

CLINICAL STUDY

Direct current therapy with/without lidocaine iontophoresis in myofascial pain syndrome

Arzu Kaya¹, Ayhan Kamanli¹, Ozge Ardicoglu¹, Salih Ozgocmen¹, Fatma Ozkurt-Zengin¹, Yilmaz Bayik²

Division of Rheumatology, Department of Physical Medicine and Rehabilitation, Firat University, Faculty of Medicine, Elazig, Turkey. drarzukaya26@hotmail.com

Abstract: *Objectives:* This study aimed to assess the effectiveness of lidocaine iontophoresis for inactivation of trigger points (TrPs) in the treatment of myofascial pain syndrome (MPS).

Methods: Fifty-eight trigger points (cervical and/or periscapular regions) in 18 female and 2 male patients with MPS were randomly assigned to two groups. These groups were treated with: lidocaine iontophoresis using direct current (3 mA, 10 min) (n: 10, 28 TrPs) or only direct current (n: 10, 30 TrPs). Lidocaine iontophoresis or direct current, followed by stretching and strengthening exercises of each of the involved muscles and postural exercises were given in both groups once daily for ten days. Clinical assessment including cervical range of motion (ROM), TrP pain pressure threshold (PPT) measurement, and manual pain scores (PS), Visual analogue scale-pain (VAS-pain), fatigue and work disability scores were evaluated at baseline, at the end of a 10 session course of treatment and at the end of fourth week. Additionally, Hamilton depression and anxiety rating scales and Nottingham Health Profile (NHP) were used to evaluate and assess depression and anxiety and quality of life, respectively. The subjects were also asked to describe their side effects.

Results: PPT, pain scores, VAS-pain were significantly improved in both groups at the end of treatment and during evaluation at fourth week. The improvement of these parameters was not significantly different between groups at the end of treatment. Quality of life (NHP scores) ($p < 0.016$) and depression and anxiety scores ($p < 0.05$) significantly improved with treatment in both groups.

Conclusion: Direct current therapy with/without lidocaine iontophoresis were determined to be effective treatment modalities in TrP management. These treatment modalities are non-invasive, cost effective and provide long term improvement. Thus, these modalities could be safely used in the management of MPS with minimal side effects, particularly if patients may not accept injection or other treatments (Tab. 3, Ref. 44). Full Text (Free, PDF) www.bmj.sk.

Key words: myofascial pain syndrome, trigger point management, lidocaine iontophoresis, galvanic current.

Myofascial pain syndrome (MPS) is a regional muscular pain syndrome characterized by the presence of hypersensitive point that is called „trigger point“ (TrP) in one or more muscle and/or connective tissue. The pain can be felt locally at the site of TrP or at a distant area through reflection (1).

Active and passive treatment approaches are recommended in the treatment of myofascial pain. Active treatment approaches include exercise, reinitiating social activities and work, ergonomically corrections, relaxation techniques and biofeedback, spraying and administration of home exercise programs following stretching. Passive treatment involves physical therapy modalities (hot, cold, massage, electrotherapy), surgery, spraying and stretching and TrP injections (2).

¹Division of Rheumatology, Department of Physical Medicine and Rehabilitation, Firat University, Faculty of Medicine, Elazig, and ²Department of Psychiatry, Firat University, Faculty of Medicine, Elazig, Turkey

Address for correspondence: Arzu Kaya, MD, Firat Universitesi, Tip Fakultesi, Fiziksel Tip ve Rehabilitasyon AD, 23119 Elazig, Turkey. Phone: +90.424.2333555/1612, Fax: +90.424.2377411

Several methods have been recommended for the inactivation of active TrP (1, 3–9) such as wet-hot applications, ice bags, fluorimethane and diathermy. These modalities result in temperature changes on the skin and the muscle and play a role in contrast-stimulation. Transcutaneous Electro Neuro Stimulation (TENS), electro-acupuncture and direct current stimulations can be utilized (10–13).

Uninterrupted direct current (galvanic current) is obtained from a battery, and the current continuously flows without change in its direction and intensity. It has solely electrical activity and does not generate heat. It is possible to stimulate the sensory, motor and sympathetic nerves using direct current (DC) particularly generated from negative electrode. It exerts its effects on sensory nerves especially in neuralgia and myalgia (13).

Iontophoresis or ion transfer is the administration of therapeutic substances to the body through direct current (13–15). Following treatment with direct current the changed ionic environment significantly decreases the stimulability of nociceptors (16). Iontophoresis is an alternative to oral or parenteral administration of drugs. Iontophoresis has been used for many years in

Tab. 1. Mean age and body mass indexes, average duration of pain and trigger point localizations of the patients in both groups.

	Number of trigger points	Age (year)	Duration of pain (month)	Body mass index	Location of trigger point	
					Right	left
LIG (n:10)	28	39.40±4.88 (30–46)	47.40±35.13 (7–96)	25.99±2.66 (19.72–29.21)	1	9
DCG (n:10)	30	33.50±6.58 (25–45)	51.60±39.21 (12–120)	23.45±4.03 (18.34–30.12)	5	5
P	>0.05	>0.05	>0.05	>0.05		

the treatment of edema, ischemic skin ulcers, hyperhidrosis, fungal infections, gout arthritis, and soft tissue inflammations like bursitis and tendinitis (15).

In this study we proposed to compare the efficacy and tolerability of the lidocaine iontophoresis via direct current versus only direct (galvanic) current on TrP in MPS.

Material and method

Twenty patients (18 female, 2 male) who were admitted to Physical Medicine and Rehabilitation outpatient clinic with at least one TrP located on cervical, back and shoulder muscles (upper, lower and middle trapezius, lavatory scapula, teres minor, supraspinatus, infraspinatus muscles), with a disease of at least 6-month duration. Patients who did not receive any treatment during the previous 8-weeks were recruited in this study. In order to compare the obtained measurements with the contralateral side of the body, patients with myofascial pain only on one side of the body were included. The patients were randomized into two groups: Lidocaine iontophoresis via direct current group (LIG) (10 cases, 28 TrPs) and control group (only direct current) (DCG) (10 cases, 30 TrPs). There were 9 female and 1 male patients in both groups. All of the patients were blind to the treatment they received in their group.

In this study diagnosis of myofascial pain syndrome was established by physical examination using the criteria by Travell and Simons and Gerwin et al (17–19). The criteria are eliciting tenderness, presence of a taut band, presence of referred pain, local twitch response, reproduction of the subject's symptomatic pain and a global assessment of the presence of TrP. The reliability of these criteria was reported high in all muscles except for local twitch response (LTR) (18).

We did not include patients with cardiovascular or respiratory disease, allergies, with injections to TrP within the last 2 months, having undergone cervical or shoulder surgery within the last year, diagnosed with fibromyalgia syndrome, cervical radiculopathy, myelopathy with severe disc or skeletal lesions, or not cooperating well. Furthermore, patients using aminoglycosides or other medications preventing neuromuscular transmission, with motor neuron diseases or diseases affecting neuromuscular junctions, or who had possible pregnancy were also not included.

Outcome assesment

Cervical range of motion (ROM) was measured with goniometry as the range on the opposite direction of the muscle con-

taining TrP (20, 21). Pressure pain threshold (PPT) measurements were performed with an algometry by placing the plastic tip to TrP. Pressure was increased by 1 kg per second and the pressure value at which the patient felt the first discomfort was recorded in kg. The same region was assessed twice in one minute intervals (8, 22–25). In order to compare the PPT values of the affected side with the healthy side, measurements were obtained from the points that were exactly symmetrical with the TrP on the opposite side.

Pain score (PS) were obtained by placing the thumb to the skin covering the muscle containing the TrP in a perpendicular fashion and exerting pressure until there is whitening of the nailbed and by evaluating the pain intensity that is felt following this application. Scoring was from 0 to 3 (0: no pain, 1: mild pain, 2: significant pain, 3: severe pain resulting in jumping sign). Subjective complaints of pain, fatigue and work disability were measured by using a visual analogue scale (VAS) scored between 0–10 cm. For the evaluation of pain related anxiety and depression were evaluated with Hamilton Anxiety and depression Inventory. Quality of life was assessed using the Nottingham Health Profile (NHP) (Domains of NHP: Pain, problems in physical mobility, loss of energy, sleeping problems, social isolation, emotional reactions).

The measurements were evaluated at baseline (first evaluation) and at the end of a course of 10-day treatment (second evaluation) and at the end of the fourth week following treatment (third evaluation).

All of the patients were treated by the same physiotherapist throughout the study and measurements were carried out by the same physiatrist who was blind to the treatment that patient received.

Application of lidocain iontophoresis via direct current and only direct current

The pieces of felt that were placed under the electrodes were impregnated with 10 ml solution of 0.5 % lidocaine (50 mg lidocain on each electrode). The positive electrode (active electrode) that was moistened with lidocaine was placed to the painful region to be treated, and to the opposite side negative electrode moistened with tap water was attached. DC was initiated at 2 mA for 2 minutes, from second minute onwards it was increased to 3 mA and continued at this dose until 10 minutes. In the control group, 0.9 % saline and tap water were used for the same application

The treatment continued for 10 sessions as one session per day. In both treatment groups the physiotherapist applied pas-

Tab. 2. Comparison of baseline and post-treatment values in both groups.

		First evaluation (I)	Second evaluation (II)	Third evaluation (III)	I-II ^a p	I-III ^b p	II-III ^c p
TrP-PPT	LIG	3.06±0.54 (2.2-3.8)	4.31±1.00 (2.2-6.0)	4.06±0.75 (2.4-5.6)	0.00 (p<0.001)	0.00 (p<0.001)	0.296 (>0.016)
	DCG	3.13±0.43 (2.4-4.2)	4.26±0.82 (2.5-6.0)	4.20±0.70 (2.7-5.6)	0.00 (p<0.001)	0.00 (p<0.001)	0.456 (>0.016)
	P	0.644	0.864	0.543			
Symmetrical point-PPT	LIG	4.89±0.81 (3.2-6.0)	4.95±1.07 (2.4-6.0)	4.84±0.99 (2.8-6.0)	0.525 (>0.016)	0.526 (>0.016)	0.213 (>0.016)
	DCG	4.62±0.97 (2.4-6.0)	4.82±0.95 (2.5-6.0)	4.84±0.85 (2.7-6.0)	0.387 (>0.016)	0.330 (>0.016)	0.746 (>0.016)
	P	0.325	0.455	0.791			
TrP-PS	LIG	2.86±0.36 (2.0-3.0)	1.50±1.07 (0.0-3.0)	1.61±0.87 (0.0-3.0)	0.00 (p<0.001)	0.00 (p<0.001)	0.651 (>0.016)
	DCG	2.77±0.50 (1.0-3.0)	1.90±1.84 (0.0-3.0)	2.07±0.69 (1.0-3.0)	0.00 (p<0.001)	0.001 (p<0.001)	0.302 (>0.016)
	P	0.537	0.148	0.043 (p<0.05)			
Symmetrical point-PS	LIG	0.71±0.98 (0.0-3.0)	0.89±1.13 (0.0-3.0)	0.68±1.02 (0.0-3.0)	0.244 (>0.016)	0.783 (>0.016)	0.277 (>0.016)
	DCG	0.97±1.07 (0.0-3.0)	0.90±0.84 (0.0-3.0)	0.97±0.85 (0.0-3.0)	0.719 (>0.016)	0.939 (>0.016)	0.723 (>0.016)
	P	0.338	0.555	0.077			
Cervical ROM	LIG	33.20±3.48 (28-40)	45.70±1.70 (43-48)	44.90±2.60 (38-48)	0.005 (p<0.016)	0.005 (p<0.016)	0.292 (>0.016)
	DCG	35.60±4.76 (30-43)	47.60±2.91 (42-50)	45.50±5.01 (32-50)	0.005 (p<0.016)	0.007 (p<0.016)	0.184 (>0.016)
	P	0.353	0.075	0.218			
VAS-pain	LIG	6.28±2.06 (2.7-8.9)	2.46±1.49 (0.7-5.1)	1.98±1.71 (0.0-6.1)	0.005 (p<0.016)	0.007 (p<0.016)	0.444 (>0.016)
	DCG	6.87±0.79 (5.3-7.9)	3.18±2.00 (0.6-7.9)	2.38±1.28 (0.5-4.5)	0.008 (p<0.016)	0.005 (p<0.016)	0.169 (>0.016)
	P	0.739	0.315	0.280			
VAS-fatigue	LIG	5.81±2.16 (2.6-9.3)	3.10±1.74 (1.4-6.5)	3.23±2.37 (0.0-7.8)	0.007 (p<0.016)	0.103 (>0.016)	0.358 (>0.016)
	DCG	5.88±2.54 (2.4-10.0)	2.65±2.28 (0.0-6.9)	2.56±1.92 (0.0-6.6)	0.005 (p<0.016)	0.007 (p<0.016)	0.953 (>0.016)
	P	0.853	0.684	0.436			
VAS-work disability	LIG	4.56±2.49 (0.0-8.0)	2.09±1.89 (0.0-5.5)	2.65±1.75 (0.0-5.4)	0.013 (p<0.016)	0.083 (>0.016)	0.475 (>0.016)
	DCG	4.41±2.04 (0.5-7.8)	2.59±2.97 (0.0-10.0)	2.14±1.26 (0.6-4.9)	0.059 (>0.016)	0.017 (>0.016)*	0.610 (>0.016)
	P	0.912	0.796	0.481			
Hamilton Depression Rating Scale	LIG	13.50±4.77 (6.0-20.0)		7.90±3.75 (4.0-11.0)		0.008 (p<0.05)	
	DCG	10.10±4.63 (3.0-17.0)		7.60±3.81 (3.0-14.0)		0.037 (p<0.05)	
	P	0.165		0.631			
Hamilton Anxiety Rating Scale	LIG	14.20±4.26 (6.0-19.0)		9.60±3.75 (3.0-14.0)		0.017 (p<0.05)	
	DCG	11.10±2.60 (6.0-15.0)		8.50±2.68 (4.0-13.0)		0.017 (p<0.05)	
	P	0.029 (p<0.05)		0.436			

First evaluation (I): Baseline, Second evaluation (II): after treatment of ten sessions, Third evaluation (III): at the first month after the treatment, ^{a,b,c}: The comparisons of groups. (*) the level of significance was taken as 0.016 (Bonferroni correction).

sive stretching exercises to all the patients just after the electrotherapy session. Additionally, the participants continued active stretching, posture and strengthening exercises at their homes.

Data analysis

Complementary statistical methods were utilized for the anthropometric and demographical data of the cases in all groups.

Chi-square test was used for measurements with ordinal variables. Inter group comparisons were made with Mann Whitney–U test and intra group comparisons were evaluated with Wilcoxon signed rank test after variance analysis with Friedman two-way ANOVA test was carried out. The threshold of significance was taken as 0.05/3 comparison number in multiple comparisons (3 comparisons; $p=0.016$). In other comparisons the threshold of significance was accepted as 0.05.

Results

The age, duration of pain, number of TrP and localizations on the body half and average body mass indexes for the patient groups are presented in Table 1. Thirtyfour percent of TrPs were localized on the upper trapezius muscle. Measurements at baseline (first evaluation), after a 10-day course of treatment (second evaluation) and at the end of first month (third evaluation) are given in Table 2.

Treatment results of the LIG

When compared with baseline values, trigger point PPT values showed significant increase at second ($p<0.001$) and third evaluation ($p<0.001$). There was significant decrease in the PS values at second ($p<0.001$) and third evaluation ($p<0.001$). VAS – pain scores significantly decreased at second ($p<0.016$) and third evaluation ($p<0.016$). There were improvements in fatigue and work disability as measured by VAS at second evaluation ($p<0.016$), yet this was not significant at third evaluation ($p<0.016$). Cervical ROM increased significantly at second evaluation (0.005, $p<0.016$) and this improvement continued at third evaluation as well (0.005, $p<0.016$).

Hamilton depression and anxiety scales significantly decreased at third evaluation ($p<0.05$).

PPT and PS measured at first, second and third evaluation from the symmetrical TrP in each patient did not significantly change ($p>0.016$).

There was not a significant difference in measurements when values of second evaluation were compared to values of third evaluation ($p>0.016$) indicating that improvement achieved with the treatment was maintained all over the first month.

Treatment results of the DCG

When compared with baseline values, PPT of TrPs values were found significantly increased at second ($p<0.001$) and third evaluation ($p<0.001$). There were significant decrease in the PS values at second ($p<0.001$) and third evaluation ($p<0.001$). VAS–pain and fatigue scores significantly decreased at second and third evaluation ($p<0.016$). There was not a significant improvement in work disability as measured by VAS at second evaluation ($p>0.016$) when compared to baseline, whereas work disability significantly improved at third evaluation (0.017, $p<0.05$). Cervical ROM increased significantly at both second and third evaluation (0.005 and 0.007, $p<0.016$).

Hamilton depression and anxiety scores showed significant decrease at third evaluation ($p<0.05$).

PPT and PS measured at first, second and third evaluation from the symmetrical TrP in each patient did not change significantly ($p>0.016$).

The comparison of the results in both groups

In the inter group comparisons of the pretreatment and post-treatment (second and third evaluation) values of trigger point and opposite side symmetrical point PPT, opposite side symmetrical point PS, pain, fatigue, work disability as measured by VAS and Hamilton depression scores did not demonstrate any significant difference ($p>0.05$). Trigger point PS values decreased more in the LIG at the third evaluation (0.043, $p<0.05$).

Significant improvement was achieved in only NHP-pain subscore in both groups at the assessment after the treatment (second evaluation) compared to baseline values ($p<0.016$), however, this improvement did not continue at third evaluation. There was no significant improvement in other NHP subscores between groups in all assessments (Tab. 3).

Side effects observed in both groups were as follows: coldness and burning sensation at the site of application 30 % (3 cases) in LIG, and 10 % (1 case) in DCG, fear and feeling of irritation 10 % (1 case) in DCG, paresthesia 70 % (7 cases) in LIG and 10 % (1 case) in DCG, palpitations 20 % (2 cases), dizziness 10 % (1 case), chest pain 10 % (1 case) and headache 10 % (1 case) in LIG. As it can be seen, other than paresthesia, the incidence of side effects was very low in both groups.

Discussion

Myofascial pain syndrome is a regional pain syndrome characterized by localized tenderness of myofascial structures (26–28). A multidisciplinary approach is recommended in the treatment because of the complex nature of the pain (29). The mainstream of the treatment is the breaking down of the vicious cycle of pain through the elimination of trigger points (1, 3, 26, 30, 31).

Gangarosa and Mahan were the first using iontophoresis modality for the treatment of temporomandibular joint dysfunction and MPS in 1982 (32). Russo et al reported that lidocaine iontophoresis provided a more long lasting local anesthesia than all routes of administration of placebo and topical application of lidocaine had shorter effects than lidocaine infiltration. It was stated that the duration of local anesthesia maintained by lidocaine iontophoresis would allow performing the short procedures of 5 minutes (33).

In our study, the effects of lidocaine iontophoresis via DC on TrP were compared with only DC. The fact that comprehensive multidimensional measurements were carried out to evaluate therapeutic efficacy, our study is different than many of the previous studies (4, 5, 21, 34, 35). We used VAS, pressure algometry, manual PS to evaluate TrP sensitivity, cervical ROM, Hamilton depression and anxiety scales, NHP scales.

In the inter-group comparisons of PPT values of the TrP and contralateral symmetrical points obtained at second and third evaluation, PS values of symmetrical points, pain, fatigue and work disability scores of VAS and Hamilton depression scales

Tab. 3. Comparison of baseline and post-treatment NHP values in both groups.

		First evaluation (I)	Second evaluation (II)	Third evaluation (III)	I-II ^a p	I-III ^b p	II-III ^c p
NHP-pain	LIG	57.31±30.73 (0-100)	23.07±16.05 (0-52.72)	24.48±22.14 (0-59.40)	0.008 (p<0.0165)	0.022 (>0.016)	0.735 (>0.016)
	DCG	61.20±26.79 (19.74-100)	8.09±10.78 (0-33.39)	18.52±29.84 (0-100)	0.00 (p<0.016)	0.017 (>0.016)*	0.624 (>0.016)
	P	0.739	0.053	0.315			
NHP-physical	LIG	25.52±17.62 (0-54.47)	19.93±7.10 (11.54-33.56)	21.54±7.86 (12.20-33.56)	0.176 (>0.016)	0.528 (>0.016)	0.207 (>0.016)
	DCG	23.13±13.34 (0-44.68)	16.24±11.52 (0-43.27)	18.57±14.59 (0-55.22)	0.050 (>0.016)	0.208 (>0.016)	0.865 (>0.016)
	P	0.796	0.156	0.143			
NHP-energy	LIG	78.88±21.48 (36.80-100)	49.42±28.72 (0-100)	50.80±38.45 (0-100)	0.039 (>0.016)*	0.084 (>0.016)	0.933 (>0.016)
	DCG	37.60±40.96 (0-100)	23.44±34.81 (0-100)	29.76±37.33 (0-100)	0.102 (>0.016)	0.522 (>0.016)	0.893 (>0.016)
	P	0.035 (p<0.05)	0.079	0.218			
NHP-sleep	LIG	33.55±23.11 (12.57-77.63)	32.23±30.16 (0-77.63)	16.56±14.15 (0-39.83)	0.893 (>0.016)	0.236 (>0.016)	0.233 (>0.016)
	DCG	18.04±31.82 (0-77.63)	16.78±32.30 (0-77.63)	1.25±3.97 (0-12.57)	0.564 (>0.016)	0.129 (>0.016)	0.157 (>0.016)
	P	0.043 (p<0.05)	0.065	0.011 (p<0.05)			
NHP-social isolation	LIG	16.77±21.38 (0-61.50)	2.44±7.33 (0-22.01)	6.39±14.72 (0-44.54)	0.068 (>0.016)	0.225 (>0.016)	0.593 (>0.016)
	DCG	13.94±32.68 (0-100)	2.20±6.96 (0-22.01)	4.21±8.89 (0-22.01)	0.285 (>0.016)	0.285 (>0.016)	0.317 (>0.016)
	P	0.393	0.968	1.000			
NHP-emotional reactions	LIG	31.09±29.35 (0-89.53)	23.30±20.22 (0-54.37)	17.29±19.86 (0-55.85)	0.575 (>0.016)	0.263 (>0.016)	0.499 (>0.016)
	DCG	29.44±23.86 (10.47-86.01)	16.02±26.56 (0-86.05)	16.37±13.28 (0-34.43)	0.123 (>0.016)	0.110 (>0.016)	0.345 (>0.016)
	P	0.971	0.356	0.971			

First evaluation (I): Baseline, Second evaluation (II): after the treatment of ten sessions, Third evaluation (III): et the first month after the treatment, ^{a,b,c}: The comparisons of groups. (*) the level of significance was taken as 0.016 (Bonferroni correction).

there were no significant differences (Tab. 2). The application of lidocaine via iontophoresis did not bring an additional benefit for the treatment of MPS when compared with the control group. Another reason behind this lack of difference in LIG and DCG might be the application of stretching exercises with proven efficacy in both groups. In order to eliminate this possible beneficial influence of stretching exercises we would require a control group in which only stretching exercises would be utilized.

In our study, in order to obtain controlled measurements for PPT and PS from TrP measurements were also conducted from symmetrical of TrP in patients with unilateral MPS. Comparisons were made between the measurements of PPT and PS obtained from TrP and its symmetrical before and after the treatment. In both of the groups PPT values obtained from TrP before the treatment were significantly lower than that of the symmetrical points while PS were significantly higher at TrP when compared to that of the symmetrical points ($p<0.05$). Therefore the sensitivity of the muscles harboring TrP was significantly higher than that of the unaffected ones as measured both subjec-

tively and objectively. The treatment did not achieve a significant change in the PPT and PS values obtained from the symmetrical points in both of the groups (Tab. 2).

It is anticipated to observe a disability and decrease in quality of life in patients with chronic MPS confronted with continuous pain and limitation of motion. In this study, we might say that disability showed significant improvements at one month after treatment either with lidocaine iontophoresis via DC or only DC, however work disability did not improve significantly.

It was reported that anxiety and depression are known to be observed frequently in suffering from MPS for a long period of time (8, 28, 36-39). In a study by Esenyel et al reported that the anxiety scores of the patients were found to be higher than their depression scores. In another study, it was reported that the severity of the pain and psychological coping strategies were in relation with response rates of MPS to treatment (40). In our study, we found moderate anxiety and depression at baseline in both groups. And there was a significant improvement in the anxiety and depression scales after the treatment ($p<0.05$).

Decrease in cervical ROM is a characteristic finding for MPS in the presence of active TrP. Cervical ROM values in our study groups demonstrated significant improvements with treatment. We found it interesting that the active trigger points were mostly located on the left side which caused limitation in lateral flexion to the right. It was improved immediately following and after the treatment in both groups ($p > 0.016$). We suggest that evaluating changes in cervical ROM may be important in following the efficacy of any treatment in MPS.

The efficacy of stretching exercises and home programs in myofascial pain have been proven in several studies (41–43). In our study, all the cases were provided by an immediate stretching of the muscles containing TrP after the treatment and were given home exercise programs. Furthermore, during the treatment period of 10 sessions, an exercise program of 45 minutes with emphasis on posture, stretching, strengthening and relaxation was applied to all the patients. As active participation to these group exercises was ensured, the compliance of the patients to the home exercise program was increased. Thereby, during the control visits the patients were observed to continue their home exercise programs to a higher extent. We think that effective physical therapy agents like iontophoresis or DC should be preferred for the treatment of MPS as they increase compliance to administered home exercise programs and provide the patients the opportunity to learn the exercises better during the duration of treatment.

When the side effects are concerned apart from paresthesia all the side effects were observed at very low frequencies in both groups. Paresthesia at the site of treatment was most commonly observed in LIG (79 %). This might be due to the utilization of lidocaine.

In another study, we found that lidocaine injection in TrP is more practical and rapid, since it causes less disturbance than dry needling and is more cost effective than BTX-A injection, and seems the treatment of choice in MPS (44).

In conclusion, we found significant therapeutic efficacy on TrP in both lidocaine iontophoresis via DC and the only DC. There was no difference between the groups concerning this therapeutic effect; severity of pain measured by VAS was decreased in both groups without having a significant difference between the groups, there were significant improvements in the anxiety and depression scores of both groups after the treatment, however this was not different between the groups. We may suggest that the application of lidocaine iontophoresis via DC or only DC has positive effects on anxiety and depression that might be observed in patients with MPS.

Several methods have been recommended for the inactivation of TrP. The treatments most commonly utilized for this purpose are dry needling of the TrP, injection treatments with local anesthetics or saline, sprays, and stretching. Some patients may not accept injection treatment. According to the results obtained from this study, we think that DC or lidocaine iontophoresis via DC can be comfortably used in the treatment of MPS as a reliable treatment modality as it gives the patients the opportunity to learn their exercise programs better during the treatment pe-

riod of the sessions, ensures their participation to home exercise programs. It is at the same time cheap, easily applicable, and non-invasive with the potential to induce limited side effects.

References

- Sola AE, Bonica JJ.** Myofascial pain syndromes. 352–367. In: Bonica JJ (Ed). The management of pain. Philadelphia; Lea and Febiger, 1990.
- McClafin RR.** Myofascial pain syndrome. Primary care strategies for early intervention. *Postgrad Med* 1994; 96 (2): 56–59, 63–66, 69–70 *passim*.
- Simons DG.** Myofascial pain syndrome due to trigger points. 686–723. In: Goodgold J (Ed). Rehabilitation medicine. St. Louis, Mosby, 1998.
- Hong CZ.** Lidocaine injection versus dry needling to myofascial trigger point. Importance of the local twitch response. *Amer J Phys Med Rehab* 1994; 73 (4): 256–263.
- Alo KM, Yland MJ, Kramer DL, Charnov JH, Redko V.** Botulinum toxin in the treatment of myofascial pain. *The Pain Clinic* 1997; 10: 107–116.
- Flor H, Birbaumer N.** Comparison of the efficacy of electromyographic biofeedback, cognitive-behavioral therapy, and conservative medical interventions in the treatment of chronic musculoskeletal pain. *J Consult Clin Psychol* 1993; 61 (4): 653–658.
- Scudds RA, Janzen V, Delaney G, Heck C, McCain GA, Russell AL, Teasel RW et al.** The use of topical 4 % lidocaine in sphenopalatine ganglion blocks for the treatment of chronic muscle pain syndromes: a randomized, controlled trial. *Pain* 1995; 62 (1): 69–77.
- Esenyel M, Çağlar N, Aldemir T.** Treatment of myofascial pain. *Amer J Phys Med Rehab* 2000; 79: 48–52.
- Janzen VD, Scudds R.** Sphenopalatine blocks in the treatment of pain in fibromyalgia and myofascial pain syndrome. *Laryngoscope* 1997; 107 (10): 1420–1422.
- Graff-Radford SB, Reeves JL, Baker RL, Chiu D.** Effects of transcutaneous electrical nerve stimulation on myofascial pain and trigger point sensitivity. *Pain* 1989; 37 (1): 1–5.
- Saggini R, Giamberardino MA, Gatteschi L, Vecchiet L.** Myofascial pain syndrome of the peroneus longus: Biomechanical approach. *Clin J Pain* 1996; 12 (1): 30–37.
- Hsueh TC, Cheng PT, Kuan TS, Hong CZ.** The immediate effectiveness of electrical nerve stimulation and electrical muscle stimulation on myofascial trigger points. *Amer J Phys Med Rehab* 1997; 76 (6): 471–6.
- Keles I.** Dogru akim. 45–58. In: Necdet Tuna (Ed). *Elektroterapi*. Istanbul; Nobel Tip Kitabevleri, 2001.
- Sengir O.** Fizik tedavi kitabi. 4–21. Istanbul; I.Ü. Istanbul Tip Fakültesi yayinlari, 1989.
- Basford JR.** Physical agents. 483–501. In: DeLisa JA, Gans BM (editors). *Rehabilitation medicine principles and practice*. Philadelphia; Lippincott-Raven Publishers, 1998.
- Arman MI.** Elektroterapi. 251–264. In: Oguz H (Ed). *Tibbi Rehabilitasyon*. Istanbul; Nobel Tip Kitabevleri, 1995.
- Simons DG.** Review of enigmatic MTrPs as a common cause of enigmatic musculoskeletal pain and dysfunction. *J Electromyogr Kinesiol* 2004; 14 (1): 95–107.

18. Gerwin RD, Shannon S, Hong CZ, Hubbard D, Gevirtz R. Inter-rater reliability in myofascial trigger point examination. *Pain* 1997; 69 (1—2): 65—73.
19. Sciotti VM, Mittak VL, DiMarco L, Ford LM, Plezbert J, Santipadri E, Wigglesworth J et al. Clinical precision of myofascial trigger point location in the trapezius muscle. *Pain* 2001; 93 (3): 259—266.
20. Yunus MB, Kalyan-Raman UP. Muscle biopsy findings in primary fibromyalgia and other forms of nonarticular rheumatism. *Rheum Dis Clin North Amer* 1989; 15 (1): 115—134.
21. Hong CZ, Hsueh TC. Difference in pain relief after trigger point injections in myofascial pain patients with and without fibromyalgia. *Arch Phys Med Rehab* 1996; 77 (11): 1161—1166.
22. Fischer AA. Pressure tresholdmeter : It's use for quantification of tender spots. *Arch Phys Med Rehab* 1986; 67 (11): 836—838.
23. Fischer AA. Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure treshold. *Pain* 1987; 30 (1): 115—126.
24. Reeves JL, Jaeger B, Graff-Redford SB. Reliability of the pressure algometer as a measure of myofascial trigger point sensitivity. *Pain* 1986; 24 (3): 313—321.
25. Ozgocmen S, Ardicoglu. Lipid profile in patients with primary fibromyalgia and myofascial pain syndromes. *Yonsei Med J* 2000; 41 (5): 541—545.
26. Berker E. Miyofasiyal agri sendromu ve tedavisi. *Romatol Tib Rehab* 1997; 8: 121—124.
27. Buskila D. Fibromyalgia, chronic fatigue syndrome, and myofascial pain syndrome. *Curr Opin Rheumatol* 1999; 11 (2): 119—126.
28. Dohrenwend BP, Raphael KG, Marbach JJ, Gallagher RM. Why is depression comorbid with chronic myofascial face pain? A family study test of alternative hypotheses. *Pain* 1999; 83 (2): 183—192.
29. Heikkila H, Heikkila E, Eisemann M. Predictive factors for the outcome of a multidisciplinary pain rehabilitation programme on sick-leave and life satisfaction in patients with whiplash trauma and other myofascial pain: a follow-up study. *Clin Rehab* 1998; 12 (6): 487—496.
30. Travell JG, Simons DG. Myofascial pain and dysfunction. Baltimore; Williams and Wilkins, 1990.
31. Han SC, Harrison P. Myofascial pain syndrome and trigger point management. *Reg Anesth* 1997; 22 (1): 89—101.
32. Lark MR, Gangarosa LP. Iontophoresis: an effective modality for the treatment of inflammatory disorders of the temporomandibular joint and myofascial pain. *Cranio* 1990; 8 (2): 108—119.
33. Russo J, Lipman AG, Comstock TJ, Page BC, Stephen RL. Lidocaine anesthesia: Comparison of iontophoresis, injection and swabbing. *Amer J Hosp Pharm* 1980; 37 (6): 843—847.
34. Cheshire WP, Abashian SW, Mann JD. Botulinum toxin in the treatment of myofascial pain syndrome. *Pain* 1994; 59 (1): 65—69.
35. Porta M. A comparative trial of botulinum toxin type A and methylprednisolone for the treatment of myofascial pain syndrome and pain from chronic muscle spasm. *Pain* 2000; 85 (1—2): 101—105.
36. Eden L, Ejlertsson G, Leden I, Nordbeck B. High rates of psychosomatic and neurotic symptoms among disability pensioners with musculoskeletal disorders. *J Musculoskeletal pain* 2000; 8: 75—88.
37. Tota-Faucette ME, Gil KM, Williams DA, Keefe FJ, Goli V. Predictors of response to pain management treatment. *Clin J Pain* 1993; 9 (2): 115—123.
38. Keefe FJ, Dolan E. Pain behavior and pain coping strategies in low back pain and myofascial pain dysfunction syndrome patients. *Pain* 1986; 24 (1): 49—56.
39. Katz WA. The needs of a patient in pain. *Amer J Med* 1998; 105 (1B): 2S—7S.
40. Scicchitano J, Rounsefell B, Pilowsky I. Baseline correlates of the response to the treatment of chronic localized myofascial pain syndrome by injection of local anaesthetic. *J Psychosom Res* 1996; 40 (1): 75—85.
41. Lewit K, Simons DG. Myofascial pain: relief by post-isometric relaxation. *Arch Phys Med Rehab* 1984; 65 (8): 452—456.
42. Hanten WP, Olson SL, Butts NL, Nowicki AL. Effectiveness of a home program of ischemic pressure followed by sustained stretch for treatment of myofascial trigger points. *Phys Ther* 2000; 80 (10): 997—1003.
43. Rosen NB. Physical medicine and rehabilitation approaches to the management of myofascial pain and fibromyalgia syndromes. *Baillieres Clin Rheumatol* 1994; 8 (4): 881—916.
44. Kamanli A, Kaya A, Ardicoglu O, Ozgocmen S, Zengin FO, Bayik Y. The Comparison of Lidocaine Injection, Botulinum Toxin Injection and Dry Needling to Trigger Points in Myofascial Pain Syndrome. *Rheumatol Int* 2005; 25 (8): 604—611.

Received September 18, 2008.

Accepted December 18, 2008.