Program and
Protocol Guidelines
Table of Contents

• Program Guidelines

• Chronic Back Pain Protocol Guidelines

• Neurological Applications Guidelines

• Shoulder Rehabilitation Guidelines

• Wrist and Hand Rehabilitation Guidelines
Neurotech is a medical devices company based in Galway, which has been active in the Irish market for over 40 years. We specialise in producing high quality, innovative electrotherapy devices and are the only Irish company in this sector investing in R&D in Ireland. Our R&D team in Galway is continually striving to create easy to use, clinically effective products for both clinic and home therapy.

MediStim XP has been designed to be easy of use while still providing a broad range of programs to treat a wide variety of conditions. MediStim XP is a digital, 2-channel neuromuscular electrical stimulation device with 9 pre-set programs.

**Programs 1, 2 & 3** are muscle strengthening and re-education programs all set at 50 Hz. The choice of program then depends on the contraction and relaxation cycle required for the patient, with Program 1 at 5 seconds on and 5 seconds off for normal strengthening. Program 2 at 5 seconds on and 10 seconds off, where fatigue may be an issue. Program 3 is at 10 seconds on and 20 seconds off for high strengthening/endurance training. This can be utilised for muscle rehabilitation on all areas of the body.

**Program 4** can be utilised for neurological rehabilitation with a setting of 35 Hz which is the setting used in the majority of neurological research. This can be utilised for footdrop, wrist extensor strengthening, and shoulder subluxation, etc (please see ‘Programs for Neurological Conditions’ section)

**Program 5** can be utilised for 2 purposes due to its settings. Firstly if the muscle is not responding / activating at the higher frequencies of 50 or 35 Hz then 10Hz can be utilised in an attempt to gain an initial response from the muscle. As this response improves then advance up to the higher frequencies for better activation. Secondly, due to the low frequency and high pulse width combination, the program can be utilised to detone overactive muscle e.g. upper trapezius post RTA. It does this by vibrating or shaking out the muscle.

**Program 6** tones and detones two opposing muscle groups alternatively; hence it will reduce spasm on channel 2 and strengthens the opposing muscle on channel 1. This program is utilised where muscle imbalance exists e.g. in the quadriceps muscle if the patient has a weak VMO and
an overactive lateral quadriceps channel 1 is used to strengthen VMO while channel 2 detones the lateral quads or where lower trapezius is weak and upper trapezius is overactive the same principle can apply.

**Program 7** is used as an oedema management program. This works on the principle that electrical muscle stimulation will increase blood circulation and hence clear the debris and fluid causing the swelling. Both channels are utilised on opposing muscles closest to the area of swelling thereby maximising the localised circulation. A good example is swelling at the wrist where one channel is placed on the extensors and one on the flexors – by stimulating to contraction level increased circulation, increased ROM, strengthening and pain management can be achieved.

**Program 8** is a pre-set program to treat facial palsy with setting at 8 Hz and 80 pulse width. Both channels can be utilised to target 2 sets of muscles depending on requirement and stimulation is increased to a moderate contraction level to facilitate rehabilitation.

**Program 9** is a sweeping TENS program that sweeps from 4 to 99Hz over a 5 second period. This is an effective treatment for acute pain and can be utilized in conjunction with other programs when required to best manage a condition. Both channels sweep from 4 to 99 Hz so the program can be used with one or both channels.

**Pricing & Access:** MediStim XP is available for patient rental for €69 plus VAT. Private patients can contact the Neurotech team on Freephone 1800 511 511 to rent or purchase a device, while physiotherapists in HSE hospital departments can apply through Community Care Physiotherapy for medical card patients.
Chronic Back Pain Protocol

This protocol was developed by Dr. Gad Alon, Associate Professor of Physiotherapy at the School of Medicine, University of Maryland. Dr Alon runs a private physiotherapy clinic and as an Associate Professor is also involved in academic training and research. The circle of pain diagram below explains chronic pain, demonstrating that a decrease in local circulation is a contributory factor in chronic pain. In clinic, the local circulation problem can be treated by using manipulation, heat lamps or stimulation. At home, the patient can perform their prescribed exercise program, but it can be problematic to treat decreased local circulation.

**Protocol:** As a response to this problem, Dr Alon has utilised neuromuscular electrical stimulation to increase local circulation to the area of pain in the home environment. By stimulating the area of pain, a demand is created for oxygen, which the muscle responds to over by activating capillaries. This helps to meet the increased demand for oxygen, thereby improving circulation and nutrition to the area. This has the effect, in combination with an exercise and body mechanics program, of decreasing pain while increasing range of motion and function.

The parameters used are as in program 1 on MediStim XP, and intensity is at motor contraction level. Session time should start at 10 minutes initially and gradually be increased to 30 minutes over 2 weeks, adding approximately 5 minutes every second day – see schedule. A second session can be started after 2 weeks, again starting at 10 minutes and working up to 30
minutes, so that by the end of month one, 2 x 30 minute sessions are performed daily. Treatment should continue at this level for the second month.

Program 1 can be combined with program 9 (sweeping TENS) by asking the patients to scroll through the programs using the Program button. By running a 30 minute TENS session after each stimulation session the patient can achieve maximum pain relief. Program 9 can also be utilised to manage pain while the patient carries out their exercise program, thereby maximising the benefit of this key rehabilitation activity.

Patient Schedule:

<table>
<thead>
<tr>
<th>Freq (Hz)</th>
<th>Pulse Width</th>
<th>Ramp Up (secs)</th>
<th>Ramp Down (secs)</th>
<th>Contract Time (secs)</th>
<th>Relax Time (secs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>250</td>
<td>1.5</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Program 1: Start with a 10 minute session, and increase by 5 minutes every second day to reach a 30 minute treatment session. At the start of week 3 add a second session, starting with 10 minutes, increasing by 5 minutes every second day, so that by the end of the month, 2 x 30 minute treatment sessions are completed daily. These 2 sessions should then be continued for a second month. After each session of Program 1 a 30 minute session of Program 9, the TENS pain relief program, can be completed.

<table>
<thead>
<tr>
<th>Week</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>30 + 10</td>
<td>30 + 10</td>
<td>30 + 15</td>
<td>30 + 15</td>
<td>30 + 20</td>
<td>30 + 20</td>
<td>30 + 25</td>
</tr>
<tr>
<td>4</td>
<td>30 + 25</td>
<td>30 + 30</td>
<td>30 + 30</td>
<td>30 + 30</td>
<td>30 + 30</td>
<td>30 + 30</td>
<td>30 + 30</td>
</tr>
</tbody>
</table>

Please Note: First number is for 1st session of the day & second number is for the 2nd session of the day. 30 minutes of Program 9 should be run after each session.

To change program on MediStim XP, simply hold down the ‘P’ button for 2 seconds, until the next program is selected. Repeat until the desired program is reach.

Please note that it is not possible to change program during a treatment session.
Chronic Back Pain Protocol - Research Support:

Cabric M, Appell HJ, Resic A. *Stereological analysis of capillaries in electrostimulated human muscles.*

The effects of two methods of electrical stimulation on the capillary density in skeletal muscle was studied. Twenty-two male physical education students randomly divided into two groups participated in the experiment. Groups I and II were subjected to the procedure of electrical stimulation of m. triceps surae daily for a period of 21 days. Group I was stimulated by an alternating current of relatively low frequency (50 Hz), and group II was stimulated by an alternating current of relatively high frequency (2000 Hz). Biopsy specimens were obtained from the lateral portion of m. gastrocnemius 1 week before the stimulation and 1 day after the completion of the stimulation period. The capillary network was analyzed using morphometric and stereological techniques. Significant changes were found for capillary number in cross section, capillary density, intercapillary distance, tissue cylinder corresponding to one capillary (Krogh's cylinder) in both groups, and for capillary number-to-fiber area ratio in group I. Differences between the results of groups I and II were not significant in any cases. The changes observed speak in favor of an improved capillary supply to skeletal muscle after electrical stimulation.


**Objectives:** A preliminary examination of NMES and combined NMES/TENS for the management of chronic back pain.

**Design:** Double-blind, placebo-controlled, randomized repeated measures.

Subjects and settings: Consecutive sample of 24 chronic back pain patients (16 women and 8 men) attending an outpatient pain clinic (mean age 51.67 years, mean pain duration 3.83 years). All treatments were administered at home.

**Interventions:** Subjects self-administered NMES, combined NMES/TENS, TENS, and placebo treatments. Each treatment had a duration of 5 consecutive hours per day over 2 consecutive days, with a 2-day hiatus between treatments to minimize carryover effects.

**Main outcomes measures:** Pain reduction was assessed through pretreatment to posttreatment differences on the Present Pain Intensity (PPI) scale, and a visual analogue scale of Pain Intensity (VAS-I). Posttreatment pain relief was assessed using a visual analogue scale of Pain Relief (VAS-R). **RESULTS:** Combined treatment, NMES, and TENS each produced significant pretreatment to posttreatment reductions in pain intensity as measured by both the PPI and VAS-I (p < .05). Combined treatment was superior to placebo on pain reduction (p
as well as pain relief (p < .001). Combined treatment was also superior to both TENS and NMES for pain reduction and pain relief (p < .01). NMES and TENS were superior only to placebo for pain relief (p < .001).

**Conclusions:** Combined NMES/TENS treatment consistently produced greater pain reduction and pain relief than placebo, TENS, or NMES. NMES alone, although less effective, did produce as much pain relief as TENS. Although preliminary, this pattern of results suggests that combined NMES/TENS may be a valuable adjunct in the management of chronic back pain. Further research investigating the effectiveness of both NMES and combined NMES/TENS seems warranted.

Miller BF, Gruben KG, Morgan BJ. *Circulatory responses to voluntary and electrically induced muscle contractions in humans.*

**Background and Purpose:** Transcutaneous electrical nerve stimulation (TENS) increases regional blood flow when applied at intensities sufficient to cause skeletal muscle contraction. It is not known whether increases in blood flow elicited by TENS differ from those caused by voluntary muscle contraction. The purpose of this study, therefore, was to compare the hemodynamic effects of these 2 types of muscle contraction.

**Subjects and methods:** Fourteen people with no known pathology, aged 18 to 49 years (mean=28, SD=8), served as subjects. Calf blood flow (venous occlusion plethysmography), heart rate (electrocardiogram), blood pressure (automated sphygmomanometry), and force (footplate transducer) were measured during electrically induced and voluntary contractions.

**RESULTS:** Both modes of exercise caused rapid, but short-lived vasodilation (calf vascular resistance [mean (SEM]): (53%(3% for voluntary contractions versus (57%(4% for electrically induced contractions). The vasodilation caused by electrically induced contractions persisted for at least 15 seconds in the postexercise period, whereas the vasodilation elicited by voluntary contractions had resolved by this time point.

**Conclusion and Discussion:** The hemodynamic changes elicited by voluntary and electrically induced muscle contractions are similar in magnitude but different in duration.
Applications for Neurological Conditions

Depending on the individual patient presentation some or all of the following programs may be useful during rehabilitation:

<table>
<thead>
<tr>
<th>Prog</th>
<th>Benefit</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Strengthening &amp; re-education</td>
<td>Used for foot drop, shoulder subluxation &amp; wrist extensor strengthening</td>
</tr>
<tr>
<td>5</td>
<td>Early muscle activation</td>
<td>Low frequency stimulation for early muscle activation</td>
</tr>
<tr>
<td>8</td>
<td>Strengthening &amp; re-education</td>
<td>Facial palsy – use both channels to target individual muscle groups</td>
</tr>
</tbody>
</table>

MediStim XP for Neurological Rehabilitation

Neurological patients can present with many diverse pathologies. NMES can be used to aid rehabilitation across a range of neurological conditions allowing the individual to achieve a higher level of active daily living and improve their quality of life. The five key benefits NMES achieves are strengthening & re-education, increased ROM, spasm reduction, decreased swelling and improved pain management.

The main conditions to consider when looking at the applications are:
- Stroke/cerebrovascular accident/head injury – foot drop, wrist extensor weakness, shoulder subluxation, quadriceps weakness, facial palsy & spasticity
- Multiple Sclerosis – quadriceps weakness, foot drop, wrist extensor weakness, incontinence & spasticity
- Cerebral Palsy – wrist extensor weakness, spasticity, quadriceps weakness & foot drop

The following programs on the Medistim XP are suitable for assisting in rehabilitation from neurological conditions. All programs are most effective when used in conjunction with physiological movement.

Program 4 - Used for strengthening and re-education. For neurological conditions the parameters on program 4 are set at 35Hz, 250 pulse width, 5 secs contraction & 5 secs relaxation, which should be applied for 2 treatment sessions of 30 minutes per day. If there is no response at 35Hz then program 5 with a frequency of 10Hz can be used to achieve an initial response.

Foot Drop – Place one electrode just under the fibular head next to the tibia. The second electrode should be placed on the bulk of the tibialis anterior. If recruitment is not achieved use the larger rectangular electrode to cover more muscle area. Occasionally, instead of dorsiflexion, neuromuscular electrical stimulation may result in eversion or inversion. In this case, the MediStim XP unit may need to be paused to alter the positioning of the electrodes.
and isolate the correct movement. The pause facility can be activated by pressing the on/off button once.

**Shoulder Subluxation** – Using one channel only, place one electrode on the supraspinatus and another on the posterior deltoid. Increase the intensity to a moderate contraction level to achieve shoulder lift but not shrug. This will help to lift the humerus head back into position, stabilising the glenohumeral joint and facilitating the recovery of the flaccid shoulder musculature. Research on this has involved treatment session times of up to 6 hours a day, but a small study of 3 patients in a stroke unit in St Patrick’s Hospital, Cashel found similar results were achieved by using 2 x 30 minute treatment sessions per day. One of the early responses to the program is a reduction or elimination of shoulder pain, with increased function being the overall goal.

**Wrist Extensor Strengthening** – Place one electrode just under the elbow at the common point of the extensors, and the second centrally just above the wrist. If deviation occurs, it may be necessary to move electrodes until correct functional movement is achieved. Where flexor spasticity exists, increasing strength of extensors can reduce spasticity, thereby improving function, leading to greater independence and quality of life.

**Program 8** – Used for strengthening & re-education of facial muscles. Both channels can be utilised to target two sets of muscles for each treatment where required. This program uses a mild contraction, with a frequency of 8 Hz, and treatment session times of up to 2 hours per day.
Shoulder Rehabilitation Guidelines

Depending on the individual patient presentation, some or all of the following programs may be useful during rehabilitation (set out in normal order of use):

<table>
<thead>
<tr>
<th>Prog</th>
<th>Benefit</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Spasm Detone</td>
<td>Upper trapezius</td>
</tr>
<tr>
<td>6</td>
<td>Dual Channel - Strengthening &amp; Detone</td>
<td>Ch.1 on lower trapezius for activation, re-education and strengthening Ch. 2 on upper trapezius for detoning Channels working alternatively allowing for active exercise to be carried out in conjunction with program</td>
</tr>
<tr>
<td>1</td>
<td>Strengthening &amp; Re-education</td>
<td>Lower trapezius activation for re-education &amp; strengthening allowing active abduction to increase ROM and speed up rehabilitation. Deltoid strengthening for muscle activation, strengthening &amp; rehabilitation.</td>
</tr>
<tr>
<td>9</td>
<td>Acute Pain Relief</td>
<td>Sweeping TENS, effective for pain relief to aid increased function &amp; ROM – use in conjunction with exercise program to maximize functional ability in ranges that are not contra-indicated</td>
</tr>
</tbody>
</table>

Shoulder Impingement:
There are a number of areas in which MediStim XP can assist the recovery process of shoulder impingement. A specific application is in the re-education of the movement of the lower trapezius, as facilitating appropriate activation of this muscle can be quite difficult. Part of the lower trapezius activation process involves dealing with the muscle inhibition which usually arises for two reasons: firstly, due to reflex pain inhibition from the impinged shoulder itself and secondly, due to spasm in the upper trapezius. There are ways of addressing both of these areas with the MediStim XP.

A good solution is to combine pain-relief and/or spasm-reduction with activation of lower trapezius. Where pain is present program 9 in conjunction with active exercise is recommended. In general program 6 is suggested. The recommended pad placement consists of channel 1 on the lower trapezius and channel 2 over the upper trapezius. The lower traps are likely to be weak and inhibited, and therefore the 50Hz frequency will work to re-educate and strengthen the muscle.

There are two primary areas to be aware of: Firstly, it is important to achieve depression and retraction, rather than just retraction. Excessive retraction or elevation would suggest that the
pads need to be placed lower or closer to the medial border of the scapula. Secondly, the lower traps activation is to be at a mild motor contraction. This is a little different to the maximal motor contraction that is normally used. The reason is that while lower trapezius activation in isolation is useful, it may be desired to combine this with several physiological movements, e.g. abduction. The scapular should start to rotate outwards at about 15 - 30 degrees of abduction but excessively strong lower traps contraction may inhibit this. Our suggested solution is to use a mild motor contraction with parameters of 5 seconds on/5 seconds off. This allows the patient time to incorporate any physiological movements that are required. This should probably be adopted for 15-20 minutes, 2 times daily, for 2 weeks and then reviewed.

This protocol is particularly good with those sub-acute to chronic shoulder impingement patients (greater than 6 weeks) where poor motor patterning has become more ingrained and does not seem to be responding to home exercise and/or taping.

If instead, it is felt clinically that the primary problem with impingement is that suprapsinatus impingement is inhibiting humeral head reduction in the first 0 - 15 degrees of shoulder movement, a good option is to use a similar program to that for shoulder subluxation, as set out in the Neurological Applications section. This involves using a single channel with electrodes over the supraspinatus and posterior deltoid, and can also be combined with physiological movements, as is deemed appropriate.
Wrist and Hand Rehabilitation Guidelines

Finger, hand and wrist issues can arise from trauma (fractures to bone or tendon damage from falls or accidents), nerve injuries and palsies (compression or overuse), crush injuries, plastic surgery complications and degenerative conditions such as arthritis. In general, patients may present with multiple problems, all of which can be treated with neuromuscular electrical stimulation or TENS.

Some of the main applications will include targeting wrist and finger extensors (which can be isolated per digit), wrist and finger flexors, thumb extension, thumb opposition, lumbrical grip and power grasp.

Programs 1 to 4 are utilised for general strengthening to aid rehabilitation and function across a number of condition:

**Ulnar or Radial Nerve Palsy** – in the early stages where re-education and initiation of the muscle is required, NMES should be utilised to contract the muscle and send a healthy signal into the area where the nerve is regenerating. Once activity is achieved patients can work with NMES for specific applications to aid rehabilitation.

**Tendon Repair** - occurs if through trauma or accident the tendon snaps and needs to be surgically reattached. Neuromuscular electrical stimulation treatment should commence after 4 - 6 weeks to encourage tendon gliding, which is achieved by producing a soft contraction. It is advisable to start a full strengthening program after 8 weeks.

**Stimulation of the intrinsics of the hand** can be achieved by using 25mm or 50mm electrodes. This may be suitable for a patient with ulnar, medial nerve palsy or where interrossi wastage between the bones on the back of the hand is an issue.

**Tenolysis** – occurs where the tendon does not glide as it should due to scar adhesions. Surgery is necessary to remove the scar tissue and thereby allow the healthy tendon to glide. The surgeon gets full motion on the table and this can be maintained by using a full contraction at strengthening parameters.

**Program 7 for Oedema Management** – Use where swelling exists at the wrist, and recruitment of the extensors and flexors is desirable to maximise muscle pumping to decrease oedema and increase range of motion. NMES is a very effective muscle pump. If patients have stubborn oedema at the wrist, place electrodes over the wrist for wrist extension; if the oedema is in the
hand (oedematous hand), place electrodes on the dorsal and palm side of the hand.

**Program 8** for initial muscle activation where low frequency is required.

**Program 9 for Pain Management** - Place electrodes over the affected area and use sweeping TENS for acute pain management.

**Motor Point Search** - Program 8 can be utilised where there is difficulty achieving wrist extension or finger flexion, or in isolating the intrinsic muscles of the hand. One 50mm adhesive and one 25mm carbon rubber electrode should be used. The adhesive electrode is placed on the muscle belly and gel is used to move around the carbon rubber electrode until the required movement is achieved. The motor point search will allow the optimum pad placement to be located for the patient if required.

If you have any questions on **MediStim XP** or any other devices in the Neurotech range please feel free to call or email us at:

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**Web www.neurotechgroup.com**