I. Treatment of pain

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Evaluation of analgesic effectiveness of infrared radiation and interference currents in degenerative diseases (IF)

Interferential therapy produces antinociception during application in various models of inflammatory pain (IF)

Short-term effects of interferential current electro-massage in adults with chronic non-specific low back pain: a randomized controlled trial (IF)

Alternating frequencies of transcutaneous electric nerve stimulation: Does it produce greater analgesic effect on mechanical and thermal pain thresholds (TENS)

Effectiveness of transcutaneous electrical nerve stimulation for treatment of hyperalgesia and pain (TENS)

Effects of burst-type transcutaneous electrical nerve stimulation on cervical range of motion and latent myofascial trigger point pain sensitivity (TENS)

Efficacy of the use of two simultaneously tens devices for fibromyalgia pain (TENS)

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Transcutaneous electrical nerve stimulation: nonparallel antinociceptive effects on chronic clinical pain and acute experimental pain (TENS)

Using tens for pain control: The state of the evidence - review (TENS)

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1. TREATMENT OF PAIN

EFFECTIVENESS OF INTERFERENCE CURRENT THERAPY IN THE MANAGEMENT OF MUSCULOSKELETAL PAIN: A SYSTEMATIC REVIEW AND META-ANALYSIS

Authors: Jorge P. Fuentes, Susan Armijo Olivo, David J. Magee, Douglas P. Gross
Affiliations: Faculty of Rehabilitation Medicine, University of Alberta, Canada
Source: Physical Therapy. 2010; 90: 1219 - 1241

ABSTRACT:

Introduction:
Interferential current (IFC) is a common electrotherapeutic modality used to treat pain. The aim of this systematic review was to analyze the available information regarding the efficacy of IFC in the management of musculoskeletal pain.

Materials and Methods:
Seven articles assessed the use of IFC on joint pain; 9 articles evaluated the use of IFC on muscle pain; 3 articles evaluated its use on soft tissue shoulder pain; and 1 article examined its use on postoperative pain.

Clinical trials:
1) Three studies were included in this comparison. Two studies used a 4-week discharge period, and one study used a one-day discharge period. One trial studied the effect of IFC on knee osteoarthritis, another trial studied the effect of IFC on frozen shoulder, and the third trial studied the effect of IFC on acute low back pain. In this comparison, the 3 studies tended to significantly favor IFC applied as a cointervention when compared with the control group. The pooled mean difference (MD) obtained for this analysis was 2.45 - 95% confidence interval (CI) = 1.69, 3.22. Thus, IFC applied as a cointervention was more than 2 points better, as measured with the VAS, in reducing pain intensity when compared with a control group in these conditions.

2) Five studies were included and 3 of them tended to significantly favor IFC as a cointervention when compared with placebo. The pooled MD obtained for this analysis was 1.60 (95% CI = 0.13, 3.34). This finding indicates that although IFC as a cointervention was statistically significantly better than a placebo at decreasing pain intensity at discharge in conditions such as osteoarthritis, chronic low back pain, and fibromyalgia, IFC tended to reduce pain in these conditions when compared with a placebo condition. In addition, the heterogeneity among studies was 96%, which is considered substantial. The pooled MD obtained for this analysis was 1.85 (95% CI = 1.47, 2.23). The findings at 2 studies in 3-month follow up data indicates that IFC as a cointervention was better than a placebo at decreasing pain intensity at this follow up.

EVALUATION OF ANALGESIC EFFECTIVENESS OF INFRARED RADIATION AND INTERFERENCE CURRENTS IN DEGENERATIVE DISEASES

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Affiliations: Gdansk University of Physical Education and Sport in Gdansk, Clinic of Rehabilitation of St. Adalbert Specialist Hospital, Gdansk, Poland

ABSTRACT:

Background:
The aim of this research is to evaluate analgesic effectiveness of infrared radiation and interference currents in degenerative diseases of joints. On the grounds of current practical and theoretical experience, the following hypothesis was formed: Application of interference currents and infrared radiation constitutes effective analgesic therapy in degenerative diseases, and in the case of the applied treatment, its effectiveness is long-term.

Materials and Methods:
Tests were conducted on a group consisting of 32 women and men in the age range of 65-87 years of age suffering from a degenerative disease of the knee joint. The patients were applied a series of 10 treatments with application of the Sollux lamp for 15 minutes and interference currents of 50-100 Hz frequency for 5 minutes and 90-100 Hz for 10 minutes during treatment. Evaluation of the efficiency of therapy was checked by means of the VAS scale and the Laitinen scale.

Conclusions:
Application of infrared radiation and interference currents indicates an analgesic effect. These treatments may be alternative or supportive to pharmacological treatment in the case of degenerative changes in people who are over 65 years of age. Results of the research suggest continuation of further research on the effectiveness of the above-mentioned therapy and the length of preserving analgesic results in people with degenerative diseases of joints.
INTERFERENTIAL THERAPY PRODUCES ANTINOCICEPTION DURING APPLICATION IN VARIOUS MODELS OF INFLAMMATORY PAIN

Authors: Sérgio Jorge, Carlos A. Parada, Sérgio H. Ferreira, Cláudia H. Tambeli
Affiliation: University of Campinas, University of São Paulo, São Paulo, Brazil
Source: Physical Therapy. 2006; 86 (6): 800 - 808

ABSTRACT:

Background and Purpose:
Although interferential therapy is used widely in the management of many painful conditions, the effectiveness and the mechanism of action of IFT in animal models of inflammatory pain have not been evaluated. The aim of this study was to evaluate the effectiveness of IFT in reducing inflammatory pain and edema in rats.

Materials and Methods:
Wistar rats (69) were used in the study. The effect of IFT application (4000 Hz carrier frequency, 140 Hz amplitude – modulated beat frequency, pulse duration 12 ms, current intensity 5 mA for 1 hour on the formalin – induced nociceptive response and edema and on carrageenan – induced mechanical hyperalgesia and edema was evaluated.

Results:
IFT significantly reduced the formalin – evoked nociceptive response when applied to the paw immediately after, but not before the formalin injection. Interferential therapy application at 2 hours after the carrageenan – induced mechanical hyperalgesia and edema was evaluated.

Discussion and Conclusion:
The results suggest that, despite its short – duration effect, IFT is effective in reducing inflammatory pain and should be considered primarily for use in the control of acute inflammatory pain.

SHORT – TERM EFFECTS OF INTERFERENTIAL CURRENT ELECTRO – MASSAGE IN ADULTS WITH CHRONIC NON – SPECIFIC LOW BACK PAIN: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT:

Objectives:
To analyse the effectiveness of a combined procedure of massage and electrotherapy with interferential current in individuals with chronic non-specific low back pain of mechanical aetiology.

Participants:
62 individuals with chronic non-specific low back pain were randomly assigned to an experimental or control group. For 10 weeks the experimental group underwent treatment comprising 20 sessions (twice a week) of massage with interferential (4000 Hz, amplitude modulation 80 Hz, intensity 30 – 50 mA, 30 min) current in the lumbar and dorsal–lumbar area, and the control group received superficial lower back massage (effleurage, superficial pressure and skin rolling).

Main outcome variables:
Oswestry Disability Index, pain visual analogue scale, Tampa Scale for Kinesiophobia, Roland Morris Disability Questionnaire, McQuade Test, Side Bridge Test, quality of life scores and the range of trunk anteflexion motion, which were all assessed before the treatment and immediately after the last treatment session.

Results:
In paired comparison to baseline values, the electro – massage group showed post – treatment improvements in almost all teste mentioned above, only physical function (P = 0.044) and range of trunk anteflexion motion (P = 0.048) showed significant differences in physical function.

Results:
The treatment group compared by pre/ post ultrasound interaction was significant (P < 0.05).
Results are summarized and presented in Table.

Conclusion:
The individuals with chronic non-specific low back pain, interferential current electro-massage achieved a significantly greater improvement in disability, pain and quality of life in comparison to superficial massage after 20 treatment sessions.
ALTERNATING FREQUENCIES OF TRANSCUTANEOUS ELECTRIC NERVE STIMULATION: DOES IT PRODUCE GREATER ANALGESIC EFFECT ON MECHANICAL AND THERMAL PAIN THRESHOLDS

Authors: K. C. Tong, MSc, Sing Kai Lo, PhD, Gladys L. Cheing, PhD
Affiliations: The American Congress of Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation

ABSTRACT:

Objective: The aim of this study was to determine whether alternating frequency transcutaneous electric nerve stimulation (TENS) at 2 and 100 Hz has a more potent hypoalgesic effect than a fixed frequency at 2 or 100 Hz in healthy participants (64 healthy volunteers).

Interventions: 32 healthy men and 32 healthy women were divided into 4 groups. Group 1 delivered 2 Hz TENS current, Group 2 delivered 100 Hz, Group 3 alternating frequency 2/100 Hz and Group 4 was a control group and had no treatment. Electric stimulation was applied over the anterior aspect of the dominant forearm for 30 min. Mechanical and heat pain thresholds were recorded before, during and after TENS stimulation.

Results: During and shortly after electric stimulation, heat pain threshold (HPT) increased significantly in the alternating frequency stimulation group (p = 0.024). Mechanical pain threshold (MPT) increased significantly in both – the 100 Hz (p = 0.08) and alternating frequency (p = 0.012) groups, but the increase was substantially larger in the 100 Hz group.

Conclusion: Alternating frequency stimulation produced a greater elevation in the HPT, but a greater increase in the MPT was achieved using 100 Hz stimulation. Our findings suggest that the alternating frequency stimulation significantly elevated the HPT that is mediated predominantly by C fibers. This implies that alternating frequency stimulation may work better than single frequency stimulation on chronic pain. In the group receiving 100Hz, however, the MPT – which is mediated predominantly by A delta fibers – was significantly elevated. This implies that 100 Hz stimulation may work better than other types of stimulation on acute pain.

Fig 1. Placement of TENS electrodes recording sites for the MPT and HPT.

EFFECTIVENESS OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION FOR TREATMENT OF HYPERALGESIA AND PAIN

Authors: Josimari M. DeSantana, PT, PhD, Deirdre M. Walsh, PT, PhD, Carol Vance, PT, MSc, Barbara A. Rakel, RN, PhD, and Kathleen A. Sluka, PT, PhD
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ABSTRACT:

Objective and background: This review updates the basic and clinical science regarding the use of TENS that has been published in the past 3 years (ie. 2005–2008). Basic science studies using animal models of inflammation show changes in the peripheral nervous system, as well as in the spinal cord and descending inhibitory pathways, in response to TENS. Translational studies show mechanisms to prevent analgesic tolerance to repeated application of TENS. This review also highlights data from recent randomized, placebo-controlled trials and current systematic reviews. Clinical trials suggest that adequate dosing, particularly intensity, is critical to obtaining pain relief with TENS.

Findings: TENS was reported to have hypoalgesic effects in two reports of “out of hospital rescue” by emergency responders. Mora et al. compared the effects of high-frequency, low-intensity TENS (100 Hz, 200 μs, 2 mA, for 30 min) with sham TENS in patients requiring medical transport determined to have acute renal colic as identified by paramedic evaluation. The active TENS group demonstrated a significant reduction in pain, anxiety, and nausea scores, as well as a lower heart rate response. No significant effects were noted with sham TENS. Five human studies have been recently published on the effect of TENS on upper limb pressure, heat, and ischemic experimental pain models.

Conclusion: Basic scientific evidence suggests that there are peripheral and central nervous system mechanisms underlying the analgesic action of TENS. Studies also show that tolerance to repeated application of TENS can be prevented by multiple strategies, both pharmacologic and nonpharmacologic. Experimental pain studies and clinical trials are beginning to refine parameters of stimulation to obtain the best pain relief. It seems that stimulation intensity is a critical factor for the effectiveness of TENS. One meta-analysis was able to show the positive treatment effects of electrical stimulation for relief of chronic musculoskeletal pain, and randomized controlled trials consistently demonstrate the effectiveness of TENS for acute, emergent, and postoperative pain conditions.
EFFECTS OF BURST-TYPE TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION ON CERVICAL RANGE OF MOTION AND LATENT MYOFASCIAL TRIGGER POINT PAIN SENSITIVITY

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Affiliations: Department of Physical Therapy, Faculty of Medicine, CEU – San Pablo University; Department of Physical Therapy, Occupational Therapy, Rehabilitation and Physical Medicine, Universidad Rey Juan Carlos, Madrid, Spain

ABSTRACT:

Objective:
To assess the effects of a burst application of transcutaneous electrical nerve stimulation (tENS) on cervical range of motion and pressure point sensitivity of latent myofascial trigger points (MTrPs).

Subject and Methods:
Participants were 45 men and 31 women with latent MTrPs in one upper trapezius muscle. Subjects were randomly divided into two groups: a tENS group that received a burst-type tENS (BTL 5000 device - 200 μs; f100 Hz, burst frequency 2 Hz) stimulation over the upper trapezius for 10 min and a placebo group that received a sham-tENS application over the upper trapezius also for 10 min. Referred pressure pain threshold (RPPT) over the MTrP and cervical range of motion in rotation were assessed before and 1 and 5 min after the intervention by assessor blinded to subjects’ treatment.

Results:
The analysis of covariance revealed a significant group vs. time interaction (p < 0.001) for RPPT: the tENS group exhibited a greater increase compared with the control group; however, between-group differences were small at 1 minute (0.3 kg/cm²; 95% confidence interval [CI], 0.1 ± 0.4) and at 5 minutes (0.6 kg/cm²; 95% CI, 0.3 ± 0.8) after treatment. A significant group vs. time interaction (p = 0.01) was also found for cervical rotation in favor of the TENS group. Between-group differences were also small at 1 minute (95% CI, 1.0 ± 2.8) and at 5 minutes (95% CI, 1.7 ± 3.8) after treatment.

Conclusion:
The results of the current study suggest that a single application of a burst-type TENS had an immediate mild hypoalgesic effect for mechanical stimuli by increasing the RPPT over latent MTrPs in the upper trapezius muscle. We also found that a burst-type TENS increases cervical rotation ipsilateral to the side of the MTrP. The changes observed were small, particularly for cervical range of motion (0.3±0.5kg/cm² for RPPT; 2.2° ± 2.9° for ipsilateral rotation), which may indicate limited clinical relevance.

EFFICACY OF THE USE OF TWO SIMULTANEOUSLY TENS DEVICES FOR FIBROMYALGIA PAIN

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Affiliations: University of São Paulo, São Paulo, Brazil
Source: Rheumatol. Int. 2013; 33:2117 – 2122

ABSTRACT:

Objective:
The purpose of the study was to evaluate the effectiveness and safety of the use of two simultaneously new TENS devices for fibromyalgia pain.

Methods:
39 patients were prospectively divided into three groups to evaluate TENS device, applied simultaneously in each patient: Group 1 - at the lower back (perpendicular to the vertebrae canal, at the level of the 5th lumbar vertebrae) and Group 2 - centrally above and below the space between the C7 and T1 spinous processes. The devices were applied for 20 min at 12-hour interval during 7 consecutive days. For the Placebo group (PG), the devices did not transmitted electrical stimulus. The single-TENS group (STG) (n = 13) had one active and one placebo TENS. The double-TENS group (DTG) applied both active TENS devices at the low back and cervical areas. Diclofenac was used as rescue analgesic. The efficacy measures were pain relief, reduction in use of daily analgesic tablets, quality of sleep and fatigue.

Results:
The evaluation within groups revealed that patients from PG refereed no pain relief when compared to their previous daily VAS pain score (8 cm, p > 0.05), while patients from the STG refereed and improvement of 2.5 cm in the pain VAS after the third day of TENS use (previous 8.5 cm compared to 6 cm after treatment) (p < 0.05), and the DTG refereed daily maintained mean reduction of 4 cm in the VAS pain after the third study day (previous 8.5 – 4.3 cm) (p < 0.002). Concurrent daily consumption of analgesic tablets was reduced in both STG (p < 0.005) and DTG (p < 0.02). Comparison among groups revealed that analgesia, as well as quality of sleep and disposition, was DTG > STG > PG (p < 0.05).

Conclusion:
Participants subjectively found the active device useful. While the application of a single active TENS improved pain relief in fibromyalgia pain, pain and fatigue were further improved when two active devices were simultaneously applied at the low back and cervical area, with no side effects.
TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION FOR PHANTOM PAIN AND STUMP IN ADULT AMPUTEES

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Affiliations: Faculty of Health and Social Sciences, Leeds Metropolitan University, Leeds, UK; Leeds Pallium Research Group, Leeds Teaching Hospitals NHS Trust

ABSTRACT:

Objective and background:
Following amputation, 50% to 90% of individuals experience phantom and/or stump pain. Transcutaneous electrical nerve stimulation (TENS) may prove to be a useful adjunct analgesic intervention, although a recent systematic review was unable to judge effectiveness owing to lack of quality evidence. The aim of this pilot study was to gather data on the effect of TENS on phantom pain and stump pain at rest and on movement.

Materials and Methods:
Ten individuals with a transtibial amputation and persistent moderate-to-severe phantom and/or stump pain were recruited. Inclusion criteria was a baseline pain score of ≥3 using 0 to 10 numerical rating scale (NRS). TENS was applied for 60 minutes to generate a strong but comfortable TENS sensation at the site of stump pain or projected into the site of phantom pain.

Results:
Outcomes at rest and on movement before and during TENS at 30 minutes and 60 minutes were changes in the intensities of pain, nonpainful phantom sensation, and prosthesis embodiment. Mean (SD) pain intensity scores were reduced by 1.8 (1.6) at rest (p < 0.05) and 3.9 (1.9) on movement (p < 0.05) after 60 minutes of TENS. For five participants, it was possible to project TENS sensation into the phantom limb by placing the electrodes over transected afferent nerves. Nonpainful phantom sensations and prosthesis embodiment remained unchanged.

Conclusion:
This study has demonstrated that TENS has potential for reducing phantom pain and stump pain at rest and on movement. Projecting TENS sensation into the phantom limb might facilitate perceptual embodiment of prosthetic limbs. The findings support the delivery of a feasibility trial.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION: NONPARALLEL ANTINOCICEPTIVE EFFECTS ON CHRONIC CLINICAL PAIN AND ACUTE EXPERIMENTAL PAIN

Authors: Gladys L. Y. Cheing, MSc, Christina W. Y. Hui – Chan, PhD
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ABSTRACT:

Objective:
To investigate to what extent a single 60 – minute session of transcutaneous electrical nerve stimulation (TENS) would modify chronic clinical pain, acute experimental pain and the flexion reflex evoked in chronic low back pain patients.

Study design:
Thirty young subjects with chronic low back pain were randomly allocated to two groups, receiving either TENS or placebo stimulation to the lumbosacral region for 60 minutes. The flexion reflex was elicited by an electrical stimulation applied to the subject’s right sole and recorded electromyographically from the biceps femoris and the tibialis anterior muscles.

Main Outcome Measures:
Subjective sensation of low back pain and the electrically induced pain were measured by two separate visual analogue scales, termed VASLBP and VASFR respectively. The intensity of TENS was adjusted to produce a tingling sensation that was approximately 2 to 3 times the sensory threshold. Placebo stimulation was delivered in the same way using units that were identical to the TENS units, except that the internal circuit had been disconnected. All patients were told that they might or might not feel the stimulation that lasted for 60min. Data were analysed using repeated measures ANOVA.

Results:
The VASLBP score was significantly reduced to 63.1% of the prestimulation value after TENS (p < 0.001), but the reduction was negligible after placebo stimulation (to 96.7%, p = 0.786). In contrast, no significant change was found in the VASFR score (p = 0.666) and the flexion reflex area (p = 0.062) during and after stimulation within each group and between the two groups (p = 0.133 for VASFR and p = 0.215 for flexion reflex area).

Conclusion:
This study is the first to demonstrate that TENS but not placebo stimulation significantly reduced chronic clinical pain (LBP) both during treatment and up to 1 hour after treatment was stopped. However, TENS or placebo stimulation did not produce any significant changes in acute experimental pain (electrically induced pain) or the FR in chronic LBP patients. Hence, we speculate that TENS may produce antinociceptive effects on chronic clinical and acute experimental pain to a different extent among these patients.
USING TENS FOR PAIN CONTROL: THE STATE OF THE EVIDENCE – REVIEW

Authors: Carol G. T. Vance, Dana L. Dailey, Barbara A. Rakel, Kathleen A. Sluka
Affiliations: The University of Iowa Physical Therapy; The University of Iowa College of Nursing, IA, USA

ABSTRACT:

Transcutaneous electrical nerve stimulation (TENS) is a nonpharmacological intervention that activates a complex neuronal network to reduce pain by activating descending inhibitory systems in the central nervous system to reduce hyperalgesia. The purpose of this article is to provide a critical review of the latest basic science and clinical evidence for TENS. The factors affecting TENS efficacy include the population and the outcome assessed, timing of the outcome measures, negative interaction of opioid use and the parameters of the TENS dose. Three important factors for TENS efficacy are tolerance to repeated TENS, intensity of the stimulation and electrode placement. A recent article by Sluka et al. provided an extensive review of variables that can affect the clinical use of TENS. The intensity of stimulation utilized is critical with TENS application. Using the strongest intensity that remains comfortable produces hypoalgesia in healthy subjects; lower intensities are ineffective. In addition to activation of greater numbers of sensory afferents, higher pulse amplitudes are proposed to activate deeper tissue afferents allowing for greater analgesia. Additional TENS reports are favorable for relief of chronic pelvic pain syndrome and pain associated with latent upper trapezius trigger points. Overall, the evidence suggests, TENS may be useful for a variety of pain conditions.

Summary and Conclusion:

Both HF and LF TENS been shown to provide analgesia specifically when applied at a strong, nonpainful intensity and HF TENS may be more effective for people taking opioids. Effective analgesia for chronic pain conditions may be limited by the development of tolerance to TENS if repeated application of either HF or LF TENS at the same frequency, intensity and pulse duration is used daily.

EFFECTIVENESS OF DIADYNAMIC CURRENT AND MENS IN HEEL PAIN: A RANDOMIZED CLINICAL TRIAL

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ABSTRACT:

Introduction:

Various studies have shown that Diadynamic current (DD) and microcurrent electrical nerve stimulation (MENS) along with conventional treatments give significant beneficial effects in pain relieving. Hence the present study was undertaken to compare and see the effect of DD current and MENS in heel pain.

Purpose:

Subjects were randomly allocated into 2 groups namely Group A (n=15) who received DD along with conventional treatment as Therapeutic ultrasound and strengthening and stretching exercises. DD current was used with increase in intensity gradually until definite vibration or pricking sensation occurs, duration was not more than 12 minutes. Group B (n=15) who received 1 μA MENS for 15 min for 7 sessions with conventional treatment same as in group A for 7 days. The outcome measures were Visual Analog Scale (VAS) for pain, Pain disability index (PDI) and foot disability index (FDI) for functional disability.

Results:

Mean difference of VAS scores for Group A was 6.9 ± 1.48 and for Group B was 4.3 ± 2.43. Mean differences of PDI scores for Group A was 274 ± 117 and for Group B was 171 ± 99. Mean difference of FDI scores for Group A was 0.36 ± 0.24 and for Group B was 0.15 ± 0.15. Intra group comparison was statistically significant with p = <0.001 for both the groups in terms of VAS, PDI and FDI respectively. Inter group comparison was statistically significant with p = 0.005, 0.031, 0.007 for VAS, PDI and FDI respectively.

Conclusion:

Diadynamic current is effective in reducing pain and secondarily improving the functional ability in subjects with heel pain.
ACUPUNCTURE: NEUROPEPTIDE RELEASE PRODUCED BY ELECTRICAL STIMULATION OF DIFFERENT FREQUENCIES

Author: Ji-Sheng Han
Affiliations: Neuroscience Research Institute, Peking University, Beijing, China

ABSTRACT:

Background and Objective:

Brain functions are regulated by chemical messengers that include neurotransmitters and neuropeptides. Recent studies have shown that acupuncture or electrical stimulation in specific frequencies applied to certain body sites can facilitate the release of specific neuropeptides in the CNS, eliciting profound physiological effects and even activating self-healing mechanisms. Investigation of the conditions controlling this neurobiological reaction could have theoretical and clinical implications.

Clinical cases:

If the point of stimulation is selected according to traditional acupuncture therapy, the process is usually called electroacupuncture (EA). There was a series of studies performed to determine whether peripheral electrical stimulation of the alternating-frequency mode would produce a significantly stronger analgesic effect than that produced by stimulation of fixed frequency in various clinical settings. Observations on the post-operative requirement of opioid analgesics revealed that the alternating mode stimulation reduced morphine requirement by 53%, whereas a constant low (2 Hz) or constant high (100 Hz) frequency produced only a 32 or 35% decrease, respectively. Ghoname et al. made similar observations in patients with chronic lower-back pain and found that the alternating mode of stimulation was the most effective in decreasing pain, increasing physical activity and improving the quality of sleep. Next examples: results obtained in EA-induced analgesia have been applied to the treatment of heroin addiction with considerable success. The withdrawal syndrome observed in rats dependent on morphine can be effectively suppressed by 100 Hz EA, which accelerates the release of dynorphin in the spinal cord.

Concluding remarks:

Evidence presented in these reviews demonstrates that it is possible to facilitate the release of certain neuropeptides in the CNS by means of peripheral electrical stimulation. Peripheral stimulation of the skin or deeper structures activates various brain structures and/or the spinal cord via specific neural pathways.

HIGH VOLTAGE PULSED GALVANIC STIMULATION ADJUNCT TO REHABILITATION PROGRAM FOR PATELLOFEMORAL PAIN SYNDROME: A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

Authors: Defne Kaya, İnci Yüksel, Michael James Callaghan, Hande Güney, Özgür Ahmet Atay, Seyit Çilaker, Gazi Huri, Onur Bilge, Mahmut Nedim Doral
Affiliations: Hacettepe University, Faculty of Medicine, Faculty of Health Sciences; Gazi University, Turkey; University of Manchester, Centre for Rehabilitation Sciences, Great Britain

ABSTRACT:

Purpose:

The aim of this study was to investigate the effectiveness of High Voltage Pulsed Galvanic Stimulation (HVPGS) in conjunction with patellar taping on pain and functional levels of patients with Patellofemoral Pain Syndrome (PFPS).

Methods:

This study was designed as a prospective randomized controlled study. Forty-five female patients with unilateral symptomatic PFPS were randomly allocated into three groups. All patients were treated with a standard rehabilitation program. In addition, Group 1 received HVPGS in conjunction with patellar taping, Group 2 received HVPGS, and Group 3 received patellar taping. All treatments were applied for six weeks. A portable galvanic stimulator with monophasic (twin-peak pulse) waveform and pulse duration of 65-75 μs was used in this study. The intensity amplitude of the HVPGS ranges from 0 to 300 V. Pain levels during step-up and step-down activities were measured. Lower Extremity Functional Scale (LEFS) was utilized to determine functional level. All tests were done before and after the treatment.

Results:

There were differences in pain levels during step-down (p = 0.01) and during step-up (p = 0.02) between Group 1 and 3 and during the step-up activities (p = 0.02) between Group 2 and 3 after the treatment. There were no significant differences in functional level between the groups after the treatment (p > 0.05). The groups that included HVPGS (Group 1 and 2) had better pain scores during step-up and down activities as compared to Group 3.

Conclusion:

Additional HVPGS application in PFPS rehabilitation may decrease in pain levels during activities including step up and down while functional status remains the same.

<table>
<thead>
<tr>
<th>Group 1 (N=15)</th>
<th>Group 2 (N=15)</th>
<th>Group 3 (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-treatment</strong></td>
<td><strong>Post-treatment</strong></td>
<td><strong>Pre-treatment</strong></td>
</tr>
<tr>
<td>Pain (VAS, mm)</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Step-down</td>
<td>60.66 ± 10.00</td>
<td>37.12 ± 17.18</td>
</tr>
<tr>
<td>Step-up</td>
<td>68.53 ± 10.87</td>
<td>34.93 ± 18.69</td>
</tr>
<tr>
<td>Squat</td>
<td>89.40 ± 19.27</td>
<td>20.21 ± 12.54</td>
</tr>
<tr>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
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<tr>
<td><strong>Step-down</strong></td>
<td><strong>Step-up</strong></td>
<td><strong>Squat</strong></td>
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<tr>
<td><strong>Pre-treatment</strong></td>
<td><strong>Post-treatment</strong></td>
<td><strong>Pre-treatment</strong></td>
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<tr>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
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<tr>
<td><strong>Pre-treatment</strong></td>
<td><strong>Post-treatment</strong></td>
<td><strong>Pre-treatment</strong></td>
</tr>
<tr>
<td><strong>Mean ± SD</strong></td>
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<td><strong>Mean ± SD</strong></td>
</tr>
<tr>
<td><strong>Pain (VAS, mm)</strong></td>
<td><strong>Step-down</strong></td>
<td><strong>Step-up</strong></td>
</tr>
<tr>
<td><strong>Step-down</strong></td>
<td><strong>Step-up</strong></td>
<td><strong>Squat</strong></td>
</tr>
<tr>
<td><strong>Pre-treatment</strong></td>
<td><strong>Post-treatment</strong></td>
<td><strong>Pre-treatment</strong></td>
</tr>
<tr>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
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<tr>
<td><strong>LEFS</strong></td>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
</tr>
<tr>
<td><strong>Step-down</strong></td>
<td><strong>Step-up</strong></td>
<td><strong>Squat</strong></td>
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<td><strong>Step-down</strong></td>
<td><strong>Step-up</strong></td>
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<tr>
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<td><strong>Step-up</strong></td>
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<tr>
<td><strong>Mean ± SD</strong></td>
<td><strong>Mean ± SD</strong></td>
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THE EFFICACY OF THERAPEUTIC FARADIC STIMULATION IN PATIENTS WITH MYOFASCIAL PAIN SYNDROME OF THE TRAPEZIUS AND LEVATOR SCAPULA MUSCLES

Authors: Hayley Anne Bedell - Sivright
Affiliations: Mini - dissertation in partial in partial compliance with the requirements for the Master’s Degree in Technology: Chiropractic, Department in Chiropractic, Durban Institute of Technology

ABSTRACT:
Background and Aim:
Faradic current is a short duration interrupted direct current with pulse duration of 0.1-1ms and a frequency of 50-100 Hz. The purpose of this study was to determine the efficacy of Therapeutic Faradic Stimulation in patients with Myofascial Pain Syndrome of the Trapezius and Levator Scapulae muscles.

Materials and Methods:
One group received Faradic Stimulation in the form of the faradic, another group received placebo and the third group received Pulsed Ultrasound. Each patient received 2 research treatments with a maximum of 72 hours between treatment 1 and 2, and the third free Chiropractic treatment being a week later. Data (both subjective and objective) were obtained from the patients at the first and second consultations, prior to treatments and at the third follow up before treatment. Subjective data were obtained with the Short form McGill pain questionnaire, the numerical pain rating Scale and the CMCC Neck Disability index. Objective data were obtained from the Pressure Algometer and the CROM Cervical Range of Motion instrument.

Conclusion:
This study consisted of 60 patients, divided into 3 groups of 20 each. The evaluation of these recordings showed Group A (faradic current group) showed improvement in the patient’s ability to manage everyday life and showed a greater reduction in the quality and intensity of pain between all three visits than the placebo group or pulsed Ultrasound group. Group A had a decreased pain intensity of the active Trapezius and Levator Scapula trigger points diagnosed. Faradic group improves consistently and significantly for all readings when comparing the extension and right lateral flexion ROM readings between groups. Thus it would seem that the Faradic current achieved greater clinical efficacy than the Placebo group or the Pulsed Ultrasound group.

Demonstration of patient/ therapist for the Placebo treatment of the upper fibres of Trapezius muscle

II. SOFT - TISSUE HEALING
TRANSRECTUANEUS ELECTRICAL NERVE STIMULATION ACCELERATES CUTANEOUS WOUND HEALING AND INHIBITS PRO-INFLAMMATORY CYTOKINES

Authors: Seren Gülşen Gürgen, Oya Sayın, Ferihan Çetin, Ayşe Tuç Yücel
Affiliations: Celal Bayar University, Dokuz Eylul University, İzmir University, Üçkuyular, İzmir, Turkey
Source: Inflammation. 2014; 37 (3): 775 – 784

ABSTRACT:
Objective:
The purpose of this study was to evaluate transcutaneous electrical nerve stimulation (TENS) and other common treatment methods used in the process of wound healing in terms of the expression levels of pro-inflammatory cytokines.

Materials and Methods:
In the study, 24 female and 24 male adult Wistar-Albino rats were divided into five groups: (1) the non-wounded group having no incision wounds, (2) the control group having incision wounds, (3) the TENS group, (4) the physiological saline (PS) group and (5) the povidone iodine (PI) group. In the skin sections, interleukin-1 beta (IL-1β), interleukin-6 (IL-6), and tumour necrosis factor-a (TNF-a) were assessed with enzyme-linked immunosorbent assay and immunohistochemical methods. TENS electrical stimulation device was used at 2 Hz pulse frequency and 250 Hz pulse frequency and 250 μG/s pulse charge that equated to dosage of 0.89 Q/day for 15 min, for group 3.

In the non-wounded group, the expression of IL-1β, IL-6, and TNF-a signalling molecules was weaker in the whole tissue; however, in the control group, significant inflammatory response occurred, and strong cytokine expression was observed in the dermis, granulation tissue, hair follicles, and sebaceous glands (P < 0.05). In the TENS group, the decrease in TNF-a, IL-1β, and IL-6 immunoreaction in the skin was significant compared to the other forms of treatment (P < 0.05). Distinctive decreases of proinflammatory cytokines observed in the dermis in the TENS group suggest that TENS shortened the healing process by inhibiting the inflammation phase.

Conclusion:
The finding of reduced pro-inflammatory cytokines (IL-1β, IL-6, and TNF-a) in the TENS group is important because wounds from normal subjects exhibit increased inflammation, and it is thought that this increased inflammation is responsible for delayed healing. Furthermore, TENS application accelerated wound healing when the reepithelialization ratio results were taken into consideration. In conclusion, the results of our study suggests that TENS treatment around the edges of the wound promotes cutaneous healing through inhibiting pro-inflammatory cytokines, up-regulating re-epithelialization and granulation tissue formation.
ELECTROTHERAPY REVERSES INFRAMALLEOLAR ISCHEMIA: A RETROSPECTIVE, OBSERVATIONAL STUDY

Authors: Robert Goldman, Barbara Brewley, RN – CRC, Linquiu Zhou, MD; Michael Golden, MD
Affiliations: University of Pennsylvania School of Medicine, Philadelphia
Source: Advances in Skin and Wound Care. 2003; 16 (2): 79 - 89

ABSTRACT:

Objective:
The purpose of this study is to determine if high-voltage pulsed current (HVPc) augments ischemic wound healing and increases periwound perfusion. It was a 5-year, retrospective observational study.

Intervention:
HVPc was applied directly to wounds at greater than 100 volts, 100 pulses per second, 1 hour per day. In addition to HVPc, patients received standard care for ischemic wounds at the study facility. Ischemic wounds for which HVPc was not indicated or not available received standard care alone.

Results:
Several wounds selected for HVPc treatment emerged from intact skin and became full-thickness wounds 20 to 100 days prior to the start of HVPc treatment. Between initial wound evaluation and the start of electrotherapy, however, wound area in the HVPc-treated wounds remained stable (12.1 ± 21.1 cm² and 12.5 ± 20.6 cm², respectively) for the month. Including only alive subject at the end of the observation period, 29% of wounds in the standard care group healed at t = 1 year compared with 90% of wounds that received HVPc plus standard care. This difference was significant (p < 0.05).

Conclusion:
This research demonstrates that HVPc plus standard care promotes healing of inframalleolar ischemic skin lesions in subjects with peripheral arterial disease who are poor candidates for vascular reconstruction and have threatened limb loss. For the HVPc group, microperfusion tended to improve relative to pretreatment, suggesting that HVPc promotes healing at least partially by means of microperfusion increase.

ACCELERATION OF WOUND HEALING WITH HIGH VOLTAGE, MONOPHASIC, PULSED CURRENT

Authors: Luther C. Kloth, Jeffrey A. Feedar
Affiliations: Program of Physical Therapy, Marquette University, Milwaukee; Preferred Physical Therapy Service of Wisconsin

ABSTRACT:

Objective:
The purpose of this study was to determine whether high voltage electrical stimulation accelerates the rate of healing of dermal ulcers. Sixteen patients with stage IV decubitus ulcers participated in the study.

Materials and Methods:
The patients were assigned randomly to either a Treatment Group (n = 9) or a Control Group (n = 7). Patients in the Treatment Group received daily electrical stimulation from a commercial high voltage generator. Patients in the Control Group had the electrodes applied daily, but received no stimulation. Frequency of 105 Hz, an intraphase interval of 50 μsec, and a voltage just below that capable of producing a visible muscle contraction (100-175 V). At 100 V with an intraphase interval of 100 μs, the single-phase charge was calculated at about 1.6 μC with a total-pulse charge accumulation of 342 μC/s.

Results:
The ulcers of patients in the Treatment Group healed at a mean rate of 44.8% a week and healed 100% over a mean period of 7.3 weeks. The ulcers of patients in the Control Group increased in area an average of 11.6% a week and increased 28.9% over a mean period of 7.4 weeks. The results of this study suggest that high voltage stimulation accelerates the healing rate of stage IV decubitus ulcers in human subjects.
THE BASIS FOR MICROCURRENT ELECTRICAL THERAPY IN CONVENTIONAL MEDICAL PRACTICE

Authors: Joseph M. Mercola, DoÖ; Daniel L. Kirsch, PhD, DAAPM
Affiliations: American College for Advancement in Medicine

ABSTRACT:

Electrotherapy, especially microcurrent electrical therapy (MET) is useful for a variety of clinical conditions. Indeed, it may be the best treatment for many pain related disorders, providing fast relief of symptoms and quickly promoting healing. It has significantly less side effects than drugs in chronic conditions. MET represents a significant improvement in rapid pain control and acceleration of healing. It uses μA range and below sensation threshold. A typical microcurrent pulse is about 0, 5 s which is 2500 times longer than the pulse in a typical TENS unit and units have approximately 10 times the electronic circuitry of a TENS unit. One of the greatest values of MET is in pain control. It also reduces inflammation, edema and swelling, increases range of motion, strength and muscle relaxation, and accelerates wound healing. It is exceptionally useful in soft tissue injuries, such as sprains, wounds, post - surgical trauma, and particularly in treatment of long - term residual pain due to post - surgical scars.

Clinical evidence:

One example of the MET effectiveness is the first human study, using direct electrical current reported complete healing of chronic venous stasis leg ulcers in 3 patients with complete healing of chronic venous stasis leg ulcers in 3 patients with 6 weeks of treatment. Direct currents of 200 – 1000 μA were used during several times repeated studies and all of them documented significant accelerated healing with electrical stimulation.

ELECTRO - MEMBRANE MICROCURRENT THERAPY FOR TISSUE HEALING - A NARRATIVE REVIEW

Authors: Michael I. Lambert, Theresa Burgess and Timothy D. Noakes
Affiliations: Unit for Exercise Science and Sports Medicine, Department of Mhuman Biology, University of Cape Town, Sport Science Institute of South Africa, South Africa

ABSTRACT:

Purpose:

Delayed onset muscle soreness (DOMS) occurs after unaccustomed physical activity or competitive sport, resulting in stiff, painful muscles with impaired function. Electro - membrane microcurrent therapy has been used to treat postoperative pain and soft tissue injury.

Methods:

30 healthy men were recruited for a double - blind, placebo - controlled trial. The muscles of their nondominant arms were damaged using an eccentric – exercise protocol. Subjects were then randomly assigned to treatment with either active or a matching placebo therapy for 96 h and monitored for a total of 168 h.

Results:

Subjects in both groups experienced severe pain and swelling of the elbow elbows after the eccentric exercise. After 24 h, the elbow joint angle of the placebo group had increased significantly more than those in the active stimulation group (13.7 ± 8.9° vs. 7.5 ± 5.5°; Placebo vs. Active treatment, P < 0.05), possibly as a consequence of the elbow flexor muscles shortening. For the first 48 h after exercise, maximum voluntary contraction of the elbow flexor muscles was significantly impaired in the placebo group by up to 25% (P < 0.05), whereas muscle function was unchanged in the actively treated group.

Conclusion:

These data show that treatment of muscle damage with electro – membrane microcurrent therapy reduces the severity of the symptoms. The mechanisms of action are unknown but are likely related to maintenance of intracellular Ca2+ homeostasis after muscle damaging exercise.
**BIOELECTRICITY AND MICROCURRENT THERAPY FOR TISSUE HEALING – A NARRATIVE REVIEW**

Authors: Leon Poltawski, Tim Watson  
Affiliations: School of Health and Emergency Professions, University of Hertfordshire, UK  

**ABSTRACT:**

**Background:**
Microcurrent therapy (MCT) uses electric currents similar to those produced by the body during tissue healing. It may be particularly beneficial where endogenous healing has failed. This paper aims to review the evidence regarding microcurrent in tissue healing and the application of MCT.

**Methods:**
The application of MCT for human bone healing was to non-united fractures. For example: a case study in which a malleolar fracture failed to unite after more than a year, was published. This fracture was healed within 9 weeks by treatment with DC of 10 μA via a cathode inserted into the fracture site. Several larger studies followed, in which MCT was applied to delayed or nonunited fractures. Brighton and colleagues reported a study involving treatment of 57 lower and upper limb non-unions with 10 – 20 μA, delivered to the site by 2 - 4 cathodes for 12 weeks, followed by 12 weeks of continued immobilisation. Of those treated, 76% went on to develop full union, with most failures accounted for by insufficient current delivery or breakage of electrodes.

**Conclusion:**
MCT appears to play a significant role in the healing process, and MCT can promote healing in a variety of bone and skin lesions. The evidence for other tissues is encouraging but presently scant. MCT may have a potential in the treatment of dysfunctional tissue healing.

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**PROMOTION OF WOUND HEALING WITH ELECTRICAL STIMULATION**

Authors: Luther C. Kloth and Joseph M. McCulloch  
Affiliations: Departments of Physical Therapy and Rehabilitation, Louisiana State University Medical Center  
Source: Advances in Wound Care. 1996; 9 (5): 42 – 45

**ABSTRACT:**
An intervention commonly used to treat chronic wounds, especially by physical therapists, is electrical stimulation (ES). The rationale for use of this method is based on the fact that the human body has an endogenous bioelectric system that enhances healing of bone fractures and soft-tissue wounds. The external current may serve as to mimic the failed natural bioelectric currents so that wound healing can proceed.

**ES Equipment and Protocol:**
Because clinical and experimental trials have consistently reported favourable treatment outcomes with monophasic, high-voltage, pulsed current (HVPC) ES devices, physical therapists use this type of device. HVPC device allows select the appropriate polarity for the treatment electrode placed on the wound as described in Fig. 1 to 4 (recommended HVPC parameters 100 pps frequency, 60 min duration, 5 days/week).

**Conclusion:**
When wound healing progress becomes very slow, stops, or regresses after 14 to 21 days of standard wound care, ES should be started. Because of success of ES in clinical trials, it is recommended that a course of ES treatment be considered for Stage II, III and IV pressure ulcers that have not responded to other conservative therapies.
III. NEUROREHABILITATION

INTERFERENTIAL CURRENT THERAPY VERSUS NARROW BAND ULTRAVIOLET B RADIATION IN THE TREATMENT OF POSTHERPETIC NEURALGIA

Authors: Intsar Salim, Waked
Affiliations: Lecture of Physical Therapy, Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Egypt

ABSTRACT:

Objective:
To compare the efficacy of interferential current versus narrow band ultraviolet B radiation in the treatment of postherpetic neuralgia.

Materials and Methods:
Forty nine patients suffering from distressing post herpetic neuralgia, assigned randomly into 2 groups; interferential group and narrow band ultraviolet B group. Intensity of pain was recorded before and after therapy using numerical rating scale. The parameters used were: frequency 250 Hz, a pulse duration 120 ms, 30 min. The treatment was given for 3 sessions per week for 5 weeks. Intensity of the impulse varied according to the patient’s tolerance. Narrow band ultraviolet B (nbUVB) apparatus was used UVB (311-312nm) to patients in group 2. The starting dose was 0.21 J/cm² and gradually increasing the dose by10 mJ/cm² each session to a maximum dose of 100 mJ/ cm² (as long as there is no adverse effects reported such as persistent erythema, burn, itching).

Results:
Both groups were comparable at the baseline regarding to the demographic and clinical characteristics. The results (see Table) showed significant reduction in pain intensity post treatment in IF group whatever type of neuralgia acute, subacute, chronic, as p value < 0.05. In nbUVB group; the results showed significant reduction of pain intensity post-treatment in acute and subacute neuralgia as p value <0.05 however no significant difference in established neuralgia as p value > 0.05.

Table: Pain intensity within both groups pre and post treatment.

<table>
<thead>
<tr>
<th>Group</th>
<th>Acute neuralgia</th>
<th>Subacute neuralgia</th>
<th>Established neuralgia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>IF Group</td>
<td>8.0 ± 0.83</td>
<td>2.0 ± 0.83</td>
<td>10.0 ± 0.84</td>
</tr>
<tr>
<td>P value</td>
<td>0.043***</td>
<td>0.043***</td>
<td>0.002**</td>
</tr>
<tr>
<td>nbUVB</td>
<td>8.0 ± 1.11</td>
<td>3.0 ± 0.899</td>
<td>8.0 ± 0.57</td>
</tr>
<tr>
<td>P value</td>
<td>0.018**</td>
<td>0.039**</td>
<td>0.55**</td>
</tr>
</tbody>
</table>

* No significant difference  ** Significant difference

Percentage of improvement in acute neuralgia:
- IF group: 75%
- nbUVB group: 62%

Percentage of improvement in subacute neuralgia:
- IF group: 62%
- nbUVB group: 56%

Percentage of improvement in established neuralgia:
- IF group: 75%
- nbUVB group: 6%
**IMMEDIATE THERAPEUTIC EFFECT OF INTERFERENTIAL CURRENT THERAPY ON SPASTICITY, BALANCE AND GAIT FUNCTION IN CHRONIC STROKE PATIENTS: A RANDOMIZED CONTROL TRIAL**

Authors: Hye Rim Suh, Hee Chul Han and Hwi-young Cho  
Affiliations: Department of Physiology, College of Medicine, Korea University, Seoul; Department of Physical Therapy, College of Health Science, Gachon University, Incheon, South Korea  
Source: Clinical Rehabilitation. 2014; 28 (9): 885 - 891

**ABSTRACT:**

**Objective:**
To determine whether a single trial of interferential current therapy (ICT) can immediately alleviate spasticity and improve balance and gait performance in patients with chronic stroke.

**Intervention:**
A total of 42 patients with chronic stroke with plantar flexor spasticity of the lower limb were included in this study. The ICT group received a single 60 min ICT stimulation of the gastrocnemius in conjunction with air-pump massage. ICT device produces a modulated rectangular waveform with a 50% duty cycle and a resultant 100-Hz beat frequency (4000 Hz on one set of leads and 4100 Hz on the other). To assess each subject’s sensory threshold, the intensity of electrical stimulation was increased until the subject felt stimulation. We applied the sensory threshold to each subject in the ICT group 2-3 times; for the placebo-ICT, electrodes were attached, but no electrical stimulation was applied.

**Main measures:**
After a single ICT application, spasticity was measured immediately using the Modified Ashworth Scale (MAS), and balance and functional gait performance were assessed using the following clinical tools: Functional Reach Test (FRT), Berg Balance Scale (BBS), Timed Up and Go Test (TUG), and 10-m Walk Test (10MWT).

**Results:**
According to the Timed Up and Go Test, gait abilities decreased significantly after interferential current therapy (19%) and placebo-ICT (6%). In addition, the results of the 10-m Walk Test improved by 16% in the ICT group and by 4% in the placebo-ICT group. Thus, interferential current therapy application significantly improved balance and gait abilities compared to the placebo ICT (Table 2, P < 0.05).

**Conclusion:**
This study demonstrated that interferential current therapy application to the gastrocnemius effectively alleviated spasticity and improved balance and gait abilities in chronic stroke patients.

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**THE EFFICACY OF INTERFERENTIAL CURRENT OF TRIGEMINAL NEURALGIA**

Authors: Abila Soomro, Muhammad Hamid, Faisal Yamin, Rukhsana Bibi  
Affiliations: Institute of Physical Medicine and Rehabilitation, Rabia Moon Institute of Neurosciences, Dow University of Health Sciences, Karachi  

**ABSTRACT:**

**Objective:**
To prove the effectiveness of interferential therapy (IFC) in trigeminal neuralgia.

**Materials and Methods:**
Thirty one patients who were diagnosed with trigeminal neuralgia and were not responding to medicines, were subjected to IFC. Intensity of the impulse varied according to the patient’s tolerance whereas frequency, pulse width and duration were fixed, i.e. 250 Hz frequency was used with a pulse of 120μs, it was applied for duration of 30 min. One electrode was placed just below the ear and the other one was at the end of the respective nerve. Pain was assessed on Visual analogue scale before and after fifteen days of therapy.

**Results:**
Twenty six patients (83.7%) improved significantly with application of IFC. Only 5 patients (16.3%) remained unresponsive to IFC using an unrelated t test on the data (t = 0,19; df = 28). The results were found to be significant at p > 0.005 for the one tailed hypothesis. This means that IFC is more effective than medication for reducing pain in trigeminal neuralgia.

**Conclusion:**
Interferential therapy is an effective, easy to use therapy with minimal side effects in patients suffering from trigeminal neuralgia not responding to conventional treatment.
The efficacy of the therapies was assessed before initiation of therapy and at 3 weeks after completion of therapy using a visual analogue scale (VAS), a symptom severity scale, the functional capacity scale of the BTCTQ, and measurement of median nerve motor distal latency (mMDL) and median sensory nerve conduction velocity (mSNCV).

Results:
In the VAS, BTCTQ, mMDL, and mSNCV, no significant difference was observed between the groups (p > 0.05). In the VAS, BTCTQ, and mSNCV, statistically significant improvements were detected in all groups (p < 0.005). There was no statistically significant difference between TENS and splint therapy with respect to improvement in clinical scores, whereas IFC therapy provided a significantly greater improvement in VAS, mMDL, and mSNCV values than splint therapy. IFC may be considered a new and safe therapeutic option for the treatment of CTS.
EFFECTIVENESS OF DIADYNAMIC CURRENTS AND TRANS CUTANEOUS ELECTRICAL STIMULATION IN DISC DISEASE LUMBAR PART OF SPINE

Authors: Barbara Ratajczak, Arletta Hawrylak, Aneta Demidaś, Jadwiga Kucie – Lewandowska, Ewa Boerner
Affiliations: The Faculty of Physiotherapy, University School of Physical Education; The Faculty of Physiotherapy; Medical University, Wroclaw, Poland
Source: Journal of Back and Musculoskeletal Rehabilitation. 2011; 24: 155 – 159

ABSTRACT:

Objective:
The aim of this study was to compare the efficiency of analgesic DD current therapy and TENS in low back discopathy.

Materials and Methods:
Eighty patients (age 45–60 years) with diagnosed low back pain syndrome due to discopathy were subjected to therapy. In the first group (DD) of 40 people, DD current therapy was applied for 10 minutes and a sequence of different diadynamic currents: DF 2 minutes, MF 3 min, LP 3 min, and CP 2 min. The intensity depended on the patient’s individual reactions and on average amounted to 15 mA. In the second group (TENS) of 40 people, TENS therapy was applied. The treatment was performed with the use of a bidirectional impulse, symmetrical and rectangular. The intensity depended on the patient’s individual reactions and on average amounted to 30 mA. The duration of the treatment amounted to 30 min. During the first 10 min, current frequency amounted to 10 Hz and during the following 20 min to 100 Hz. The third group of 40 people was a control group in which a functional fitness test was performed for comparison purposes. The control group was in this case an equivalent to a norm. Before the beginning and on the completion of therapy in all patients, a pain level measurement and functional fitness test were performed. In order to define the differences in efficacy of DD and TENS therapy a T-Student test was applied.

Results:
On the basis of research conducted it was stated that both therapies reduce pain level effectively. Obtained analysed results conclude that both therapies applied have an analgesic effect. In the group of patients in which DD currents were applied the average value of pain level before therapy equaled 6.55, whereas after therapy it was 4.10. At the same time in the group in which TENS therapy was applied the average pain level before therapy was 7.07 whereas after treatment it equaled 3.35. On the basis of T-test one can clearly state that a significant statistic efficacy of both therapies was on the level of p < 0.05.

Conclusion:
DD current and TENS therapies in low back discopathy have an analgesic impact and improve functional fitness. The applied therapies have a comparable impact on researched parameters.

EMPIRICAL STUDY TO DETERMINE OPTIMUM PARAMETER OF MUSCLE STIMULATOR

Authors: Ms. A. V. Shah, Mr. J. B. Vyas
Affiliations: Biomedical Engineering Department, Gujarat Technological University, India

ABSTRACT:

Introduction and purpose:
Muscle stimulation therapy has the potential to assist individuals who are moderately to severely affected by stroke in restoring voluntary motor functions. It is extensively used therapeutically to initiate and facilitate voluntary contraction of muscle. There are clear effects of stimulation on excitable tissue, that is nerve and muscle, which lead to numerous indirect effects. This study aims to provide the optimum patterns of stimulation for the paralyzed patients.

Materials and Methods:
This study has been performed using a muscle stimulator with Faradic current, which was applied to the patients. The pulse duration of Faradic current was ranging from 0.1 ms and 1 ms and a frequency of 50 to 100 Hz. Faradic currents are always surged for treatment purposes to produce a near normal tetanic – like contraction and relaxation of muscle. Current surging means the gradual increase and decrease of the peak intensity. The most comfortable pulse is either 0.1 ms pulse, with a frequency of 70 Hz or 1 ms pulse with a frequency of 50 Hz.

Results and Conclusion:
Study has been carried out on 15 patients. Common reasons for the paralysis were High Blood pressure or accidental injury on to the brain. EMG Signal has also been obtained for the patients. EMG signal is half than that of healthy person. It can be concluded that surge faradic current is suitable for the treatment of the paralysed persons. With the regular treatment suggested by the doctors muscle regeneration is possible and the range of current required for the patients is 30 mA to 70 mA.
**STRENGTH – DURATION PROPERTIES OF HUMAN PERIPHERAL NERVE**

Authors: Ilona Mogyoros, Matthew C. Kiernan, David Burke

Affiliations: Prince of Wales Medical Research Institute and the Department of Neurology, The Prince Henry and Prince of Wales Hospitals, Sydney, Australia


**ABSTRACT:**

**Purpose:**

20 healthy volunteers to compare strength-duration curves for compound sensory and muscle action potentials, to determine the most appropriate curve fitting equation for the data, and to examine the reproducibility of the calculated time constant on different days, for potentials of different amplitude and at different sites along the nerve.

**Materials and Methods:**

Using a computerized threshold tracking system, stimulus intensity was adjusted to produce an antidromic compound sensory action potential (cSAp) or an orthodromic muscle action potential of 30% of maximum. The stimulus was a square wave pulse with rise and fall times of 10 μs for a 40-50 mA stimulus. Duration was increased every minute in 20 μs steps from 20 μs to 1 ms. The time constant for compound sensory potentials (665 ± 182 μs) was longer than that for compound EMG potentials (459 ± 126 μs).

**Results and Conclusion:**

Weiss’s formula, which relates threshold charge to stimulus duration, provided an accurate fit for the experimental data, and the study validated that, using it, relatively few experimental measurements were required to calculate the time constant. In repeated studies on the same subject, time constants usually differed by less than 400 μs for sensory axons and less than 250 μs for motor axons. They were identical at different sites along the nerve and did not alter with the size of the compound action potential. These characteristics suggest that the determinations of strength-duration time constant could be suitable for clinical usage.

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**EFFECTIVENESS OF ELECTROTHERAPY AND AMITRIPTYLINE FOR SYMPTOMATIC RELIEF**

Authors: Dinesh Kumar, MD; Michael S. Alvaro, DPM; Inderjeet S. Julka, MD; Howard J. Marshall, DPM

Affiliations: Division of Endocrinology, Diabetes and Hypertension, the Department s of Medicine and Podiatry, Los Angeles, County University of Southern California Medical Center


**ABSTRACT:**

**Objective:**

The purpose of this study was to evaluate the efficacy of combining electrotherapy with amitriptyline for the management of chronic painful peripheral neuropathy in patients with Diabetes type 2.

**Research design and Methods:**

Patients with peripheral neuropathy were treated with amitriptyline. After 4 weeks, those patients who failed to respond to amitriptyline or who only had partial relief were randomized between a sham treatment group (control) or an electrotherapy group. Transcutaneous electrotherapy was given for 12 weeks by the H – wave machine that generated a biphasic exponentially decaying waveform (pulse width 4 ms, 25 – 35 V ≥ 2 Hz). The degree of pain and discomfort was graded on a scale of 0 - 5. An analogue scale was used to record the overall change in symptoms.

**Results:**

Amitriptyline produced some degree of symptomatic relief in 60% of the patients by the 4th week; pain scores decreased from 3, 8 ± 0, 1 to 2, 9 ± 0, 2 (p < 0, 1) and the overall reduction in pain was 26 ± 5% on an analogue scale. In the amitriptyline plus sham treatment group (n = 9), pain scores declined from 2, 8 ± 0, 3 to 1, 9 ± 0, 5 (p < 0, 03) and the overall reduction in pain was 55 ± 12% suggesting a procedure – related placebo effect. In the group receiving combined electrotherapy, symptomatic improvement occurred in 12 (85%) patients. Pain scores declined from 3, 2 ± 0, 2 to 1, 4 ± 0, 4 (p < 0, 01) and the overall reduction in pain was 66 ± 10%. The degree of reduction in pain scores and the incremental relief (above the amitriptyline effect) were significantly greater (p < 0, 03) with electrotherapy as compared with sham treatment. The outcomes indicate a substantial beneficial effect of electrotherapy over and above any placebo influence.
SHORT-TERM ELECTRICAL STIMULATION ENHANCES THE EFFECTIVENESS OF BOTULINUM TOXIN IN THE TREATMENT OF LOWER LIMB SPASTICITY

Authors: S. Hesse, M.T. Jahneke, D. Luecke, K.H. Mauritz
Affiliations: Department of Neurological Rehabilitation, Free University Berlin, Klinik Berlin, Germany

ABSTRACT:

Purpose:
The study tested the spasmolytic effect of Botulinum toxin A in two groups of hemiparetic patients with lower limb spasticity.

Materials and Methods:
The first group (n = 5) was injected into the soleus, tibialis posterior and both heads of gastrocnemius muscles alone; the second (n = 5) received additional repetitive alternating electrical stimulation (constant current pulses (20 Hz, 200 μs, 50-90 mA) was used for stimulation of M. tibialis anterior and plantar flexors for 30 min six times per day during the 3 days following the injection. Muscle tone, rated by the Ashworth spasticity score, and gait analysis including recording of vertical ground reaction forces, were assessed before and 4 weeks after injection.

Results:
The combined treatment proved to be more effective with respect to the clinically assessed reduction of muscle tone, gait velocity, stride length, stance- and swing-symmetry (p < 0.05). The result is discussed with reference to animal experiments demonstrating enhanced toxin uptake and accelerated onset of its paralytic effect by electrical stimulation.

IV. TREATMENT OF UROLOGICAL DISORDERS

MANAGEMENT OF FAECAL INCONTINENCE BY PELVIC FLOOR MUSCLE EXERCISE, FARADIC ELECTROSTIMULATION AND BEHAVIOURAL TRAINING – A CASE STUDY

Authors: Sokunbi O.G.; Okusanya E.
Affiliations: Physiotherapy Department, College of Medicine, University of Lagos; Physiotherapy Department, Lagos University Teaching Hospital, Lagos

ABSTRACT:

Objective and Methods:
This paper presents a case study of a 10-year-old girl with a diagnosis of faecal incontinence secondary to sexual assault. Before the commencement of treatment, the strength of the pelvic floor muscles was assessed using a pelvic floor muscle grading system. The severity and frequency of incontinence, as well as the subject’s attitude to incontinence were also assessed with the aid of a questionnaire. The assessment was followed by six weeks of physiotherapy treatment with pelvic floor muscle strengthening exercises, faradic electrostimulation and behavioural training. The frequency of treatment was twice a week for a period of 6 weeks (12 sessions).

Results:
The outcome of the treatment revealed no remarkable improvement for the first and second weeks of treatment. At the third week of treatment, however, an increase in the pelvic floor muscle strength from 2/5 to 3/5 was observed, the severity of incontinence was reduced from ‘soiling the outer clothing’ to ‘soiling the underwear’. The time between meal and defecation also increased from 2 minutes to 20 minutes. By the end of the 4th week, the frequency of incontinence was further reduced. By then, the subject no longer perceived the incontinence as a major problem but as a minor inconvenience, since she could now hold on for 60 minutes after eating before defecating.

Results:
The outcome of this study has demonstrated the efficacy of pelvic floor exercises, faradic electrostimulation and behavioural training as an effective method of treatment for faecal incontinence.

Fig. 1: Frequency of incontinence of the subject
PELVIC FLOOR ELECTRICAL STIMULATION IN THE TREATMENT OF GENUINE STRESS INCONTINENCE: A MULTICENTER, PLACEBO - CONTROLLED TRIAL

Authors: Peter K. Sand, MD; David A. Richardson, MD; David R. Staskin, MD; Steven E. Swift, MD; Rodney A. Appell, MD; Kristene E. Whitmore, MD; Donald R. Ostergard, MD

Affiliations: Evanston Continence Center, Evanston Hospital, Northwestern University, Hutzel Hospital, Wayne State University, Beth Israel Hospital, Harvard Medical School, Memorial Medical Center, University of California, Irvine, Louisiana State University, Graduate Hospital, University of Pennsylvania


ABSTRACT:

Introduction: Studies in the medical literature suggest that pelvic floor electrical stimulation is an effective and safe therapy for women with genuine stress incontinence, improvement rates from 35% to 70% and cure rates ranging from 0% to 50%.

Purpose: We proposed to compare the electric pelvic floor stimulator to a placebo device. We wanted to specifically study the objective and subjective changes in patients’ urinary symptoms, urodynamic testing, and quality of life before and after pelvic floor electrical stimulation.

Materials and Methods: Women with an urodynamically genuine stress incontinence proven (according to the International Continence Society criteria) were successfully enrolled at six sites for this clinical trial. 35 patients were randomized to receive the “active” transvaginal stimulation system and 17 to receive the sham device. The device emitted stimulation at 50 cycles/s and 12.5 cycles/s. The pulse duration was of 0.3 ms and a current range of 0 to 100 mA. The sham device consisted of the same system, but was limited to have no perceptible sensation or effect on skeletal muscle. Patients were instructed to use the device twice a day for 12 weeks and gradually adjust the amperage on both channels to 60 to 80 mA or to the highest tolerable level they could reach. Duty cycle progressed throughout the study to allow for improvement in the resistance to fatigue of skeletal muscle as it is exercised over time.

Results: Comparisons of changes from baseline between active-device and control patients showed that active-device patients had significantly greater improvement in weekly (p = 0.009) and daily (p = 0.04) leakage episodes, pad testing (p = 0.005) and vaginal muscle strength (p = 0.02) when compared with control subjects. Significantly greater improvement was also found for both visual analog scores of urinary incontinence (p = 0.007) and stress incontinence (p = 0.02) as well as for subjective reporting of frequency of urine loss (p = 0.002), and urine loss with sneezing, coughing, or laughing (p = 0.02) when compared with controls. Pad testing showed that stress incontinence was improved by at least 50% in 62% of patients using an active device compared with only 19% of patients using sham devices.

THE SURGED FARADIC STIMULATION TO THE PELVIC FLOOR MUSCLES AS AN ADJUNCT TO THE MEDICAL MANAGEMENT CHILDREN WITH RECTAL PROLAPSE

Authors: Simmi K Ratan, Kamal Nain Rattan1, Poonam Jhajhria, Yogesh Parshad Mathur, Atul Jhanwar, Dimple Kondal

Affiliations: Department of Physiotherapy; Department of Pediatric Surgery, Department of Biostatistics, Post Graduate Institute of Medical Sciences, Rohtak, Haryana; Department of Biostatistics, All India Institute of Medical Sciences, New Delhi, India

Source: BMC Pediatric. 2009; 9 (44): 1 – 6

ABSTRACT:

Background: To assess the role of the surged faradic stimulation to the pelvic floor muscles as an adjunct to the conservative management in the children of idiopathic rectal prolapse.

Methodology: Surged faradic stimulation using modified intraluminal rectal probe, was given on the alternate days. The patient was asked to do voluntary and contraction with each stimulus. The electrical stimulation was achieved with pulses of duration of 1 ms with a frequency of 30 Hz (faradic type). About 90 contractions were given in each session to avoid muscle fatigue, over 3 minutes (30 contractions per minute). Each patient was given 1 session per day 3 times a week (on alternate days). The conventional conservative medical management was also continued. The extent of relief and the number of the sittings of faradic stimulation required were noted at various stages of follow-ups.

Results: The mean number of sittings in the completely cured group (n = 28 (64%)) was (12.4 ± 7.8) and was comparable with very poor responder (n = 6(13%)). There was higher percentage of relief (76%) at the first follow up (at 15 days) in completely cured vs. other (37%) and also the poor responders showed (20%) vs. other (68%) and was statistically significant.

Conclusion: With use of faradic stimulation, even the long-standing rectal prolapse can be fully cured. The follow up visit at 2 weeks is very important to gauge the likely success of this modality in treatment of the patients with rectal prolapse. Those showing poor response at this stage may require alternative treatment or take a long time to get cured.

“Intrarectal pen electrode (left) used for giving faradic stimulation and the inactive electrode (right)”
V. ELECTROSTIMULATION
BELL’S (FACIAL) PALSY TREATMENT

CUTANEOUS ELECTRICAL STIMULATION TREATMENT IN UNRESOLVED FACIAL NERVE PARALYSIS – AN EXPLORATORY STUDY

Authors: Hyvärinen A., Tarkka I. M., Mervaala E., Pääkkönen A., Nuutinen J.
Affiliations: University of Kuopio, Kuopio University Hospital, Kuopio, Finland

ABSTRACT:
Objective:
The purpose of this study was to assess clinical and neurophysiological changes after 6 months of transcutaneous electrical stimulation in patients with unresolved facial nerve paralysis.

Design:
All patients received below sensory threshold transcutaneous electrical stimulation for 6 months for their facial nerve paralysis. The intervention consisted of gradually increasing the duration of electrical stimulation of three sites on the affected area for up to 6 hours/day. Assessments of the facial nerve function were performed using the House-Brackmann clinical scale and neurophysiological measurements of compound motor action potential distal latencies on the affected and nonaffected sides. Patients were tested before and after the intervention. The patient placed the surface electrodes (diameter 2.5 cm) daily on the main branches of the facial nerve (as an anode), one on the temporal region, one on the zygoma block, and one on the lower jaw. The reference electrode (as a cathode) was placed on the mastoid process. The stimulation frequency was 20 Hz with a monophasic twin pulse, with the duration of each pulse being 100 s. The current was the same in all three channels.

Results:
The House-Brackmann scale exhibited some improvement in all 10 patients. An improvement of one grade was seen in four patients in all of the main branches, in four patients it was observed, in two branches and in one patient in only one main branch of the facial nerve. In one patient, the score improved by two grades in one and by one grade in the other branches. The patients reported various alterations in their individual condition of the facial paresis. Dryness of the eyes had decreased or even disappeared in two patients. In two other cases, the patients had reacquired the ability to whistle. Eye closure improved in three patients and one individual spontaneously reported that she obtained relief from her sleeping problems.

EFFECT OF A LONG-TERM ELECTRICAL STIMULATION ON MOTOR RECOVERY AND IMPROVEMENT OF CLINICAL RESIDUALS IN PATIENTS WITH UNRESOLVED FACIAL NERVE PALSY

Authors: Robert S. Targan, PhD., DPharm; Gad Alon, PhD.; Scott L. Kay, MD, FACS
Affiliations: University of Maryland, School of Medicine, Princeton Otolaryngology, Washington, USA

ABSTRACT:
Purpose:
This study investigated the efficacy of a pulsatile electrical current to shorten neuromuscular conduction latencies and minimize clinical residuals in patients with chronic facial nerve damage caused by Bell’s palsy or acoustic neuroma excision. The study group included 12 patients with idiopathic Bell’s palsy and 5 patients whose facial nerves were surgically sacrificed. The meantime since the onset of paresis/paralysis was 3.7 years and 7.2 years (range 6 – 9 years) for the Bell’s and neuroma excision groups, respectively.

Methods:
Motor nerve conduction latencies, House-Brackmann facial recovery scores, and a 12-item clinical assessment of residuals were obtained 3 months before the onset of treatment, at the beginning of treatment, and after 6 months of stimulation. A stimulator produced a monophasic current waveform, having a pulse duration of 86 μs, and delivered 1 pulse every 700 ms. The direction of flow of the monophasic pulse was reversed with each pulse, and the pulses were interrupted to yield an on time of 6 seconds followed by an off time of 6 seconds. Ramp up was 1 second and ramp down 0.5 second. Stimulation intensity was maintained at a submotor level so that the patient was able to perceive the pulses without concomitant muscle contraction.

Results:
Eight patients showed more than 40% improvement, 4 better than 30% and 5 less than 10% improvement in residuals score.

Conclusion:
Long-term electrical stimulation may facilitate partial reinnervation in patients with chronic facial paresis/paralysis. Additionally, residual clinical impairments are likely to improve even if motor recovery is not evident. Extending the stimulation period and combining it with a specific exercise program may further increase the success rate of such intervention.
ELECTRICAL STIMULATION AS A THERAPEUTIC OPTION TO IMPROVE EYELID FUNCTION IN CHRONIC FACIAL NERVE DISORDERS

Authors: John Gittins, Kevin Martin, James Sibbald, Ashwin Reddy, Leonard Tbean
Affiliations: Departments of Medical Physics and Ophthalmology, Leicester Royal Infirmary; Department of Ophthalmology, Colchester, United Kingdom
Source: IOVS. 1999; 40 (3): 547 - 554

ABSTRACT:

Purpose:
To establish whether it is possible to improve orbicularis oculi muscle function in the eyelids of patients with a chronic seventh cranial nerve palsy by using transcutaneous electrical neurostimulation (TENS) to the point at which electrical stimulation induces a functional blink.

Methods and Materials:
Ten subjects with chronic, moderate to severe facial nerve palsy were recruited into the study. The stimulation regimen was implemented using transcutaneous electrical nerve stimulators. The stimulators had a constant voltage output with a compensated monophasic pulse shape. The pulse frequency could be varied between 2 Hz and 200 Hz and the pulse length between 50 μs and 200 μs. A thumbwheel with a scale of 1 to 10 controlled the peak voltage level. Lagophthalmus, voluntary and spontaneous eyelid movements were assessed, using an optical measuring system, before, during, and after a 3-month treatment period. Voluntary and spontaneous lid velocities were also measured and compared with eyelid kinematic data in normal subjects.

Results:
Therapeutic electrical stimulation applied over 3 months produced improvement in eyelid movement (> 2 mm) in 8 of 10 patients during voluntary eyelid closure.

Conclusion:
Electrical stimulation using TENS stimulator units can improve voluntary eye closure, apparently because of a reduction in stiffness of eyelid mechanics, rather than an improvement of muscle function. The stimulation protocols used here did not give detectable contractions in the orbicularis oculi muscle (OOC). Therefore, these protocols could not be used to restore eyelid function by stimulation therapy followed by implantation of stimulating electrodes. However, other benefits were achieved apart from the improvement in voluntary closure. These included a reduction in the amount of artificial tear preparations used in four patients and subjective improvement in facial tone reported by all patients.

IMPACT OF ELECTRICAL STIMULATION ON REHABILITATION PROCESS IN PERIPHERAL FACIAL PARALYSIS

Authors: Guzelant Ya., Sarıf características Ab., Saraçoğlu Gv., Can I., Ünala
Affiliations: Department of Public Health and Department of Physical Medicine and Rehabilitation, Department of Neurology, Namık Kemal University School of Medicine, Turkey
Source: Acta Medica Mediterranea. 2014; 30: 1375

ABSTRACT:

Aim:
The purpose of this study is to discuss the efficiency of electrical stimulation in the treatment of facial paralysis, and its contribution to the rehabilitation process and its impact on recovery.

Materials and Methods:
18 participants were enrolled into the study. ES were applied to the motor points of eight muscles innervated by facial nerve with 100 ms intermittent galvanic current for motor point treatment, 30 times as 3 rounds to each point and at a current intensity as to obtain minimal contraction. ES was discontinued after the active mimic muscles movement started. Hot application and exercise were continued. Treatment program was applied in 20 sessions. Home exercise program was given to all patients. The first group was followed-up with hospital rehabilitation program that included electrical stimulation, while the second group was organized to receive only home exercise program. Functional response to treatment was assessed by the House-Brackmann scale grading system.

Results:
Clinical improvement was observed more significantly in the 6th week. There was no significant difference between House-Brackmann scale scores in pre-treatment and after 6 - week visits of the patients in home exercise program group (p = 0.16). However, the House-Brackmann scale scores were detected to be statistically significantly different between pre-and 6 months after the treatment in both of the treatment groups (p = 0.005).

Conclusion:
The short – term recovery rates was seen to be more in the rehabilitation group including ES. Electrical stimulation in addition to the exercise in PFP treatment; appears to be able to minimize the muscle atrophy during the period needed for peripheral nerve regeneration in denervated muscles, protect muscle strength and prevent the trophic disorders. As a result, the recovery time is faster in the patients treated with the rehabilitation group that includes electrical stimulation. Therefore electrical stimulation therapy is an acceptable effective method for the treatment of facial paralysis.
MANAGEMENT OF PERIPHERAL FACIAL NERVE Palsy

Authors: Josef Finsterer
Affiliations: Neurological Department, Krankenanstalt Rudolfstiftung, Vienna, Austria

ABSTRACT:

Introduction:
Peripheral facial nerve palsy (FNP) may or may not have a detectable cause. Three quarters of peripheral FNP are primary and one quarter secondary. This minireview wants to give an overview on the current knowledge about the prevalence, causes, pathogenesis, diagnosis, treatment and prognosis of primary and secondary facial nerve palsies. Therapy of secondary facial nerve palsy aims to omit the particular cause of the palsy. One of the treatment modalities mentioned in this review is “Pulsatile electrical current” (transcutaneous electrical stimulation). Particularly, in patients with poor outcome and chronic facial nerve damage long-term electrical stimulation may be beneficial.

Intervention:
In a study on 12 patients with chronic Bell’s palsy and 5 patients whose facial nerves had been surgically sacrificed with a mean latency between onset and electrotherapy (TENS) of 3.7 year stimulation of the most affected muscles at a submotor level for 6 hours a day during 6 months significantly reduced facial nerve latencies, the House – Brackmann score (HBS – scoring system of peripheral facial nerve severity), and collective scores of the 12 clinical impairment measures after 6 months. An improvement by 40, 30, or less than 10% was reported in 5, 4, and 8 patients respectively. The beneficial effect was explained by facilitation of re-innervation through electrical stimulation.

Conclusion:
All patients in whom secondary facial nerve palsy is suspected a diagnostic work-up for the presence or absence of possible causes should be promptly initiated. If any of these causes is detected, it should be assessed if there is a causal relation between the palsy and the detected cause or not. Though a final decision on the optimal therapy of acutely developing Bell’s palsy cannot be actually proposed, patients should be provided with all measures to avoid secondary affection of the eyes if the lid closure is insufficient or in case of impaired tearing.

THE EFFICACY OF ELECTROTHERAPY FOR BELL’S PALSY: A SYSTEMATIC REVIEW

Authors: Quinn R., Cramp F.
Affiliations: University of York, Centre for Reviews and Dissemination
Source: Database of Abstracts of Reviews of Effects. 2013: 1 - 3

ABSTRACT:

Objective:
Author’s objective was to assess the efficacy of electrotherapy of Bell’s palsy. However also studies of patients with other conditions were also eligible and such patients formed the majority of participants in the included studies.

Randomised control trials (RCT) and Clinical Control Trials (CCT):
One CCT (n=40, including 39 patients with Bell’s palsy for between 0.5 and 29 years) found that electrical stimulation significantly improved the Facial Paralysis Recovery Profile from baseline (P<0.0001). The other CCT (n=17, including 12 patients with Bell’s palsy for between 1 and 7 years) found that electrical stimulation decreased mean motor nerve latency (P=0.0001) and improved House-Brackmann scores (P=0.0003) from baseline.

One RCT (25 patients including 4 with Bell’s palsy) found that electromyography plus mirror feedback and mirror feedback alone significantly improved symmetry of voluntary movement and facial expression from baseline (P < 0.01 and P < 0.03, respectively). The study selected 7 patients living remotely as the no treatment control. The other RCT (21 patients including 9 with Bells’ palsy) found that standard biofeedback and small movement therapy both significantly improved symmetry of facial movements from baseline, but found no significant difference between treatments.

Author’s conclusion:
The evidence suggested that electrical stimulation is beneficial in patients with chronic Bell’s palsy. Studies indicated that electromyographic feedback was beneficial when muscle activity was present.
V. ELECTROSTIMULATION OTHERS

ELECTRICAL STIMULATION COMBINED WITH EXERCISE INCREASE AXONAL REGENERATION AFTER PERIPHERAL NERVE INJURY

Authors: Elena Asensio-Pinilla, Esther Udina, Jessica Jaramillo, Xavier Navarro
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Centro de Investigación Biomédica en Red sobre Enfermedades Neurodegenerativas (CIBERNED), Spain

ABSTRACT:

Purpose:
In this study we aim to elucidate the role of neuronal activity, induced by nerve electrical stimulation and by exercise, in promoting axonal regeneration and modulating plasticity in the spinal cord after nerve injury.

Materials and Methods:
Four groups of adult rats were subjected to sciatic nerve transection and suture repair. Two groups received electrical stimulation (3 V, 0.1 ms at 20 Hz) for 1 h, immediately after injury (ESa) or during 4 weeks (1 h daily; ESc). A third group (ES+TR) received 1 h electrical stimulation and was submitted to treadmill running during 4 weeks (5 m/min, 2 h daily). A fourth group performed only exercise (TR), whereas an untreated group served as control (C). Nerve conduction, H reflex and algometry tests were performed at 1, 3, 5, 7 and 9 weeks after surgery, to assess muscle reinnervation and changes in excitability of spinal cord circuitry. Histological analysis was made at the end of the follow-up period.

Results:
Groups that received acute ES and/or were forced to exercise in the treadmill showed higher levels of muscle reinnervation and increased numbers of regenerated myelinated axons when compared to control animals or animals that received chronic ES. The facilitation of the monosynaptic H reflex in the injured limb was reduced in all treated groups, suggesting that the maintenance of activity helps to prevent the development of hyperreflexia.

Conclusion:
Acute electrical stimulation is able to accelerate axonal regeneration and enhance muscle reinnervation after sciatic nerve injury. There was a synergistic effect when acute stimulation was combined with moderate intensity active exercise only in the early phase of regeneration, suggesting additive mechanisms involved in the two treatments, but no need for maintaining activity on the long term. Our results also show an activity-dependent modulation of spinal hyperreflexia by electrical stimulation and treadmill training.

INTERFERENTIAL ELECTRIC STIMULATION APPLIED TO THE NECK INCREASE SWALLOWING FREQUENCY

Authors: Takayuki Funuta, Masanori Takemura, Junta Tsujita, Yoshitaka Oku
Affiliations: Department of Physiology, Hyogo College of Medicine; Department of Health and Sport Sciences, Hyogo College of Medicine, Nishinomiya, Japan
Source: Dysphagia. 2012; 27: 94 - 100

ABSTRACT:

Introduction:
Recently, surface electrical stimulation applied to the neck region has received increased attention as a new modality to treat pharyngeal dysphagia. We evaluated the effects of interferential currents (IFCs), the most popular modality of amplitude-modulated 1 kHz frequency.

Materials and Methods:
Protocol 1 was designed to evaluate the differential effects of kilohertz AC stimulation with and without amplitude modulation; which one parameter set yielded pure 2 000 Hz Acs and another set yielded 2 000 Hz Acs with a 50 Hz amplitude modulation. For this protocol we used pure 1 kHz Acs without burst modulation. Each session was made up of a 5-min control period, 5-min stimulation period, and 5-min after stimulation period without stimulation.

Protocol 2 was designed to examine whether the stimulus effect on the swallowing reflex depends on the carrier frequency. Burst modulation was applied (stimulation time 100 ms, pause 200 ms, burst frequency 3.3 Hz, duty cycle 33%) to each kHz Ac, so that swallowing activity was easily discernible on the EMG.

Protocol 3 was designed to evaluate whether a prolonged stimulation has an additional effect on the facilitation of the swallowing reflex. Subjects underwent either an IFC stimulation (carrier frequency = 2 000 Hz, beat frequency = 50 Hz) or a pure 2000-Hz AC stimulation for 15 min in random order. In addition, we observed the natural time course of swallowing frequency without stimulation during the same period of time. For this protocol we used pure-kilohertz Acs without burst modulation.

The data were analyzed by two-way repeated-measurement analysis of variance (ANOVA), followed by post-hoc Bonferroni/Dunn testing. P values were shown after Bonferroni’s correction; p<0.05 was considered statistically significant.

Results:
We found that IFC stimulation at the sensory threshold with 50 - Hz modulation significantly increased the number of swallows without any discomfort, but pure AC stimulation at the carrier frequency did not have a significant effect. We found that IFC stimulation applied to the neck region at the intensity of the sensory threshold facilitates swallowing behaviour in healthy male subjects. The effect disappears when the stimulation is stopped. Pure AC stimulation did not affect the number of swallows per a given time, suggesting that a low-frequency amplitude modulation is required for the facilitation of swallowing behaviour. There was no statistically significant difference in the time course of the number of swallows among different carrier frequencies.
**EFFECT OF UNIPOLAR ACU-STIM ON MUSCLE REEDUCATION FOLLOWING TENDON TRANSFER - A CASE STUDY**

Authors: Uday Raj, J.; Srikanth, R.; Khyati, G.; Balakrishna, G.
Affiliations: Department of Plastic and Reconstructive Surgery; College of Physiotherapy; Apollo College of Physiotherapy; Apollo Hospital
Source: Int. J. Physiother. 2015; 2 (1): 347 - 351

**ABSTRACT:**

**Background:**
Unipolar Acu-Stim (UAS) is an innovative technique where an acupuncture needle is used to stimulate the transferred tendon with Surged Faradic Currents (SFC). The objective of the study is to identify if the application of SFC using UAS method, is effective to re-educate a transferred muscle.

**Materials and Methods:**
The subject was a 24 year old male who had a loss of finger and thumb extension following Posterior Interosseus Nerve (PIN) palsy, for which Flexor Carpi Radialis (FCR) was transferred to Extensor Digitorum Communis (EDC) and Palmaris Longus (PL) was transferred to Extensor Pollicis Longus (EPL). Following removal of the POP, UAS with surged faradic current was applied for 4 weeks along with re-education exercises. Prognosis of finger extension was assessed by goniometry and video recordings. Therapy parameters were - surged faradic current of 1 ms duration, intensity causing a tetanic contraction, each session consisted of 30 contractions (3 sets with 1 min rest between sets; 1 session a day for 4 weeks.

**Results:**
At the end of 8th week, as observed on goniometry and video recordings, complete finger extension was achieved. It was observed that Unipolar Acu-Stim with surged faradic current proved to be effective in muscle re-education following tendon transfers. However, Unipolar Acu-Stim is recommended over the Russian, interferential, and square waveforms, when desiring to stimulate isometric contractions that cause the least tissue trauma to the skin with the greatest subjective and objective comfort for the patient.

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**TOWARDS THE OPTIMAL WAVEFORM FOR ELECTRICAL STIMULATION OF HUMAN MUSCLE**

Authors: Scott D. Bennie, Ć Jerrold S. Petrofsky, Ć Jodi Nisperos Mitchell, Tsurudome Ć Mike Laymon
Affiliations: Department of Physical Therapy, Loma Linda University; Department of Physical Therapy, Azusa Pacific University

**ABSTRACT:**

**Materials and Methods:**
Four male and three (all of them healthy) female subjects participated in this study. The effect of four waveforms, including Russian, interferential, sine, and square, on the mean stimulation current required to achieve the desired contraction force, subjective comfort, and physiological responses was studied. Frequency was maintained at 30 pps for all waveforms. Pulse width varied as follows: 100 μs for interferential, sine, and square waveforms and 200 μs for the Russian waveform. Amplitude was manipulated throughout each 4-min contraction to maintain a contraction force equal to 10% of the subjects’ maximal voluntary contraction MVC. The subjective pain measure, the VRS, was obtained every minute during the 4-min-long electrically stimulated contractions.

**Results:**
The contractions elicited by electrical stimulation utilizing the sine waveform required significantly less mean stimulation current to maintain the desired force of contraction with consistently lower verbal rating scale scores and greater increases in oxygen consumption than either the Russian or square waveform stimulations. Russian waveform stimulation produced a significantly greater rise in galvanic skin resistance than the sine or square waveform while the changes in respiratory quotient were similar between waveforms. The data support sine wave stimulation as working the best by producing the desired muscle tension with the least mean stimulation current and therefore, the least tissue trauma while providing the most subjective comfort.

**Conclusion:**
In conclusion, the sine waveform is recommended over the Russian, interferential, and square waveforms, when desiring to stimulate isometric contractions that cause the least tissue trauma to the skin with the greatest subjective and objective comfort for the patient.
VI. MUSCLE STRENGTHENING (ELECTROGYMNASTICS)

NEUROMUSCULAR ELECTRICAL STIMULATION

Authors: Tim Watson
Source: NMES: Tim Watson. 2103

ABSTRACT:

Purpose:
There is an increasing application of long term (i.e. chronic) electrical stimulation in order to modify or change muscle function. This work was initially concentrated around athlete strengthening and function, but in recent years, the intervention has crossed the boundary into clinical practice with an increasing range of applications. There are numerous studies that indicate that such stim is capable of changing muscle function parameters e.g. strength and endurance. The mechanism of this intervention relates primarily to muscle fibre type and stimulation frequency, though there are almost certainly other parameters that have an influence (e.g. waveform, stimulation pattern, electrodes etc.).

Kramer et al (1984), Walmsley et al (1984), Snyder-Mackler et al 1989) have all published evidence which supports the asymmetric over the symmetric waveform (max quads force production). Ferguson et al, 1989; Underwood et al, 1990 investigated "Approximately linear relationship between current intensity and force of contraction" and concluded that the greatest effects are with least current intensity by using biphasic pulsed or burst alternating current.

Stimulation frequency affects force generation of higher forces produced with tetanic contractions, but also more discomfort and potential for muscle damage, more especially with patients (the tetanic stim is widely researched with athletes/fit individuals rather than those with muscle dysfunction), maximum at 60 - 100Hz (Binder et al 1990), but also get higher fatigue with 20Hz stimulation will achieve about 65% force, but also much less fatigue.

ELECTRICAL STIMULATION USING KILOHERTZ – FREQUENCY ALTERNATING CURRENT

Authors: Alex R. Ward
Affiliations: Musculoskeletal Research Centre, Faculty of Health Sciences, La Trobe University, Victoria, Australia

ABSTRACT:

Materials and Methods:
This article reviews the known physiology and clinically relevant, laboratory-based studies of electrical stimulation, which offer some insight into the mechanism of action of burst – modulated alternating current (BMAC) and provide some answers to the questions “Does BMAC stimulation have an advantage over pulsed current (PC)?” and “What are the optimum treatment parameters for BMAC stimulation?”

For example Bankov in 1980, compared 5 kHz alternating current (AC), modulated at 60 Hz, using stimulation intensities that produced just enough contraction of the biceps brachii muscle to maintain the elbow at 90 degrees of flexion with the upper arm vertical (an antigravity flexion level of muscle activity). He compared rectangular bursts of 1, 2, and 5 ms duration and reported that the 1 ms burst was the most comfortable. Another study reported by Bankov in the same year compared 60 Hz sinusoidally modulated bursts of AC, which varied in their modulation depth from 0% (steady, continuous AC; Fig. 1A) to 100% (fully modulated; Fig. 1), and hypermodulated bursts of AC (gaps between bursts). He reported that force increased with the degree of modulation but that with them associated discomfort showed little variation. In 1981, Bankov and Daskalov compared 5 kHz AC applied in 2 ms bursts with PC of varying pulse widths. Each was applied 3 s “on” and 3 s “off” at the intensity that produced antigravity flexion of the biceps muscle. The 5 kHz stimulus was found to be more comfortable.

These early studies, thus, had 2 major findings: First that for a given level of force production, burst-modulated AC is preferable to continuous AC or PC, and the Second that a short AC burst duration (1 or 2 ms) is optimal for least discomfort. These are only examples included in this research.

A later study compared Russian current (2.5 - kHz AC applied in 10 ms bursts) and “Aussie current” (1 kHz AC applied in 4ms bursts) with PC of the same phase duration (200 and 500 μs, respectively) in terms of discomfort and torque production. The AC bursts (Fig. 1C) were more comfortable than their PC counterparts. Both Aussie current and the 2 forms of PC produced similarly high torques, but, perhaps surprisingly, Russian current evoked less.

Thus, it seems reasonable to conclude that a stimulus waveform that consists of 1 kHz frequency AC in short-duration bursts (2–4 ms) is more comfortable and elicits greater maximum electrically induced torque than PC, continuous AC, Russian current, or interferential current stimulation.

Figure 1
INTERFERENTIAL AND BURST - MODULATED BIPHASIC PULSED CURRENT YIELD GREATER MUSCULAR FORCE THAN RUSSIAN CURRENT

Authors: James W. Bellew PT, EdD, Zach Beiswanger DPT, Erica Freeman DPT, ATC, Carrie Gaerte DPT & Jane Trafton DPT

Affiliations: Krannert School of Physical Therapy, University of Indianapolis

Source: Physiotherapy Theory and Practice. 2012; 28 (5); 384 – 390

ABSTRACT:

The purpose of this investigation was to compare muscle force production of three electrical stimulating waveforms when using equivalent stimulus parameters.

Materials and Methods

Waveform 1 (conventional Russian current) was a 2500 Hz burst modulated sinusoidal alternating current (AC), burst modulated at 50 bursts/ s with 10 ms bursts and 10 ms inter-burst intervals resulting in 400 μs cycle durations and 200 μs phase durations. Waveform 2 (IFC) was a 2500 Hz amplitude-modulated sinusoidal AC, beat modulated at 50 beats per second by interfering 2500 and 2550 Hz sinusoidal AC waveforms with 20 ms beat duration, also with 400 μs cycle durations and 200 μs phase durations. Waveform 3 was a burst-modulated BP current (BMPC) also delivered at 50 bursts per second. Each burst consisted of three consecutive biphasic pulses with 200 μs phase durations and 100 μs inter-phase and inter-pulse intervals. This resulted in the burst duration of 1700 ms and an inter-burst interval of 18, 3 ms. The percent of maximal voluntary isometric knee extensor force (%MVIF) elicited using interferential, Russian, and burst-modulated biphasic pulsed currents were compared in 23 healthy college-aged subjects.

Results:

The overall ANOVA showed significance for the main effect of waveform (F = 39.25, p < 0.001) and an observed effect size of 0.789. The mean %MVIF elicited with IFC (66.1%) and BMPC (62.5%) were significantly greater (p < 0.001) than that elicited with Russian stimulation (35.8%).

Conclusions:

The results of this investigation suggest that IFC and burst-modulated BP current are viable waveform options for purposes of eliciting muscle force. These findings offer significant new evidence with strong clinical implications when selecting waveform parameters for elicitation of muscle force for NMES.

Percent of MVIF force elicited for each waveform (IFC – interferential current; BP – burst-modulated biphasic pulsed current)
RUSSIAN ELECTRICAL STIMULATION: THE EARLY EXPERIMENTS

Authors: Ward, Alex R.; Skuratova, Nataliya
Affiliations: Department of Human Physiology and Anatomy, Faculty of Health Sciences, La Trobe University, Australia
Source: Physical Therapy. 2002; 82 (10): 1019 – 1030

ABSTRACT:
This article reviews and provides details of the original studies by Kots and co–workers, who claimed force gains of up to 40% in elite athletes as a result of what was then a new form of stimulation.

Delitto et al. reported a single–subject experiment using an elite weight lifter undergoing weight training who was given periods of Russian electrical stimulation during the course of training, accompanied the periods of stimulation. They compared force gains produced using voluntary exercise following anterior cruciate ligament surgery. The electrically stimulated group showed higher force gains than the group that received voluntary exercise. Subsequent studies of force recovery following anterior crucial ligament surgery confirmed the earlier findings and established a correlation between training intensity and amount of force recovery.

Adrianova et al. conducted a study, which included a part of investigation of the optimal indirect–stimulation frequency. Whether 1 kHz is the optimal for indirect stimulation, whereas 2, 5 kHz is the optimal frequency for direct stimulation, was investigated. They used wrist and finger flexors and a continuous alternating current (AC) stimulus. Both frequencies were compared. These results were in agreement with the findings of the previous part of the study, although only stimulation with a continuous waveform was used in this part of the study. They noted that both indirect and direct stimulation produced similar levels of maximum force, although at different frequencies.

Conclusion:
Russian currents are widely used in physical therapy, but the support for their use in the English language literature is scant. However there are several studies reported in the Russian literature (some of them mentioned above), providing relevant experimental data and supporting the use of Russian currents in rehabilitation.

VASTUS MEDIALIS ELECTRICAL STIMULATION TO IMPROVE LOW EXTREMITY FUNCTION FOLLOWING A LATERAL PATELLAR RETINACULAR RELEASE

Authors: Valma J. Robertson, PhD.; Alex R. Ward, PhD.
Affiliations: School of Physiotherapy; School of Human Biosciences, La Trobe University, Bundoora, Australia

ABSTRACT:
Objective:
To examine the effect of electrical stimulation of the vastus medialis muscle on stiffness, pain and function for a patient with delayed functional progress following a lateral patellar retinacular release.

Methods and Measures:
An electrical stimulation program producing approximately 300 contractions daily of the vastus medialis muscle was implemented. The electrical stimulation applied for 33 of the 36 days was a rectangular and balanced biphasic pulse of 625-μs duration, 70-Hz frequency, 8-second peak on-time, 3-second off-time, 1-second ramp-up, and 0.5-second ramp-down. Objective measures of stair climbing and hopping, together with the subjective measure of therapist-palpated superomedial patella displacement force, were recorded for each treatment visit. Other subjective measures were the patient’s daily recordings of knee pain and stiffness.

Results:
Patient-reported stiffness reduced rapidly as the actual and cumulative number of daily contractions of the vastus medialis muscle increased. After 8 days of electrical stimulation, the patient was able to ascend stairs unassisted and after another 21 days was able to hop unsupported.

Conclusions:
Stiffness rapidly reduced and function started to improve once the electrical stimulation program was implemented. Recovery during the 36 days of treatment with electrical stimulation was greater than during the previous 5 months using other methods. Compliance was not an issue, nor was muscle soreness.

“The location of the 2 sets of electrodes used to stimulate the vastus medialis muscle: 2 small electrodes days 2 to 8. 2 large electrodes days 9 to 37”
A COMPARISON OF TORQUE GENERATING CAPABILITIES OF THREE DIFFERENT ELECTRICAL STIMULATING CURRENTS

Authors: Lynn Snyder - Mackler, PT, MS, SCS; Mark Garrett, PT, BS; Mark Roberts, PT, BS
Affiliations: Sargent College of Allied Health Professions. Boston University, Boston; Rehab Hospital of Altoona, Physical Therapy and Athletic Training Associates

ABSTRACT:

Objective:
The purpose of this study was to test the torque generating capabilities of three commercially available neuromuscular electrical stimulators (NMES) having different current characteristics.

Methods and Measures:
Twenty healthy adults were positioned in sitting on an isokinetic dynamometer. Maximum voluntary isometric knee extension torque was determined. Subsequently, two 10-s, maximally tolerated contractions were elicited with each machine. The order of stimulation was randomized and there were 2-min rest periods between contractions. Electrically elicited torque values were expressed as a percentage of the maximal voluntary isometric torque (% MVIT). Analysis of variance with one repeated measure showed a significant difference among %MVIT produced by the stimulators.

NMES 2 produced significantly less %MVIT than either NMES 1 or NMES 3 (VMS). The NMES 1 machine delivers a 2500 Hz alternating current (200 μs phase duration) with a 10 ms duty cycle. The VMS device (NMES 3) delivers a symmetrical biphasic square wave that was set at a frequency of 50 pulses per second (pps) and phase duration of 200 μs. The NMES 2 device delivered two different alternating currents and was set to provide currents of 4000 and 4050 Hz, which gives an amplitude modulation frequency of 50 beats/s and phase duration of 125 μs.

Conclusion:
Although all three devices were capable of producing %MVIT that has been shown to be sufficient for strengthening, it appears that NMES 2 does not have the capacity to provide “overload” as strength increases.

BLOOD FLOW CHANGES IN TRAPEZIUS MUSCLE AND OVERLYING SKIN FOLLOWING TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

Authors: Margareta L Sandberg, Matilda K Sandberg, Johanna Dahl
Affiliations: Department of Biomedical Engineering, Linköping University, Sweden
Source: Physical therapy 2007; 87: 1047 – 1055

ABSTRACT:

Objective:
The purpose of this study was to examine the effects of transcutaneous electrical nerve stimulation (TENS) on local blood flow in the trapezius muscle and overlying skin.

Subjects and Methods:
Thirty-three healthy women, aged 25 to 55 years, were randomly assigned to receive 1 of 3 different modes of TENS. The subjects were tested in a sitting position with their back supported up to the lower part of the scapula. Skin and muscle blood flow were monitored noninvasively using a new application of photoplethysmography for 15 minutes of TENS applied at high frequency (80 Hz burst mode) and sensory-level intensity and at low frequency (2 Hz burst mode) and motor-level intensity and for 15 minutes after stimulation. Subliminal 80-Hz TENS was used as a control. Blood flow was monitored simultaneously on stimulated and nonstimulated shoulders.

Results:
The stimulation intensity (initial stimulation intensity and adjusted stimulation intensity, respectively) was between 2.2 and 2.4 times the sensory threshold (220%–240% of sensory threshold) with sensory-level 80-Hz TENS and 0.2 times the sensory threshold (20% of sensory threshold) with subliminal TENS. With motor level 2-Hz TENS, the intensity was 2.6 to 3.3 times the sensory threshold (260%–330% of sensory threshold), or 1.8 to 2.3 times the motor threshold (180%–230% of motor threshold).

Conclusions:
The primary results of this study were that the trapezius muscle blood flow in women who were healthy increased significantly with motorlevel 2-Hz TENS, which produced visible muscle contractions, lasting 3 minutes poststimulation, whereas no increase existed with sensorylevel 80-Hz TENS, which elicited a strong sensation of paresthesia but no muscle contractions, or with subliminal TENS. As was evident when comparing stimulated and nonstimulated shoulders, skin blood flow overlying the trapezius muscle did not increase following any of the TENS interventions. This new application of PPG allows noninvasive and simultaneous measurements of local muscle and skin blood changes.
TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION: EFFECT ON PERIPHERAL NERVE CONDUCTION, MECHANICAL PAIN THRESHOLD AND TACTILE THRESHOLD IN HUMANS

Authors: Deirdre M. Walsh, DPhil, Andrea S. Lowe, DPhil, Kenneth McCormack, BSc, Jean Claude Wilier, MD, G. David Baxter, DPhil, Jim M. Allen, PhD
Affiliations: Rehabilitation Sciences Research Group, School of Health Science, University of Ulster at Jordanstown, Northern Ireland; Département d’Explorations Fonctionnelles Neurologiques, Hôpital Pitié – Salpêtrière, Paris, France

ABSTRACT:

Objective: The aim of this study was to investigate the effect of different transcutaneous electrical nerve stimulation (TENS) parameters on nerve and on peripheral mechanical pain threshold (MPT) and tactile threshold (TT), and to further the current knowledge of the neurophysiologic effect of TENS.

Study design: Fifty healthy human subjects were randomly allocated in equal numbers to a control group or one of four TENS groups to receive electrical stimulation consisting of four combinations of TENS pulse durations (50μsec and 200μsec) and frequencies (4Hz and 110 Hz). In the TENS groups, TENS was applied under double-blind conditions for 15 minutes over the superficial radial nerve in the dominant forearm. Over an 1 hour period, compound action potentials, MPT readings, and TT readings were recorded bilaterally.

Subjects and Methods: Thirty-three healthy women, aged 25 to 55 years, were randomly assigned to receive 1 of 3 different modes of TENS. The subjects were tested in a sitting position with their back supported up to the lower part of the scapulae. Skin and muscle blood flow were monitored noninvasively using a new application of photoplethysmography for 15 minutes of TENS applied at high frequency (80 Hz burst mode) and sensory-level intensity and at low frequency (2 Hz burst mode) and motor-level intensity and for 15 minutes after stimulation. Subliminal 80-Hz TENS was used as a control. Blood flow was monitored simultaneously on stimulated and nonstimulated shoulders.

Results: Only one combination of TENS parameters (110 Hz, 200 μs) effected consistent changes in all of the variables assessed, ie. TENS produced a significant increase in negative peak latency while simultaneously increasing both MPT and TT.

Conclusions: The findings from this study suggest that at least a part of TENS - mediated hypoalgesia is a consequence of a direct peripheral effect of TENS, although a “central” effect may not be excluded.
EFFECTS OF DIFFERENT TYPES OF ELECTROSTIMULATION THRESHOLD PRESSURE IN HEALTHY SUBJECTS IN UNIVERSIDAD METROPOLITANA DE CIENCIAS DE LA EDUCACIÓN

Authors: Venegas De la Paz, Mauricio; González Contreras, Nicole; Sanhueza Pozo, Carla
Affiliations: Universidad Metropolitana de Ciencias de la Educación, Santiago, Chile

ABSTRACT:

Introduction:
Electrostimulation is used in multiple studies (Morillo, 1998). In clinic, transcutaneous electrical nerve stimulation (TENS) and interventional currents (IF), are used for pain relief modifying sensory thresholds, there is no agreement in application mode, types of current and accessibility. The effects of EE on thresholds show that high frequencies and high intensity stimulation with TENS, produces changes in the UPP (threshold pressure), while applying IF modified thresholds in 10 min, noting placebo component, do exist significant difference in changing thresholds at 15 and 30 min of treatment. It has been shown that the UPP are modified only during intervention.

Purpose:
To determine the effect of the electrostimulation in variation threshold pressure in healthy students of UMCE (Universidad Metropolitana de Ciencias de la Educación).

Materials and Methods:
The sample of 64 volunteers, 50% women, students UMCE, randomized into groups (TENS, IF, Placebo Control). Dynamometry in muscle erector right of back. The application parameters for TENS, 110 Hz and 200 μs, TIF 4000 Hz with AMF 100 Hz, sensitive threshold intensity. Topline BTL-4825S equipment and pressure dynamometer (FDMIX) were used.

Results:
According to ANOVA, there are no differences in the UPP recorded in the study subjects, among research groups in UPP, being stratified by sex, there are differences between men and women by ANOVA (p = 0.042) for times 0, 15 and 30 minutes of application. Significant explanatory variables threshold are: size, mass and folding without higher incidence to 50%.

Conclusions:
TENS is more effective than TIF to modify the UPP in healthy women. The effects found are attributed to neurophysiological effects, revealing no clinical significance because they are not involved subjects with pathology, what is proposed for future research (Taylor P, 1981, Watson T., 2009). The differences between groups are supported that TENS is better than IF in modifying the UPP (Chesterton, L 2003). Once compared between TENS and IF, it reflected a statistically significant difference in favor of TENS at all times programed of EE.
EFFECT OF ELECTRICAL STIMULATION WITH HIGH VOLTAGE PULSED GALVANIC CURRENT AND RUSSIAN CURRENTS ON LACTIC ACID ACCUMULATION: A PRELIMINARY STUDY

Authors: Zuhal Gültekin, Ayşe Kin İşler, Öзgür Sürenkök, Nuray Kirdi
Affiliations: Department of Physical Therapy and Rehabilitation, Department of Sport Sciences, Department of Vocational School of Health Sciences, Baskent University; School of Physical Therapy and Rehabilitation, Hacette University, Ankara, Turkey
Source: Fizyoterapi Rehabilitasyon. 2006; 17 (2): 89 – 94

ABSTRACT:

The purpose of this study was to compare the effects of electrical stimulation with two different currents on lactic acid accumulation.

Materials and Methods:
Twenty healthy male volunteers participated in this study, and were equally divided into high voltage pulsed galvanic current (Hvpgc) and Russian currents groups. In both groups, electrical stimulation was applied to the quadriceps muscle of the dominant leg. A regime of ten stimulus repetitions for 5 s followed by 5 s of rest to Hvpgc group, and a regime of ten stimulus repetitions for 10 s followed by 50 s of rest to Russian currents group were applied. Subjects’ blood lactic acid levels were determined before, in the middle and immediately after the electrical stimulation and at the third and fifth minute of recovery period.

Results:
Mean blood lactic acid levels before, in the middle, after electrical stimulation and at the third and fifth minute of recovery are given in Table. According to 2 x 5 ANOVA with repeated measures significant time effects were found in blood lactic acid levels before, in the middle and immediately after and at the third and fifth minutes of electrical stimulation.

Conclusion:
This study compares two different currents and their effect on muscular fatigue and therefore on lactic acid accumulation. Results indicated that the two currents did not result in different effect with regard to lactic acid accumulation. However in both groups lactic acid concentrations were significantly higher than immediately after and at third and fifth min of recovery between groups.

<table>
<thead>
<tr>
<th></th>
<th>HVPGc (N=10) X±SD</th>
<th>Russian (N=10) X±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLA levels (mmol)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>0.99±0.38</td>
<td>0.74±0.22</td>
</tr>
<tr>
<td>Middle</td>
<td>0.75±0.40</td>
<td>0.76±0.34</td>
</tr>
<tr>
<td>After</td>
<td>0.72±0.24</td>
<td>0.55±0.22</td>
</tr>
<tr>
<td>3rd min recovery</td>
<td>0.71±0.34</td>
<td>0.59±0.29</td>
</tr>
<tr>
<td>5th min recovery</td>
<td>0.68±0.41</td>
<td>0.61±0.28</td>
</tr>
</tbody>
</table>

There is a difference between before and 3rd min recovery, between before and 5th min recovery, in each group (p<0.05).

MUSCLE OXYGENATION OF VASTUS LATERALIS AND MEDIALIS MUSCLES DURING ALTERNATING AND PULSED CURRENT ELECTRICAL STIMULATION

Authors: Abdulaziz Aldayel, Makki Muthalib, Marc Jubeau, Michael McGuigan, Kazunori Nosaka
Affiliations: Department of Physical Education and Movement Sciences, King Saud University, Saudi Arabia; Jean Monnet University, Saint – Etienne, France; New Zealand Academy of Sport North Island; University of Technology, Auckland, New Zealand; Queensland University of Technology, Brisbane, Australia

ABSTRACT:

Objective:
This study compared between alternating and pulsed current electrical muscle stimulation (EMS) for muscle oxygenation and blood volume during isometric contractions.

Purpose:
To determine the effect of the electrostimulation in variation threshold pressure in healthy students of UMCE (Universidad Metropolitana de Ciencias de la Educación).

Materials and Methods:
Nine healthy men received alternating current EMS (2500 Hz) modulated at 75 Hz on the knee extensors of one leg, and pulsed current EMS (75 Hz) for the other leg separated by 2 weeks in a randomised, counter-balanced order. Stimulation parameters were matched between conditions and 30 isometric contractions were induced at the knee joint angle of 100° (0° full extension). Changes in tissue oxygenation index (DTOI) and total hemoglobin volume (DTHb) of vastus lateralis and medialis muscles over 30 contractions were assessed by a near-infrared spectroscopy, and were compared between conditions by a two way repeated measures ANOVA.

Results:
Peak torque produced during EMS increased over 30 contractions in response to the increase in the stimulation intensity for pulsed current, but not for the alternating current EMS. The torque during each isometric contraction was less stable in alternating than pulsed current EMS. The changes in DTOI amplitude during relaxation phases and DTHb amplitude were not significantly different between conditions. However, the decreases in DTOI amplitude during contraction phases from baseline were significantly greater (p < 0.05) for the pulsed current than alternating current from the 18th contraction (-15.6 ± 2.3 vs. -8.9 ± 1.8%) to 30th contraction (-10.7 ± 1.8 vs. -4.8 ± 1.5%). These results suggest that the muscles were less activated in the alternating current EMS when compared with the pulsed current EMS.
NEW PERSPECTIVES IN EDEMA CONTROL VIA ELECTRICAL STIMULATION

Authors: Frank C. Mendel, PhD.; Dale R. Fish, PhD, PT
Affiliations: Department of Anatomical Sciences, State University in New York;

ABSTRACT:
Objective:
We recently conducted a series of controlled, blinded studies on several nonhuman animal models to determine the efficacy of several forms of ES, but high-voltage pulsed current (HvPC) in particular, in controlling acute posttraumatic edema. We observed that acute posttraumatic edema is curbed by HvPC when certain protocols are used. Results of these studies suggest to us that waveform, polarity, treatment schedule, intensity and frequency of pulses all influence ES.

For example, there is a compilation of the results of the first experiment (Fig. 1). Data were normalized for each study by expressing results as percentage swelling relative to peak swelling of control limbs. Results of individual experiments are superimposed on a composite. This composite was assembled as follows: the darker (upper) stippled band represents the range of swelling observed for all untreated limbs (all experiments) and all treated limbs in which no treatment effect was detected; the lighter (lower) stippled band represents the range of swelling observed in treated limbs, which exhibited significant treatment effects. The dashed line on the graph (superimposed on the bands) represents the response of the untreated limbs during that particular experiment; the solid line represents the response of the treated limbs during that experiment. If, for any particular experiment, the dashed line overlies the lower band, then a significant treatment effect was found in that experiment. Black rectangles on the abscissa indicate times during which treatments were administered. This was the first experiment and the first to show a treatment effect of HvPC on acute edema in frog hind limbs. Treatment effect was significant from the end of the first 30-min treatment to the end of data collection.

- Frog
- Impact
- High Volt (Pulsed)
- Continuous
- Cathodal
- 120 PPS
- 90% Visible Motor Threshold
- Immersion
- Immediate Multiple (Four 30min Rx; 1hr Rests; Monitor 17hrs)

Stimulation parameters
CURRENT CONCEPTS IN ELECTROTHERAPY

Authors: T. Watson  
Affiliations: Department of Physiotherapy, University of Hertfordshire, UK  
Source: Hemophilia. 2002; 8: 413 – 418

ABSTRACT:
This paper aims to review the current concepts of electrotherapy intervention, taking into account various theories which support the principles. Application of various energies in this way can result in significant benefit for the patient.

Higher energy therapies:
The first method is to deliver an energy form that will overcome the electrical activity of the cell membrane and thus force the cell to change its’ excitement levels’ and hence its activity. Electrical stimulation in its various forms appears to work in this way. Activation of the A-beta sensory fibres appears to be most efficiently achieved with electrical stimulation at frequencies in the range of 90 –130 Hz. Activation of these fibres influences the pain - gate mechanisms at spinal cord level, serving to ‘shut the gate’ and hence reduce the patients perception of pain. The A - delta sensory fibres are most efficiently stimulated with much lower frequencies (in the 2 – 5 Hz range). The result of such activation induces the release of endogenous opioids in the cord and thus brings about pain relief by means of a different mechanism. The commonality of electrical stimulation modes in use within physiotherapy is that the nerve is the target tissue. It is possible to employ alternative modes of current application in order to influence tissues other than the nerves. For example, small DC currents can be utilized to influence the healing responses of the musculoskeletal tissues and interferential therapy has been employed to enhance fracture healing.

Low – energy therapies:
The effects are essentially ‘non-thermal’, although there must be a thermal component with any energy absorption. The intention is to bring about an increase in cell membrane activity (usually by influencing a variety of ion gates or channels), and by doing so, to bring about a change in cell state without overt heating effects. It has been demonstrated that ‘non-thermal’ effects can strongly influence the tissues, inducing significant changes in tissue activity. By utilizing the energy mode that is preferentially absorbed in the target tissues it is possible to trigger a range of physiological changes that can be subsequently employed to achieve therapeutic benefit.

Conclusion:
An electrotherapy modality applied in the most appropriate circumstances should be able to achieve significant benefit. Applied at a less than fully appropriate energy level, amplitude or frequency, it is likely to ‘miss the mark’ and a less beneficial outcome may result. As one part of the therapeutic armoury, electrotherapy has well - earned place in the modern management of patient problems. Its use in combination with other forms of physical therapy, e.g. manual therapy, exercise therapy, postural correction and patient education, is likely to achieve the most significant results. Used inappropriately, it is at best ineffective.

SOMATOTOPY OF PERCEPTUAL THRESHOLD TO CUTANEOUS ELECTRICAL STIMULATION IN MAN

Authors: N. J. Davey, A. V. Nowicky, R. Zackman  
Affiliations: Division of Neuroscience and Psychological Medicine, Imperial College School of Medicine, Charing Cross Hospital; Department of Sport Sciences, Brunel University, Isleworth, London  

ABSTRACT:
Purpose:
The aim of this study was to compare measure perceptual threshold (PT) and two – point discriminative ability (TPDA) on a number of dermatomes in order to assess the degree of somatotopic change in PT and to assess its reliability and repeatability for use as a clinical assessment tool.

Materials and Methods:
In this study we have tested normal subjects on key ASIA points on 7 spinal and 2 trigeminal (V) dermatomes using PT and compared the results with TPDA. Two points of a pair of calipers were used for measuring TPDA, were applied to the skin and the subject was asked to report whether the sensed one or two points. PT was measured using electrical stimulation (0.5 ms pulse width; 3 Hz) applied to the same locations on each dermatome via a circular self - adhesive cathode and an anode strapped to the wrist or ankle. Initially, the stimulus current was adjusted to an intensity that was clearly perceived by the subject, it was then lowered until it was no longer sensed.

Results:
As in previous studies, TPDA differed according to dermatome (ANOVA on ranks, P < 0.001), ranging from 5.6 ± 1 mm on the thumb to 43 ± 5 mm on the neck; but was not different (Student’s paired t test, p > 0.05) on opposite sides of the body for any dermatome. PT also differed according to dermatome (P < 0.001), ranging from 0.95 ± 0.1 mA on the shoulder to 0.5 ± 0.2 mA on the foot; but was not different (P > 0.05) on opposite sides of the body for any dermatome.

Conclusion:
We have shown PT to be easily measurable and reliable and therefore possibly a useful assessment tool with which to monitor recovery or deterioration of following neurotrauma as well as peripheral nerve function.
EFFICACY OF LOW – FREQUENCY AND LOW – INTENSITY ELECTROTHERAPY IN THE TREATMENT OF BREAST CANCER–RELATED LYMPHOEDEMA: A CROSS – OVER RANDOMIZED TRIAL

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ABSTRACT:

Objective:
To compare the efficacy of low-frequency low-intensity electrotherapy and manual lymphatic drainage in the treatment of chronic upper limb breast cancer-related lymphoedema.

Materials and Methods:
Thirty-six women with chronic upper limb breast cancer-related lymphoedema. Patients were randomized to undergo 10 sessions of manual lymphatic drainage followed by 10 sessions of low-frequency low-intensity electrotherapy or to undergo first low-frequency, low-intensity electrotherapy followed by manual lymphatic drainage.

Measures:
Outcomes were lymphoedema volume, pain, heaviness and tightness, and health-related quality of life measured with the Functional Assessment of Cancer Therapy Questionnaire for Breast Cancer version 4 (FACT-B+4). The treatment was effected through a wave of carrier frequency ranging from 0.31 to 6.16 Hz and a modulation between 400 and 2120 Hz; the low offset voltage is always between + 12 and – 12 V.

Results:
30 patients finalized treatment. Comparing the changes in low-frequency low-intensity electrotherapy with manual lymphatic drainage changes, there were no significant differences. Low frequency low-intensity electrotherapy did not reduce lymphoedema volume (mean of change = 19.77 ml, P = 0.36), but significant reductions were observed in pain, heaviness and tightness (mean of change = 13.1, 16.2 and 6.4 mm, respectively), and FACT-B+4 summaries improved significantly (Trial Outcome Index mean of change = 5.4, P = 0.015). Manual lymphatic drainage showed no significant changes in any of the outcomes.

Conclusion:
Although there are no significant differences between treatment changes, the observed trend towards a better health-related quality of life is remarkable in low-frequency, low-intensity electrotherapy.