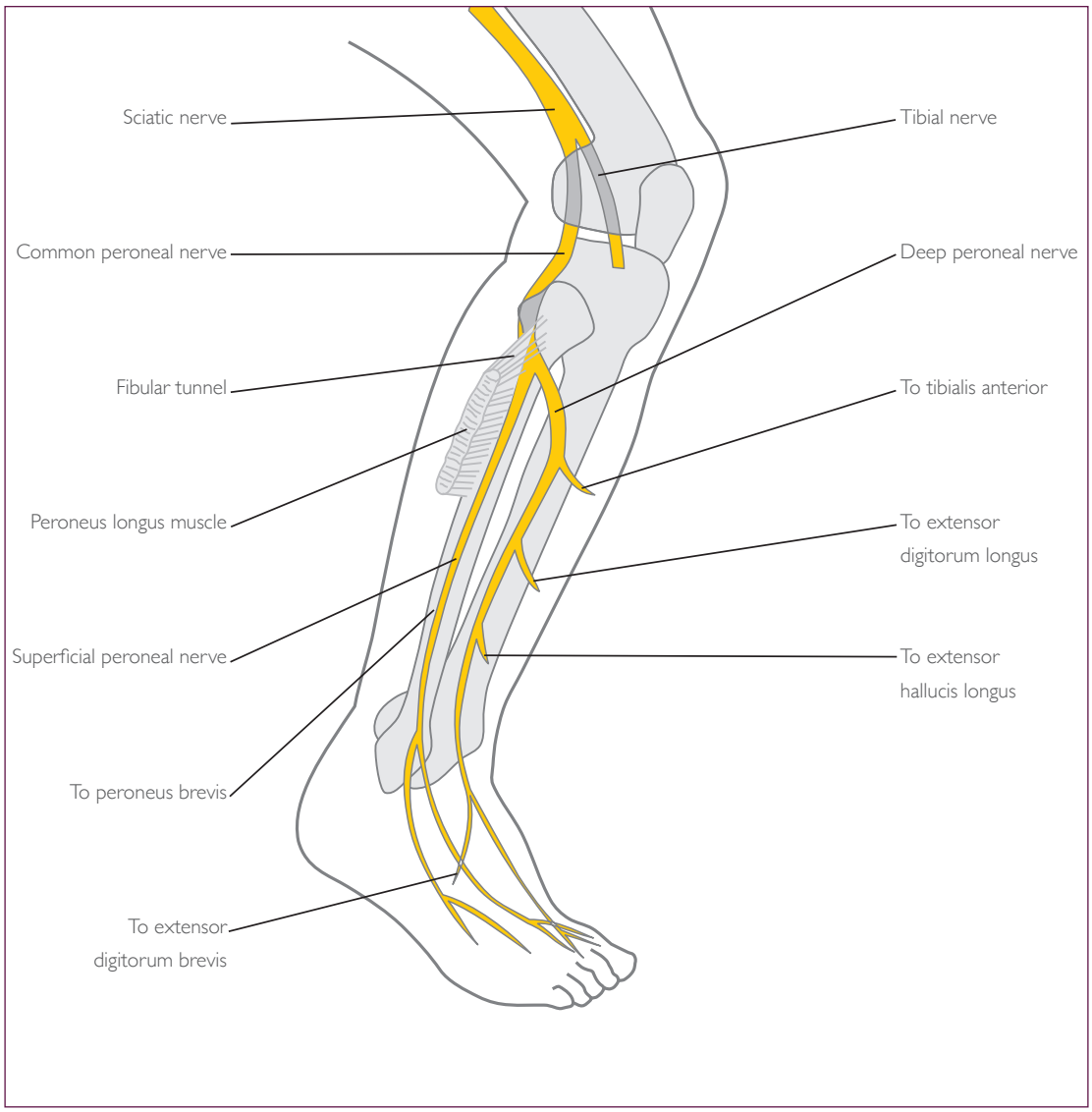


Figure 20

Each application may be given for 5 mins and if necessary a 10 minute application given for treatment of the most severe area e.g. femoral nerve (St 30) for medial knee pain. Multiple sites may be treated for 5 mins each if necessary.

Other conditions may be treated in different regions:

Head: headache, trigeminal neuralgia, neuropathic pain

Neck: see cervical

Face: facial palsy, post herpetic neuralgia, toothache, other neuralgias.
There are many conditions that require treatment on the head, neck and facial regions and accurate application to the nerve or region involved will produce the best results.

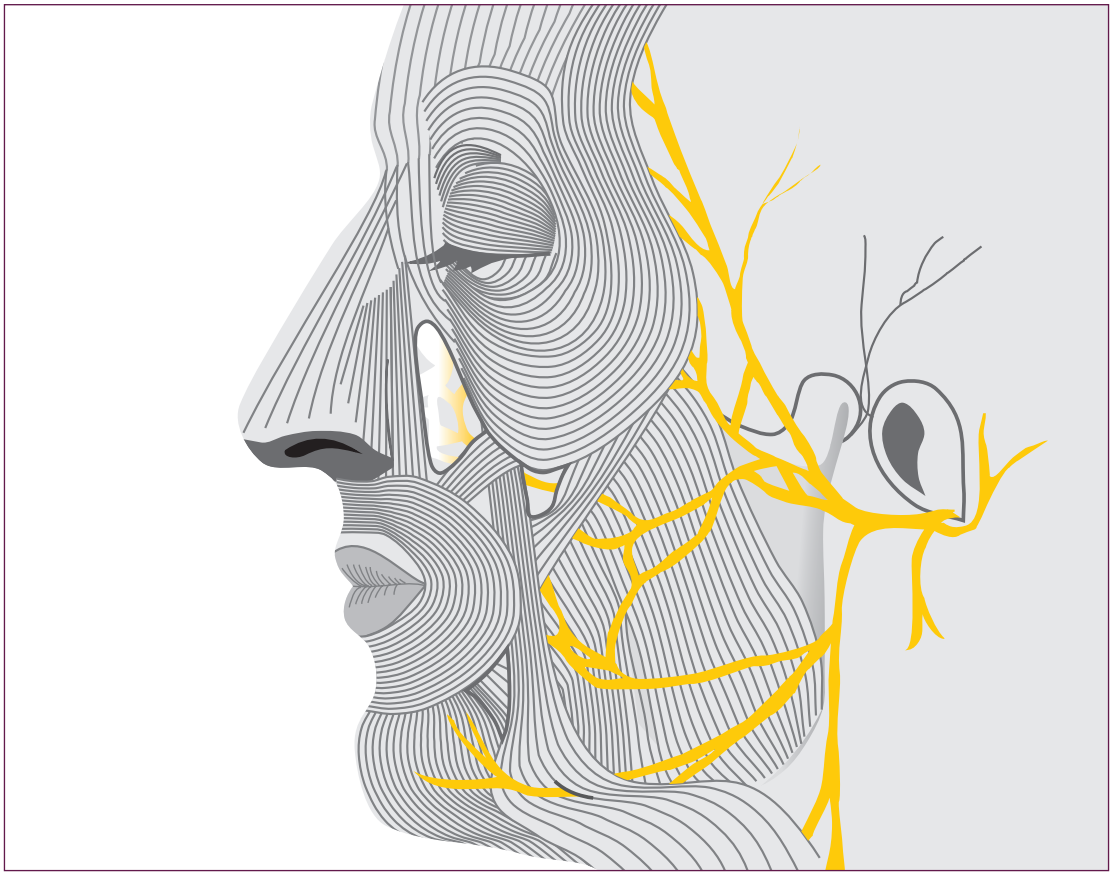


Figure 21

Spine:

- *Cervical*: degenerative disc disease/spondylosis/spondylolisthesis, nerve root compression, neuralgia, headaches, trauma, neuropathic pain
- *Thoracic*: degenerative joint disease, osteoporotic pain, post herpetic neuralgia, fractures of the ribs, neuropathic pain
- *Lumbar:* degenerative disc disease, nerve root compression, post-herpetic neuralgia, neuropathic pain
- *Sacral, coccyx:* fractures, injuries, neuropathic pain, nerve root compression

- *Sacroiliac joint*: degenerative joint disease, fractures, trauma

Shoulder to the hand:
- Cervical nerve root compression
- Brachial plexus lesion
- Anterior shoulder pain
- Golfers elbow
- Tennis elbow
- Radial nerve entrapment
- Ulna nerve entrapment
- Carpal tunnel
- OA shoulder, elbow, wrist, fingers
- Pain in the arm
- Injuries
- Complex regional pain syndrome in the shoulder, hand

Hip to the foot:
- OA knee, hip
- Knee pain
- Meralgia paraesthetica
- Complex regional pain syndrome in the leg, knee, foot
- OA ankle, foot
- OA LS/SIJ
- Injuries
- Post knee pain
- Diabetic neuropathy

Other conditions that may be present that may respond to NMS therapy

Post-operative pain in any area of the body

Wounds that are painful, thickened or fibrous

Neuropathies presenting with weakness and pain

Discussion:
It appears that any region of pain should initially be treated with the NMS 460. The result of this is that many or all aspects of the pain may disappear. If there is complete resolution of pain in possibly **three treatments**, as it appears in many individuals, then a new and cost effective method of treatment is now available. This will have a profound effect on medical benefits for patients, their medical benefit schemes and the country.

If there is residual pain, other means of treatment may then be successful in clearing the condition. This treatment benefits continuing rehabilitation, return to activities of daily living including self maintained exercise regimens and improves the quality of life.

NMS therapy can be given as a stand alone treatment or combined with other treatment modalities. If NMS is combined with other therapies care must be taken to avoid using electrical currents that may increase the current intensity of each device and that may cause harm to the patient.

If acute pain is removed, many chronic pain conditions may be prevented and if chronic pain is alleviated, patients will not require increasing amounts of medication and will be less disabled by their pain conditions.

Chapter Eight

What are the contra-indications to this treatment?

This is a newly developed device and the side effects and contra-indications have not yet been fully explored.

Since treatment has been initiated with this device there appear to be minimal side effects.

It has been noted that very small superficial burns may occur on the skin at the site of the treatment probe only if firm pressure is NOT applied during treatment. This is due to poor technique in handling the probe rather than a defect in the device.

There may be more pain in certain individuals post treatment but this effect usually augurs well as it appears that the condition only continues to improve with pain relief and increased mobility after at least three weeks to one month after the treatment has been completed.

Even after surgical decompression or invasive pulsed radio frequency treatment, patients often experience severe pain for weeks to months thereafter as the trauma from these procedures improves.

There do not appear to be any other negative aspects at this time except if there is nil response to treatment.

What are the contra-indications to this treatment?

As with all transcutaneous electrical currents, treatment is avoided in the following areas:

- On either side of the temples
- Over the carotid arteries
- If the patient has a pace maker
- Pregnancy
- Care should be taken with other high frequency therapies applied simultaneously and in close proximity with the NMS pulsed radio frequency to prevent spiking of either current.

Conclusion

Although this device has only recently been developed the prototype of the device was used in mapping nerve tissue during anaesthetic procedures and in surgery. There were no ill affects from these previous testing procedures and their use has now been in practice over considerable time.

It has been very difficult to relieve many patients of severe pain and despite many procedures and multiple medications the medical profession has not found a treatment that consistently alleviates both neuropathic pain to name one type of pain, and a treatment that expedites recovery from

facial paralysis. In fact it is unusual to expect a pain relieving treatment to have any effects on neural regeneration. Perhaps the concept of neural regeneration will produce a new generation of treatment for pain that is due to disturbance or damage within the nervous system.

If certain patients with severe pain respond in three short treatments to NMS therapy then it is imperative that this treatment is implemented as a definitive treatment not only for severe and or chronic pain but also in acute to sub-acute conditions to prevent the co-morbidity of many serious and debilitating affects of pain.

Studies of the treatment with NMS therapy in many types of pain conditions are in progress but it is important to continue to build a large case history base of the innumerable patients that have had positive results to enable researchers, physicians and therapists to determine the best practice with the NMS 460.

The placebo effect is always present in most treatments. However if patient's with intractable pain with prior poor results with previous treatments compare the effects post NMS 460 therapy and if dramatic changes are evident (even after years of pain) then these results should be documented and NMS therapy considered a valuable tool in the armamentarium against pain.

Another remarkable effect of the NMS is the improvement in Bell's palsy patients in their active facial function within 4 to 5 short treatments in the acute phase and a month's treatment in the chronic phase. Placebo effects are not usual in neuropraxic conditions and this treatment could be considered a new approach to nerve conduction stimulation. These specific effects are not evident with other muscle-nerve stimulation devices.

It appears that both pain blocking and nerve stimulation occur with the use of NMS 460. It is therefore incumbent upon the medical profession to explore the benefits that this device may have on other neurological and musculoskeletal conditions.

Chapter Nine

This Chapter is Dedicated to the Available Publications that Reflect the Present Research

The Stimpod/NMS 460 was introduced to physiotherapists in 2009 and over the past five years has been evaluated by using the device in the treatment of many patients with various different conditions. The results of treatment indicated two remarkable events – the first being rapid relief of severe pain that had not responded to normal physiotherapy approaches and the second was almost immediate changes in neural and as a result muscular activation in Bell's palsy, specifically.

The first event of pain relief that occurred was surprising as usually severe pain whether neuropathic or neurogenic usually takes weeks or even months to resolve and in some patients there is no resolution. This implies that we have a new solution to pain control that has a different mechanism to our usual approach that includes a gating mechanism in the spinal cord but also engages a magnetic field at a high frequency that is not normally applied cutaneously.

Besides pain relief this type of current has been observed to improve wound healing and also increase mobility probably due to stimulation of nerves and therefore effectively reconnecting muscles in disuse – a condition that is evident as soon as pain inhibits activity.

The second event that has been observed of changing nerve conduction in a neuropraxia is also remarkable as it usually commences during the first treatment. In a "normal" attack of Bell's palsy with medication that usually lasts between two and six weeks it now appears we can resolve this condition within two to five treatments. This has a profound effect on the patient not only for relieving the discomfort of paralysed facial muscles but also for the psyche. The Stimpod has now been used in many different conditions of muscular weakness due to neuropraxia, for example nerve damage causing a foot drop among others.
This opens a whole new avenue of treatment for nerve damage from many different situations.

Since 2009 there have been many conditions that have been treated by this device demonstrating positive effects:

- Neuropathic pain and symptoms
- Neuropathy – Diabetic Neuropathy, Polyneuropathy
- Complex Regional Pain Syndromes
- Fibromyalgia
- Persistent Post Surgical Pain Syndromes - mastectomy, hernia, total knee replacement, tennis or golfer's elbow repair, removal of sesamoid bones, bunionectomy etc
- Persistent Idiopathic Facial Pain
- Degenerative spinal disease
- Failed back syndrome
- Chronic thoracic pain
- Vestibular conditions

- Perineum pain
- Spasticity/post stroke
- Injury, joint pain, stiffness
- Inability to void urine
- Bell's palsy, post acoustic neuroma removal
- Long thoracic nerve injury

This list goes on as more physiotherapists and pain management specialists use the Stimpod/NMS 460 in their various environments. Randomized and placebo controlled studies are hard to come by for many reasons. This treatment is difficult to compare with placebo as both the investigator and the patient would be able to recognize whether a treatment was or was not given.

Research has however now commenced with a pilot study comparing patients who have had Stimpod/NMS 460 as a stand-alone treatment after elbow surgery for tennis and golfer's elbow release with those who have not had this type of intervention. Other projects that will proceed in the future will be studies on Bell's palsy, Diabetic and HIV neuropthies, post mastectomy and reconstruction and relief of sciatica due to degenerative processes that have not responded to surgical interventions.

Two articles, one in publication at present and one a case history that has been recently published are presented below.

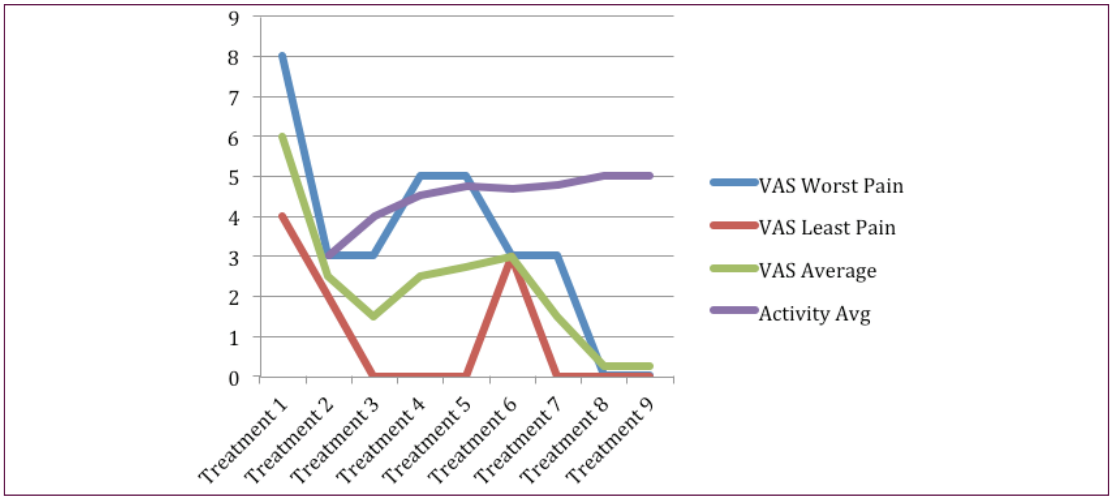
The following is in publication at present and is an excerpt from a comment on recent developments on non-invasive electrical devices for pain management. Berger P. (2014 In publication) "Comment on recent developments on non-invasive electrical devices for pain management".

> "A newly developed device, Stimpod (NMS 460) has been in use since 2009 with most promising results specifically but not exclusively in neuropathic pain from different aetiologies. The treatment is an externally applied, non-interventional, pulsed radio frequency (PRF) device that delivers 133 kHz of power via a small probe to a nerve or region such as a joint or muscle that may be involved in either a neuropathic or nociceptive condition or combination of these conditions. The most commonly treated area is the peripheral nerve or even central nerve root (spinal) that supplies the painful region. The probe may be applied to the skin for only 5 mins even once weekly for 3 treatments and often, complete resolution of symptoms may occur in certain individuals. The NMS 460 targets the nerve responsible for the pain and it is specifically the neuropathic component of pain where the most demonstrable and profound effects occur.

In addition to pain relief, improvement in mobility and strength also occurs post treatment and this has encouraging effects for continuance of other/normal treatment modalities for nociceptive or other pain conditions and also in the rehabilitation phase of a condition. It is believed that the current applied either to peripheral nerves or central nerve roots activates pain-blocking mechanisms at the dorsal root ganglion mimicking the effects that may occur at the **dorsal root ganglion** as in an interventional approach yet without causing any injury or damage to the nerve. The **bioelectronic** effects occurring from the pulsed radio frequency aspect of the current is too fast for ionic flow effects and rather capitalizes on the semiconducting properties of soft tissue structures due to the magnetic field effects. There is also a bioelectric effect when applying this current. The current also delivers: a low frequency current between 1 – 10 Hz, a square direct current pulse wave with the PRF portion superimposed upon the latter aspect of the wave. It is possible that the direct current square wave portion of the current may even be seen as a red flare that appears on the skin after the treatment has been delivered. This may affect the polarity of the tissues below the probe, influencing circulation and changes in action potentials.

Since its development Stimpod has been used to treat many patients with varying conditions including headache, wounds, diabetic neuropathy, neuropathic pain from both peripheral and central regions including complex regional pain and lumbar degenerative pain even including a patient experiencing meralgia paraesthetica.

A pilot study is presently being conducted on post-operative pain after elbow surgery, for either tennis or golfer's elbow (Berger and Jacks) with Human Ethics Research Committee of the University of the Witwatersrand, Johannesburg approval. These patients have had chronic pain in the elbow for a protracted period with many other treatments applied before going to surgery. It was thought that persistent post-operative pain syndromes that could occur in certain individuals, especially those who had experienced chronic pain, may be prevented by using the NMS 460 in this situation and also that the NMS 460 treatment may expedite wound healing and increase function. The results appear to demonstrate rapid relief of pain and discontinuance of analgesics and anti-inflammatories within the first week of treatment after the surgical procedure, before the cast is removed. Once the cast is removed, rapid relief of pain occurs as movement commences and improvement of range and function is visible within three weeks of twice weekly treatments using only the NMS 460 device for 20 mins per treatment. Most patients undergoing this type of surgery normally have extensive physiotherapy and or occupational therapy that is time consuming and costly.



Patient 102	*VAS Worst Pain*	*VAS Least Pain*	*VAS Average*	*Activity Avg*
Treatment 1	8	4	6	
Treatment 2	3	2	2,5	3
Treatment 3	3	0	1,5	4
Treatment 4	5	0	2,5	4,5
Treatment 5	5	0.5	2,75	4,75
Treatment 6	3	3	3	4,67
Treatment 7	3	0	1,5	4,77
Treatment 8	0.5	0	0,25	5
Treatment 9	0.5	0	0,25	5

In the example of one of the participants in the above study the first 3 treatments before the splint is removed demonstrate good pain relief. Once the splint is removed and movement of the elbow is possible the pain levels increase as the range of movement improves and function increases but then pain levels reduce once again rapidly. The most impressive aspect of the treatment is the improvement in function with 5/5 being optimum movement and the rapid increase in range of movement without any additional treatment required. As the study is ongoing the results and conclusions will subsequently be submitted for publication.

It is also evident that there are insufficient randomized placebo controlled trials of sufficient strength to arrive at definitive conclusions on the use of the above devices. It seems however that at this stage continual clinical evidence should be gathered to encourage pilot studies and randomized controlled trials to be undertaken in this arena in the future".

Phyllis Berger BSc Physio (Wits) Dipl Acup SA
pberger@icon.co.za
082 411 7777

Acupuncture and Related Therapies 2 (2014) 14–18

Contents lists available at ScienceDirect

Acupuncture and Related Therapies

journal homepage: www.elsevier.com/locate/arthe

Case report

Electrical current and acupuncture treatment for a paediatric patient with a recurring long thoracic nerve paralysis

Phyllis Berger*

Pain Management Practice, Rochester Place, 173 Rivonia Road, Morningside, Johannesburg, South Africa

ARTICLE INFO

Keywords:
Long thoracic nerve palsy
Pain
Complex regional pain syndrome
Electrical stimulation
Acupuncture

ABSTRACT

A female paediatric patient aged 9 years presented with right long thoracic nerve palsy for the second time. The first injury that occurred in 2011 was due to a fall and although the patient had a paralysis of the serratus anterior muscle and was unable to elevate the arm, with rehabilitation and conventional physiotherapy, she recovered completely according to the nerve conduction test that was conducted six months post recovery.

The second injury to the long thoracic nerve was due to a ballet movement that occurred in 2012. Besides the nerve palsy that reoccurred there was also a complication of severe pain and evidence of a complex regional pain syndrome (CRPS). The second injury was limited by the inability to participate in rehabilitation exercises and physiotherapy due to pain and hyperaesthesia in the distribution of C5 and C6 dermatome both in the trapezius and shoulder region. The third nerve conduction test deteriorated to those recorded after the first nerve conduction test.

A different physiotherapy approach was then applied – initially to reduce pain and decrease hyperaesthesia and then to attempt to *increase* nerve conduction by the inclusion of an electrical device that simultaneously delivers both a low and a high frequency current. This treatment was *combined* with various pain resolving tactics including acupuncture, individual sub-liminal, low and high frequency electrical currents. Several interventions were applied to tailor the treatment to the patient to achieve maximal improvement in pain and mobility. It is therefore difficult to attribute improvement to one particular modality or even natural resolution of the condition however previous clinical application and experience of activating nerve conduction with the combination current in other conditions implied that improvement could be expected. This particular electrical current is a combination of a low frequency and a magnetic field.

The condition resolved completely with full movement and no pain after 13 treatments over two months – it was evident that *the combination* of treatment had an effect on expediting the healing in the nerve. The patient was able to resume all her normal activities including gymnastics and ballet.

1. Background

Most patients diagnosed with long thoracic nerve injury with a resulting paralysis of serratus anterior may only recover after two years. The fact that the paediatric patient mentioned in this case history was able to recover within two months was unexpected and seemed remarkable. It has been discovered that a recently developed non-interventional high frequency current has been able to stimulate a nerve root, plexus or branch nearest to a nerve injury with rapidly improving strength occurring in the compromised muscle. This has been illustrated clinically in patients with Bell's palsy. It is noteworthy that faradic current, transcutaneous electrical nerve stimulation (TENS) and galvanic type current cannot be expected to accelerate normal nerve conduction in this type of neuropraxia.

2. Literature review

The first report of the non-interventional pulsed radio frequency device was made by T Goroszeniuk and S Kothari on "External Stimulation: Simplistic Solution to intractable pain?" at the Pain Management Centre, St. Thomas' Hospital, London in 2009. A prototype of the device called the Neurotrace III was used on 35 patients with peripheral neuropathic pain. Three treatments were given once weekly for 5 min per treatment and there were no negative results, with 19 patients achieving 100% improvement. The second report given by a physiotherapist from Pretoria, South Africa by DA Muller in 2010 on a patient with left sided Bell's palsy that had

* Tel.: +27 11 883 2000; fax: +27 11 883 3111.
E-mail address: pberger@icon.co.za

2211-7660/$ – see front matter © 2013 Elsevier GmbH. All rights reserved.
http://dx.doi.org/10.1016/j.arthe.2013.11.002

Case history of a child with long thoracic nerve compression injury
Berger P. Acupuncture and Related Techniques

A nine years old female was diagnosed with long thoracic nerve compression for the **second time.**

Injury to the long thoracic nerve causing paralysis or weakness of the serratus anterior muscle can be disabling. Patients with serratus anterior muscle palsy may present with pain, weakness, limitation of shoulder elevation, and scapular winging with medial translation of the scapula, rotation of the inferior angle toward the midline, and prominence of the vertebral border[1].

Long thoracic nerve dysfunction may result from trauma or may occur without injury. Fortunately, most patients experience a return of serratus anterior function with conservative treatment, **but recovery may take as many as 2 years**. Bracing often is tolerated poorly. Patients with severe symptoms in whom 12 months of conservative treatment has failed may benefit from surgical reconstruction. Although many surgical procedures have been described, the current preferred treatment is transfer of the sternal head of the pectoralis major tendon to the inferior angle of the scapula reinforced with fascia or tendon autograft. Many series have shown good to excellent results, with consistent improvement in function, elimination of winging, and reduction of pain[2].

This young patient's first injury occurred in July 2011, due to a fall at school resulting in a subluxation of her right shoulder joint. This injury to the long thoracic nerve created winging of the scapula (see Figures 21 and 22) that recovered fully after 6 months. This original injury was not accompanied with pain but the patient was limited by her inability to elevate her right arm. The subject's normal activities included gymnastics and ballet.

A new injury occurred in October 2012 that also eventually recovered with treatment after only 2 months that included recently developed pain blocking and nerve stimulation modalities. This second injury was caused by holding hula-hoops during a ballet class while practicing for a concert. This time, the condition was complicated, by a **complex regional pain syndrome**, characterized by sensory, motor, and autonomic, abnormalities[3], as diagnosed by the paediatric rheumatologist.

The nerve conduction studies by the neuro-physiologist (17 October 2012) indicated a 70% drop in amplitude of the right motor nerve conduction compared to the left side (0.4 compared with 2.1) with a severely delayed latency (5.1 compared with 3.0). The sensory nerve conduction studies of the ulna and median nerves were normal. These results were similar to the previous nerve conduction studies in August 2011 performed

after the first injury and that had returned to normal on re-testing in July 2012.

Arm held by the side of the body

Arm elevated as high as possible

Figures 22 and 23: First injury occurred 2011-07-28, recovered fully after 6 months

The treatments given prior to the first consultation after the second injury:

- Biokinetics: Exercises
- Physiotherapy: Active and passive movements plus electrical current stimulation
- Hydrotherapy

These treatments increased stress and pain and were therefore discontinued.

Assessment of pain at the first consultation 25 10 2012:

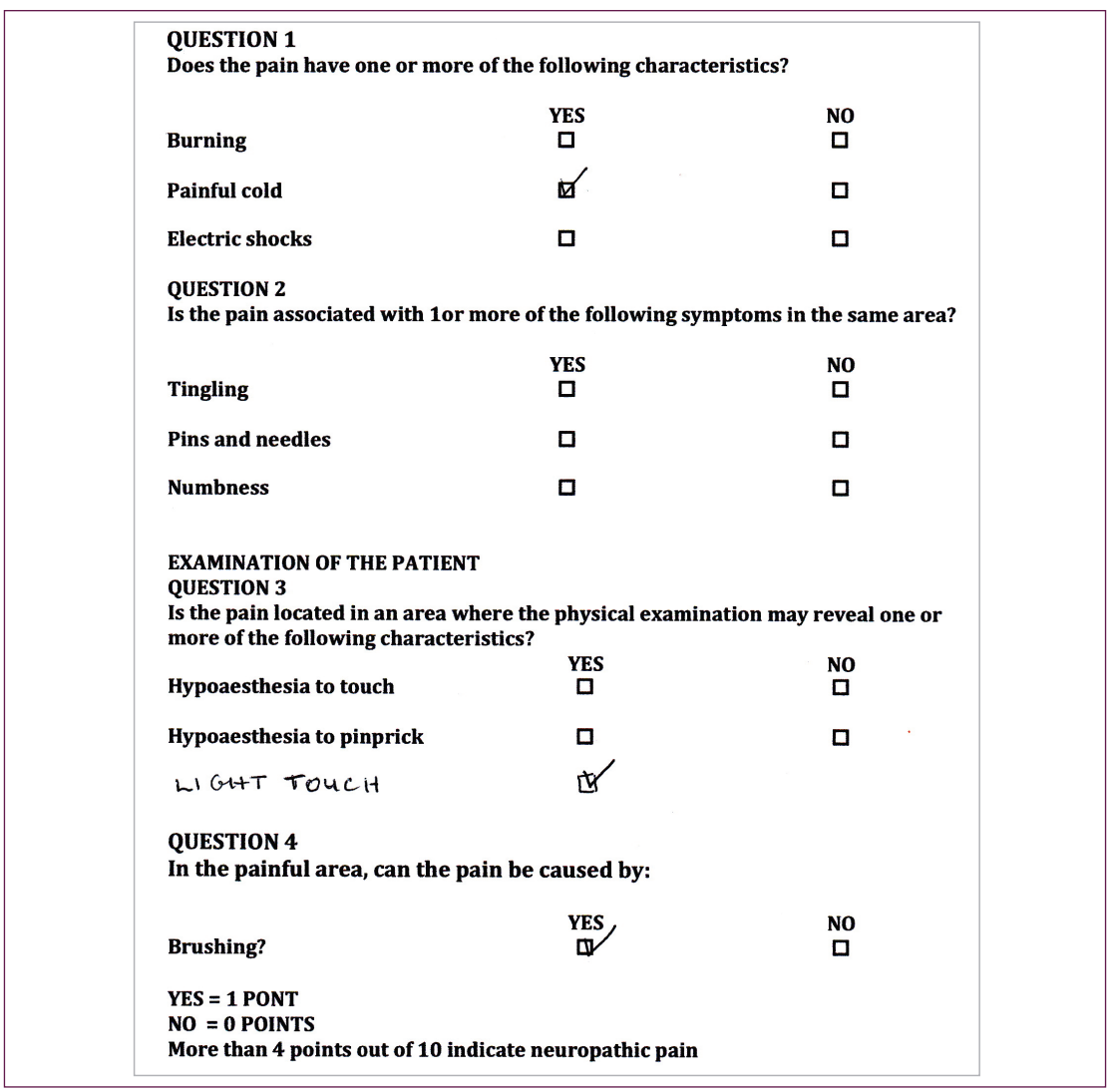
- Visual analogue scale (VAS): Best is 7.5/10, worst 10+/10
- Pain was constant, aching, allodynia present with movement, hyperaesthesia to light touch and a sensation of painful cold or freezing pain.
- The patient was assessed for neuropathic pain on the Doleur Neuropathique 4 screening tool developed by Bouhassira et al. (2008)[4] and had brush allodynia, hyperaesthesia to light touch and painful cold or freezing pain, among her other complaints rating 3/10 on the DNP 4 scale for neuropathic pain (4/10 indicates neuropathic pain). See Figure 23.
- Sleep is disturbed by pain (lying is painful).
- The pain is aggravated by lying, moving and writing activities. There was no use of the right arm and all schoolwork was done with the left hand.
- Nil eases the pain
- Mood: The patient indicated that she was anxious, sad (weeping at times) and the mother, a psychologist, felt that her child was depressed. The patient expressed irritation that this problem had reoccurred and that it prevented her from participating in sports and ballet. She also mentioned that the condition was unfair and she felt that her arm was like

"carrying an elephant!" The combination of pain and depression or anxiety is commonly seen in clinical practice and this was highly evident in this case history[5].

- In assessing the general health – nil except for a mild heart murmur and seasonal rhinitis.
- This patient presented as a fit and healthy child, highly intelligent and motivated towards getting better.

Medication: Trepilene, Gabapentin, Neurontin.

At the time of her first consultation she was still participating in hydrotherapy although this also appeared to increase her pain.



QUESTION 1
Does the pain have one or more of the following characteristics?

	YES	NO
Burning	☐	☐
Painful cold	☑	☐
Electric shocks	☐	☐

QUESTION 2
Is the pain associated with 1or more of the following symptoms in the same area?

	YES	NO
Tingling	☐	☐
Pins and needles	☐	☐
Numbness	☐	☐

EXAMINATION OF THE PATIENT
QUESTION 3
Is the pain located in an area where the physical examination may reveal one or more of the following characteristics?

	YES	NO
Hypoaesthesia to touch	☐	☐
Hypoaesthesia to pinprick	☐	☐
LIGHT TOUCH	☑	

QUESTION 4
In the painful area, can the pain be caused by:

	YES	NO
Brushing?	☑	☐

YES = 1 PONT
NO = 0 POINTS
More than 4 points out of 10 indicate neuropathic pain

Figure 24: The DN4 Screening tool for neuropathic pain for this patient.
Bouhassira D, Attal N, Alchaar H et al. Doleur Neuropathic 4 (DN4). Pain 2005; 114(1-2):29-36.

As the previous physiotherapy was discontinued pain management with treatment of the peripheral (ascending) and the central (descending) mechanisms commenced. Treating the peripheral (ascending) mechanisms implied treating the local region with modalities that would not increase pain through sub-liminal applications that could possibly decrease the sensation of pain and improve circulation to assist in blocking the pain. Treating the central (descending) mechanisms implied interacting with the patient to assist in increasing endorphins by the physiotherapist: explaining pain, teaching relaxation, breathing techniques and visualization[6], demonstrating 'mirror therapy' encouraging assisted movements that did not increase pain and giving the patient confidence to cope, control the pain and acceptance of the situation that the nerve would eventually recover. Case studies and anecdotal data are overwhelmingly supportive of mirror therapy, or 'virtual' mirror therapy, in which a virtual reality environment is used instead of a mirror to relieve phantom limb pain, complex regional pain syndrome (CRPS), and for post-surgical rehabilitation[7].

Objective examination:

- Winging of the scapular was evident.
- There was severe pain from the lateral cervical region from C4/5 referring to the shoulder both anteriorly and laterally, (deltoid region).
- The area was hyperaesthetic generally with a red flare of discolouration mainly in the neck when touched or even if the patient was distressed by the ***thought*** of having the shoulder touched or moved. This is consistent with a complex regional pain syndrome (CRPS) condition. CRPS often manifests with allodynia, hyperaesthesia, discolouration, oedema and dysfunction of mobility. Clinical features of CRPS may include a mix of sensory, autonomic, and motor symptoms, particularly intractable pain, limb edema, blood flow and sudomotor changes, cutaneous trophic irregularities, and movement disorders[8]. The patient held her upper arm close to the chest with the elbow flexed. There was full movement of the right forearm, hand and fingers but nil active movement of the shoulder in all ranges. The scapular winged noticeably, the right upper trapezius muscle was depressed with the cervical spine tilted to the right with 50% limitation of right rotation of the cervical spine.

Figure 25: The appearance of the scapular in this patient on the second occurrence of the long thoracic nerve injury and paralysis, October 2012.

Treatment:
13 treatments were given.

A combination of treatment has been given that has been applied with a selection of the modalities listed below initially to determine best treatment for the patient and the condition but the treatment would often need to change depending on the mental and physical state of the patient at each appointment.

- Microcurrent/subliminal9 current sensation 0.5-1Hz for hypersensitivity – (Alpha-Stim/AS) applied in a cross fire technique around the sensitive region
- Cranial electrotherapy9 (CES) applied with clips on the ears to give the same treatment as above and found to produce relaxation and decrease stress.
- Acupuncture10, 11 for:
  relaxation, stress and pain: Du 20, Li 4, Liv 3
  increasing shoulder mobility: electro-acupuncture (EA) at Li11, Li15,
  improving pain, muscle spasm and mobility in the shoulder: GB34, St38, GB21
- NMS/Stimpod is pulsed non-interventional radiofrequency at 133,000 Hz and is usually applied at the nerve root (relevant facet joint) or nearest plexus in this case the brachial plexus (BP) either superior or inferior to the clavicle or even on an area of muscle spasm12.
- Laser (Low level laser) applied for hypersensitivity over but not in contact with the sensitive region (has been found by the author to reduce hyperaesthesia in some patients)
- TENS13 for home use with a rate of 200 Hz and a width of 80ms for pain
- Direct current for inflammation and swelling (APS)14
- Transeva/faradism to stimulate the muscles along rhomboids, deltoid, trapezius and serratus anterior
- High frequency current 10,000 Hz (Panag)15, 16
- Explaining pain
- Visual imagery (colour and size changes) breathing exercises and relaxation
- Mirror therapy

01) 25 10 12 Supine: AS to shoulder, CES; acupuncture points for depression and stress; NMS at Brachial plexus inferiorly and C4/5 facet joint region on the right.

02) 26 10 12 Possibly slightly better, until bumped at school.
Supine: AS; NMS to BP and on C4, 5, 6; acupuncture as above.
Hydrotherapist sees some slight improvement in mobility.

03) 30 10 12 **Pain VAS = 8/10**; slightly improved shoulder flexion Acupuncture in side lying: Du20, EP1, Li4, (Li11 and 15 EA), GB34, IRL to BP, C4, 5, 6, 7 and along

thoracic spine from T1 – 6.
TENS on T1 – 7 and inferior to the deltoid muscle. imaginary colour changed from black to light blue
Pain VAS post treatment = 7.4/10; *the pain feels different*

04) 01 11 12 **Pain VAS 7/10,** imaginary colour of pain changes from black to blue; able to do simple exercises
Mood has improved, not weepy, mother says she now has a different child!
TENS from T1 – 7 and below GH joint, Acupuncture – Du20, EP1, Li4, (Li11, Li15 EA), NMS to BP and C4/5 and along rhomboid region adjacent to the scapular border
APS anterior to chest wall and posteriorly alongside medial scapular
TENS for home use

05) 06 11 12 **Pain VAS = 8/10** (blue – but dark colour becoming less dark)
Appears more mobile, no further changes
Acup: Du20, EP1, Left St38, Right GB34, Left EA to Li15 to GB21
NMS for 10mins to BP, GH joint, trapezius
In prone position: Acup: Bilat UB 57, Thoracic (T1), C4/5
NMS along scapular – able to get contraction at lower medial border and 1 point in upper scapular region
Pain VAS = 7.5/10 post treatment.
To obtain own TENS unit for home use

06) 08 11 12 **Pain VAS = 8/10**. Has own TENS unit
Supine: Acup Du20, E1, EA to Lu7, Li4, SJ5 (the latter 2 points also assist pain along the meridians involved), NMS at sternocleidomastoid muscle and C3/4/5/6, BP, deltoid
Side lying: NMS thoracic/rhomboid region
Faradism - able to get contraction
Panag electrodes placed on CS and Th spine to the region below deltoid
The patient is able to now use the arm but the pain inhibits activity. She uses the forearm more actively and the upper arm is able to move away from the body/thorax.
Pain post Rx VAS 7/10

07) 13 11 12 Pain increased due to busy weekend however the upper and medial trapezius appear to have improved in strength and is now at shoulder level and the winging of the scapular has reduced.
TENS does not appear to help in the regions used before and now

changed to treating the SNS (sympathetic nervous system) region with low frequency of a rate of 2 Hz and a width of 200 ms.
Acup to Du20, Li4, Li11, Li15, GB34, St36, Liv3
Could not use NMS (sensitivity seemed to increase)
Panag tolerated on CS and below shoulder

08) 15 11 12 Better attitude, holding teddy bear and carrying TENS unit. Panag, EA to sh/arm, Li4, Liv3, GB34, Du20. Gave new exercises and explained pain

09) 19 11 12 Mirror therapy and scapular setting exercises
Farradism, NMS and **massage** on posterior cervical and thoracic region

10) 23 11 12 Prone: massage NMS, EA, AS for sensitivity

11) 27 11 12 Rehab exercises, NMS to GH joint,
Prone: massage, EA, AS for sensitivity, NMS to cervical spine – C2 - 6

12) 05 12 12 No perceptible change except for a more cheerful attitude
Mobs and massage to CS, Th spine
EA to CS and Th spine, Panag from CS to Thoracic spine

13) 10 12 12 **Pain VAS = 6/10**
Supine: able to **massage** arm and in tender region of shoulder – most tender in the deltoid region and supraspinatus
Prone: **massage**, NMS, EA, Panag on upper arm and cervical region
C4/5, Trigger Point's along traps and right axillary nerve region

14) 07 01 13 Returned with nil pain VAS = 0/10 and full ROM

All movements returned between Christmas 2012 and New Year 2013
Patient is now discharged

Discussion:
It was not expected that the nerve damage could repair from a severe loss of conduction within less than three months. Compared with the first attack on the long thoracic nerve which took six months to repair, one can only assume that one of the treatments offered has had an influence on restoring nerve conduction. The condition on the second attack was also complicated by severe pain and a diagnosis of CRPS that would also influence the outcome and make it more difficult to treat.

The availability of non-interventional pulsed radio frequency (NI-PRF) on many neuropathic pain conditions treated over the past three years has demonstrated remarkable effects within 3 treatments. This treatment has also improved patients' with early Bell's palsy within 2 – 5 treatments in some cases, during the past thee years. A long standing Bell's palsy patient complicated at a later stage by a stroke also had restored complete movement to the facial muscles but over a three-month period of once weekly treatments. This then demonstrates that the NI-PRF is able to inhibit pain and improve nerve conduction whether it is due to a neuropraxia or a minimal nerve injury. One patient developed a tumour on the sciatic nerve in the upper thigh in 2012. Surgery to remove the tumour caused an axonotmesis and this condition has not responded to this treatment.

When this patient was first assessed it was important to try as soon as possible to break the pain cycle and relieve the anxiety and depression. Many patients who have hyperaesthesia and allodynia do not improve if passive or active movements are forced or have increased pressure, ultrasound, TENS applied to the hypersensitive area due to the presence of sensitization. Therefore acupuncture and cranial electrotherapy were used to relieve stress, anxiety and pain and microcurrent and IRL (both being sub-liminal or having very little sensation) was used to relieve hyperaesthesia. However it was not a simple journey as it was difficult to find the treatment that would not distress the patient and give her confidence that physiotherapy would not increase the pain.

The mainstay of the treatment was the consistent use of NI-PRF in specific positions. The long thoracic nerve is usually formed from three cervical nerve roots - the fifth, sixth and or seventh cervical nerves, but the root from the seventh may be absent. The upper two roots pierce the scalenius medius obliquely, uniting either in the substance of the muscle or on its lateral surface and the nerve so formed descends dorsal to the brachial plexus and the first part of the axillary artery. Having crossed the upper border of serratus anterior to gain its outer surface, it is soon joined by the root of C7 which emerges from the interval between scalenius anterior and scalenius medius at a lower level and descends on the lateral surface on the latter muscle. The nerve continues downwards to the lower border of serratus anterior supplying in its course filaments to each of its digitations[17].

The serratus anterior is a muscular sheet that passes backwards around the thorax from an extensive costal attachment to a more limited attachment on the scapula. Its muscular digitations arise from the outer surfaces and superior borders of the upper eight, nine or even ten ribs. The muscle is closely applied to the chest wall and attaches ventral to the scapular and the attachments are at the triangular area on the costal surface of the superior angle, directed backwards to almost the whole length of the costal surface of the medial border and then lastly to the costal surface of the inferior angle.

The activity of the muscle with the pectoralis minor draws the scapular forwards and is the chief muscle concerned in reaching and pushing movements. The upper part of serratus anterior together with levator scapulae and the upper fibres of trapezius provide a muscular suspension for the scapula, supporting the unloaded arm. The lower fibres of serratus anterior play an important part in raising the arm above the head[18].

The target of treatment with NI-PRF therapy in this condition was to treat C5, 6, 7 at the nerve roots as they exit the cervical foramina, the brachial plexus superior and inferior to the clavicle, in the levator scapulae and upper trapezius muscles and along the costal border of the ribs and close to the ventral scapula attachment of the serratus anterior but some of these areas were severely limited by the hyperaesthesia.

The newly developed device, Stimpod (NMS 460) has been in use since 2009 with most promising results specifically but not exclusively in neuropathic pain from different aetiologies. The treatment is an externally applied, non-interventional, pulsed radio frequency (PRF) device that delivers 133 kHz of power via a small probe to a nerve or region such as a joint or muscle that may be involved in either a neuropathic or nociceptive condition or combination of these conditions. The most commonly treated area is the peripheral nerve or even central nerve root (spinal) that supplies the painful region. The probe may be applied to the skin for only 5mins even once weekly for 3 treatments and often, complete resolution of symptoms may occur in certain individuals. The NMS 460 targets the nerve responsible for the pain and it is specifically the neuropathic component of pain where the most demonstrable and profound effects occur.

In addition to pain relief, improvement in mobility and strength also occurs post treatment and this has encouraging effects for continuance of other/normal treatment modalities for nociceptive or other pain conditions and also in the rehabilitation phase of a condition. It is believed that the current applied either to peripheral nerves or central nerve roots activates pain-blocking mechanisms at the **dorsal root ganglion** mimicking the effects that may occur at the dorsal root ganglion as in an interventional approach yet without causing any injury or damage to the nerve. The **bioelectronic** effects that occur from the pulsed radio frequency aspect of the current are too fast for ionic flow effects but rather capitalize on the semiconducting properties of soft tissue structures due to the magnetic field effects. There is also a bioelectric effect when applying this current. The current also delivers: a low frequency current between 1 – 10 Hz, a square direct current pulse wave with the PRF portion superimposed upon the latter aspect of the wave. It is possible that the direct current square wave portion of the current may even be seen as a red flare that appears on the skin after the treatment has been delivered. This may affect the polarity of the tissues below the probe, influencing circulation and changes in action potentials.

Since its development Stimpod has been used to treat many patients with varying conditions including headache, wounds, diabetic neuropathy, neuropathic pain from both peripheral and central regions including complex regional pain and lumbar degenerative pain even including a patient experiencing meralgia paraesthetica[19].

DATE	No of Rx	VAS before	VAS post	Mobility	Touch	Mood
25/10/2012	1	8-10				
26/10/2012	2	Unable to score				
30/11/2012	3	8	7.4			
01/11/2012	4	7				
06/11/2012	5	8	7.5	Using arm		
08/11/2012	6	8	7			
13/11/2012	7	Unable to score		Holding teddy bear		
15/11/2012	8	Unable to score		Using arm		Improved
19/11/2012	9	Not measuring		Using arm		Improved
23/11/2012	10	Not measuring		Using arm	Massage	Improved
27/11/2012	11	Not measuring		Using arm	Massage	Improved
05/12/2012	12	Not measuring		Using arm	Massage	Improved
10/12/2012	13	6		Using arm	Massage	Improved
07/01/2013	14	0		Full ROM	Nil treatment needed	

Figure 26: Chart shows dates, numbers of treatments, visual analogue scale before and after a treatment, mobility, ability to touch the area of pain and mood of the patient.

In the chart above, it can be seen that the first six treatments did decrease pain by between 10 – 30%. However there were also improvements in mobility, stress and sleep quality and it was thought that it was not positive to emphasize pain relief score rather mobility therefore after the sixth treatment, the patient was not asked to score the pain but rather to measure her activity. The hyperaesthesia and the discolouration diminished by the tenth treatment and massage and mobilization was then possible indicating that the CRPS/neuropathic component of the condition had settled. Once the severe pain had decreased it was easier to increase exercise and improve strength.

Figure 27: A photograph taken on 05 December 2012 where the deformity of the scapular winging had improved and was only slightly visible.

Conclusion

The main thrust of the treatment was to achieve pain free mobility even if full strength was not obtainable or expected due to the long thoracic nerve injury. It was also important to get the patient's confidence in the treatment and co-operation with practicing the exercises and increasing activities. Although it was hoped, it was not expected that full strength would be achieved in such a shortened period – six months was the previous benchmark for recovery. The NMS/Stimpod device has achieved pain relief with neuropathic and other pain conditions, has rapidly improved strength in Bell's palsy and also in many case histories demonstrating loss of activity due to nerve pressure or oedema (minimal nerve injury) over the past three years. It may therefore be possible to assume that this device contributed to the rapid and unexpected recovery in this case history. It should be noted that it would not have been best practice to use only the NMS therapy treatment as each and every patient deserves every modality and approach that may help the individual condition.

Phyllis Berger BSc Physio (Wits) Dipl Acup SA
pberger@icon.co.za
082 411 7777

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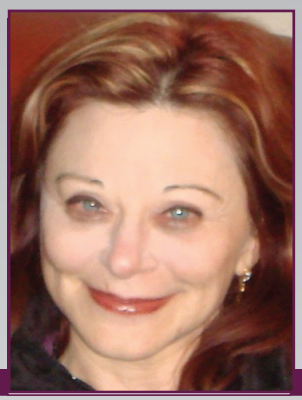
Intro NMS 460



Phyllis Berger

Phyllis Berger is a physiotherapist and acupuncturist with a special interest in electrical currents in relation to the treatment of pain. Phyllis realized that certain types of electrical current relieve various conditions and symptoms related to either acute and or chronic pain.

Her clinical experience in pain management commenced in 1994 working at the Rand Multidisciplinary Pain Clinic. She has attended many international pain conferences, published many articles and four books on pain management and has lectured on this subject both nationally and internationally.

Phyllis continues to evaluate advances in electrical pain management and is presently involved in research on this subject in her Pain Management Practice situated in Johannesburg.