

Combined Physiotherapy in Patients with Arthrogenous Pain of Temporomandibular Joint

Temporomandibular Eklem Artrojenik Ağrılı Hastalarında Kombine Fizyoterapi

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ABSTRACT

Objective: The objective of this study was to investigate, in a random study design, whether home exercise program (HEP) combined with phonophoresis, ultrasound (US) and low level laser therapy (LLLT) in different modes were more effective than HEP alone in the improvement of mouth opening and pain in patients with chronic temporomandibular disorder.

Methods: Eighty nine patients with chronic temporomandibular disorder were included in the study. Vertical mouth openings (VMO) and protrusion openings (PO) were measured. Joint pain at rest and at motion were evaluated using visual analogue scale (VAS). All evaluations were made before the treatment (BT) and repeated again after the treatment (AT) and on the 30th and 90th days AT. Twenty-four patients were randomly assigned to group-1 (phonophoresis+LLLT+HEP), 25 patients to group-2 (US+LLLT+HEP), 20 patients to group-3 (LLLT+HEP), and 20 patients to group-4 (HEP).

Results: The main effects of the time course and the treatment type on VMO, PO scores and on VAS scores at rest and mobility were found to be significant. Group-1 was found to have significantly better effects on all parameters than group-4. For all parameters, statistically significant improvements were found when BT values were compared with AT, 30th and 90th days AT values.

Conclusion: Improvement was obtained in mouth opening and pain parameters in other treatment groups, while the best improvement in these parameters was obtained using combined treatment of phonophoresis+LLLT+HEP. (*J PMR Sci 2010;13:6-14*)

Keywords: Temporomandibular joint disorder, physical therapy modalities, low-level laser therapy, ultrasound, rehabilitation

ÖZET

Amaç: Bu çalışmanın amacı kronik temporomandibular bozukluğu olan hastalarda ağrı ve ağız açıklığı iyileşmesinde ev egzersiz programına (EEP) farklı şekillerde kombine edilmiş fonoforez, ultrason (US) ve düşük şiddette lazer tedavisinin (DŞLT) tek başına EEP'ye göre daha etkili olup olmadığının randomize çalışma dizaynı içinde incelenmesidir.

Yöntemler: Çalışmaya kronik temporomandibular bozukluğu olan 89 hasta dahil edildi. Vertikal ağız açıklıkları (VAA) ve protrüzyon açıklıkları (PA) ölçüldü. İstirahat ve hareket halinde eklem ağrısı görsel analog skala (GAS) kullanılarak değerlendirildi. Tüm değerlendirmeler tedavi öncesi (TO) yapıldı ve tedavi sonrası (TS), TS 30 ve 90. günlerde tekrarlandı. Yirmidört hasta randomize olarak grup-1'e (fonoforez+DŞLT+EEP), 25 hasta grup-2'ye (US+DŞLT+EEP), 20 hasta grup-3'e (DŞLT+EEP), 20 hasta grup-4'e (EEP) atandı.

Bulgular: Zamanın ve tedavi tipinin temel etkisi VAA, PA puanları, istirahat ve hareket GAS puanları üzerine anlamlı bulundu. Grup-1 tüm parametreler üzerine grup-4'den anlamlı olarak daha etkili bulundu. Tüm parametreler için TÖ değerler, TS, TS 30 ve 90. gün değerleri ile karşılaştırıldığında istatistiksel olarak anlamlı iyileşmeler bulundu.

Sonuç: Diğer tedavi gruplarında ağız açıklığı ve ağrı parametrelerinde iyileşme saptanmakla birlikte bu parametrelerde en iyi iyileşme fonoforez+DŞLT+EEP kombine tedavisinin kullanılması ile elde edildi. (*FTR Bil Der 2010;13:6-14*)

Anahtar kelimeler: Temporomandibular eklem bozuklukları, fizik tedavi modaliteleri, düşük şiddette lazer tedavisi, ultrason, rehabilitasyon

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Introduction

Temporomandibular disorders (TMD) are very common and cause important drawbacks in the daily lives of the patients since they affect important functions such as eating, speech etc. TMD are classified as a musculoskeletal condition resulting in craniofacial pain, functional limitations and disability (1). Studies indicate that 75% of adult population have at least one symptom associated with TMD, and approximately 30% have more than one symptom while only 3-7% apply for treatment (2,3). An estimated 20-25% population is affected, with female to male ratio ranging between 3:1 to 6:1 (4,5,6). TMDs are classified under two main groups which are articular disorders and masticatory disorders. Disc-derangement disorders (displacement with reduction, displacement without reduction and disc perforation) are included in articular disorders group (7) and are defined as an abnormal positional relationship of the disc relative to the mandibular condyle and the articular eminence (8).

Current treatment modalities in TMD are mostly conservative (7, 9). Management of TMD consists combination of home self-care, counseling, physiotherapy, pharmacotherapy, jaw-appliance therapy, physical medicine, behavioral medicine, and surgery (7,9). American Academy of Craniomandibular Disorders and the Minnesota Dental Association cites physical therapy as an important treatment in TMD (4). The most commonly employed methods of physiotherapy treatment are short wave diathermy, ultrasound (US) and laser therapy (10). Despite US being a frequently-employed treatment method, there is little evidence to support the use of US therapy in the treatment of musculoskeletal disorders (11,12,13). Phonophoresis is a therapy approach consisting of combined application of a pharmacology agent with US. Studies involving the use of phonophoresis and US method in patients with TMD are very limited in the literature. Shin et al, in a study they carried out on 20 patients with temporomandibular joint (TMJ) pain, compared the efficiencies of indometacin gel and placebo gel phonophoresis. They found a significant reduction in visual analogue scale (VAS) and pressure pain in the group which received indometacin gel (14).

There are some studies in the literature carried out on the effectiveness of low-level laser therapy (LLLT) in patients with arthrogenous TMD reporting that LLLT decreases pain level compared with placebo (15), and that mid-laser application produces significant improvement in pain and mouth opening (16). In contrast, there are also other studies arguing that LLLT is not different from placebo with respect to the effects on pain and mouth opening in patients with arthrogenous pain (17,18,19). Our

literature survey has revealed fewer articles related with the effectiveness of exercise in patients with TMD involving chronic disc displacement (20,21). Gray et al investigated the effects of short wave diathermy, intermittent short wave diathermy, US and soft laser in patients with TMJ pain and/or muscle tenderness, and showed that all four methods were more effective than the placebo, without however any significant differences among these methods (10).

It is emphasized that the use of more than one treatment modality is necessary while controlling chronic conditions over a long period (17). In most cases, especially in acute conditions, counseling and education will suffice to meet the demand of the patients. In chronic conditions, however, it is often necessary to perform a symptomatic treatment involving multiple interventions and a clinical management (22,23).

We did not come across any other study in the literature, which compared the effects of home exercise program (HEP) combined with laser, ultrasound, or phonophoresis in patients with chronic TMD. The objective of our study was to investigate whether the effectiveness of phonophoresis added on HEP+LLLT (group-1) and combined physiotherapy modalities (groups-2,3) were different from HEP alone (group-4) in patients with disc displacement of temporomandibular joint suffering from chronic pain.

Materials and Methods

Subjects

This study included 89 chronic TMD patients (suffering from TMJ pain for at least 6 months), aged between 19-40 years, who presented with TMJ pain to Oral Diagnosis and Radiology Department of Dentistry Faculty, Ankara University. The patients were assessed by a dentist (trained in evaluating TMD patients) and given a TMD diagnosis (24,25). Patients with disc displacement who failed to obtain satisfactory pain relief despite application of initial treatment protocol (home self-care, non-steroidal anti-inflammatory drugs, and occlusal appliance) by the same dentist were included in the study. The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) provides standardized criteria for TMD diagnosis. According to RDC/TMD axis-I classification, patients are divided into 3 groups: group-I: muscle disorders, group II: disc displacement, group-IIIa: arthralgia, group-IIIb-c: osteoarthritis and osteoarthrosis (26). Inclusion criteria included the followings: (a) Patients falling into group II and group IIIa (arthralgia) according to RDC/TMD axis I classification, (b) patients with pain restricted to TMJ area, (c) patients with no muscle tenderness during palpation. Exclusion criteria

included the followings: (a) congenital anomaly, (b) inflammatory or neoplastic disease, (c) acute trauma history, (d) use of non-steroidal anti-inflammatory drugs and occlusal appliance during the last 1 week, (e) allergy to topical drug administration, (f) presence of a pacemaker, (g) previous engagement in a physical therapy program, (h) bilateral TMJ pain, and (i) myofascial pain and osteoarthritis of TMJ. All patients were evaluated with magnetic resonance imaging (MRI) (1.5 Tesla Siemens® Magnetom Vision), and disc-condyle relation was determined more clearly.

Procedure

The physiotherapist was not aware of the patients' symptoms or range of motion at initial examination; the clinician (first investigator) was unaware of what physiotherapy was applied. All patients were evaluated by the first investigator in Ankara Physical Medicine and Rehabilitation Education and Research Hospital after their informed consents had been obtained. Active vertical mouth opening (VMO) and protrusion opening (PO) were measured in millimeters by the physical therapy and rehabilitation specialist (physiatrist) (first investigator) before treatment (BT, first evaluation). VMO was measured as the opening between the upper and lower central incisors, by instructing the patients to open the mouth as much as possible (27,28). The PO was measured while the patient was protruding the lower jaw as much as possible, as the distance in the horizontal plane of the lower central incisors from the upper central incisors. The joint pain at rest and motion was recorded on a 100 mm Visual Analog Scale (VAS). 0 on VAS denotes no-pain, and 100mm the greatest.

Randomization and Drop-Out Rate

Patients were then randomly assigned to treatment groups; phonophoresis+LLLT+HEP (group-1, n=24), US+LLLT+HEP (group-2, n=25), LLLT+HEP (group-3, n=20) and HEP (group-4, n=20) groups. At the beginning of the study the application order of 4 different treatment conditions was determined by lot. Each presenting patient was included in the relevant treatment group according to the order of treatment determined by lot. Accordingly, 26 patients each were assigned to group 1 and 2, and 25 patients each to groups 3 and 4. At the beginning 102 patients were taken into the study, but 13 of them were excluded there from due to various reasons. 3 patients each from group 3 and 4 were excluded from the study due to their teeth problems, and 2 patients each from the same groups were excluded for not presenting regularly for follow-up. Similarly, total 3 patients from groups 1 and 2 were excluded from the study for not presenting regularly for follow-up.

Statistical analyses were made on the basis of the results obtained from total 89 patients who completed the period of the study.

Physical Treatments

Group-1, group-2, and group-3 were applied the physical therapy consisting of 10 sessions. LLLT was performed 5 days a week for two weeks with an Endolaser 476 apparatus, using the gallium arsenide aluminum (GaAsAl) laser at 780 nm wavelength at the dose of 3.6 J/cm² and for a period of 4 minutes in a continuous contact. US and phonophoresis were performed 5 days a week for two weeks. US and phonophoresis were applied with a Sonicator 730 instrument at 3 MHz frequency, at a dose of 1.5 watt/cm² for a period of 5 minutes continuously. Phonophoresis was performed by applying 3-4 mm thick gel containing 2.5% ketoprofen on the skin over the joint. It has been demonstrated that local application of ketoprofen reaches significantly at higher concentrations in subcutaneous and intraarticular tissues than in plasma by minimal systemic effect or by side effects, and US application improves transdermal absorption of ketoprofen (29,30,31,32). An HEP was organized for all patients and they were asked to make the exercises regularly both during and after the study period of 3.5 months. This program consisted of active and passive jaw movement exercises, muscle stretching, isometric tension exercise against resistance, manual joint distraction, disc condyle mobilization, correction of body posture and relaxation techniques. The physiotherapist showed the exercises to each patient on the first day the therapy began and asked them to do the exercises themselves in order to ensure a correct performance. The 2nd day all patients, including those in group 4, performed the exercises accompanied by the physiotherapist. In this way, wrong and imperfect performances were corrected. Patients were requested to progressively increase the exercise intensity and repeat number, two times daily for a period of at least 15 minutes.

All patients were initially evaluated with respect to VMO, PO, VAS rest and VAS mobility measurements at the beginning of the treatment (first evaluation) by the first investigator, who was blinded to treatment groups immediately after treatment (AT, second evaluation), on the 30th day (third evaluation) and the 90th day (fourth evaluation) AT. Patients were instructed to adhere to this treatment protocol during the study period, they were not subjected to treatment within the last 1 week before the trial.

Data Analysis

Statistical evaluation of the data was made using SPSS-10.0 software package. Chi-square test, independent samples t-test, mixed ANOVA analysis, Bonferroni and Tukey HSD tests for multiple comparisons, were employed for the statistical analyses. The level of p<0.05 was considered statistically significant.

Results

There were no statistically significant differences between four groups with respect to demographical characteristics and disc displacement type (Table 1). No significant differences were determined between four groups with respect to VMO ($p=0.412$), PO ($p=0,894$), VAS rest ($p=0.520$) and VAS mobility scores ($p=0.868$) BT.

When mixed ANOVA analysis was applied in order to examine the main effects of treatment type (group-1, group-2, group-3 and group-4) and time course on VMO, PO, VAS rest and VAS mobility scores, these two factors were found to be significant on all parameters ($p<0.05$). The common effect of treatment type and time course was found to be significant only on PO and VAS mobility scores. The results of mixed ANOVA analysis are given in Table 2. Mean values of VMO, PO, VAS rest and mobility scores BT, AT, on 30th and 90th days AT are given in Table 3. Changes observed by time in all parameters depending on treatment types are shown in Figures 1-4.

Post Hoc Tukey HSD tests were applied in order to find out which group was associated with the significance in the main effect of treatment type. As a result of post hoc

analysis, a significant difference was found between the mean values of group-1 and group-4 with respect to VMO ($p=0.029$), PO ($p=0.047$), VAS rest ($p=0.038$) and VAS mobility parameters ($p=0.001$). In other words, combined phonophoresis+LLLT+HEP (group-1) application was determined to be significantly superior than HEP alone (group-4). Post hoc analysis indicated also a significant difference between group-1 and group-3 with respect to VAS mobility scores ($p=0.049$). VAS mobility scores of group-1 were significantly lower than group-3. On the other hand, no significant difference was determined among the mean values of all parameters of group-1, group-2 and group 3 ($p>0.05$) (except the difference between group-1 and group-3 with respect to VAS mobility). In addition, there was not any significant difference between mean values of group-2 and group-3, and group-4 ($p>0.05$).

Multiple comparisons were made in order to find out which evaluation period was associated with the significance observed in the main effect of time course. A significant improvement was found in all parameters in all AT periods (2nd, 3rd, and 4th evaluations) compared to the same scores in the BT period (1st evaluation) (Figures 1-4).

Table 1: Means and standard deviations (SD) of ages, demographic characteristics and disc displacement ratios of the patients in the treatment groups

Treatment Type	Age (year)	Sex % (n)		Education % (n)		Disc Displacement % (n)	
		Female	Male	High school	University	Reducible	Non-reducible
Group-1	28.73	87.5	12.5	45.83	54.17	66.60	33.40
	(9.53)	(21)	(3)	(11)	(13)	(16)	(8)
Group-2	24.25	88	12	66.00	44.00	64.00	36.00
	(7.59)	(22)	(3)	(14)	(11)	(16)	(9)
Group-3	33.25	90	10	25.00	75.00	65.00	35.00
	(7.70)	(18)	(2)	(5)	(15)	(13)	(7)
Group-4	32.81	90	10	40.00	60.00	60.00	40.00
	(7.14)	(18)	(2)	(8)	(12)	(12)	(8)
p values	$p=0.082$	$p=0.913$		$p=0.320$		$p=0.977$	

Table 2: Results of mixed ANOVA analysis for the effects of the treatment type and time course on VMO, PO, and VAS rest and mobility scores

Parameter	Treatment Type (A)		Time Course (B)		Treatment Type X Time Course (AXB)	
	F	p	F	p	F	p
VMO	3.143	0.034*	26.37	0.000*	2.320	0.088
PO	3.134	0.032*	59.57	0.000*	6.380	0.001*
VAS rest	2.782	0.050*	35.67	0.000*	0.788	0.505
VAS mobility	6.186	0.001*	141.657	0.000*	10.793	0.000*

*Statistically significant difference
VMO:Vertical mouth opening
PO: Protrusion opening
VAS:Visual analogue scale

Discussion

This study aims to investigate whether the effectiveness of phonophoresis added on combined physiotherapy (group-1) and combined physiotherapy (groups 2, 3) are different from HEP alone in patients with TMD suffering from chronic pain. Phonophoresis+LLLT+ HEP was determined to be significantly more effective than HEP alone with respect to all parameters. A close look at Figures 1 and 2 shows improvements in mouth opening parameters by time in all combined treatment groups, compared to HEP alone, with more marked improvements in group-1 and group-2. Phonophoresis+LLLT+HEP combination was significantly more effective on VAS mobility than LLLT+HEP and single HEP treatments. The significant effect of phonophoresis+LLLT+HEP combination on especially VAS mobility in this group may be associated with the use of a pharmacologic agent, such as ketoprofen, that can reach subcutaneous tissues and intraarticular structures. That this combination is significantly better than HEP alone with respect to pain and mouth opening, may also be associated with the pharmacotherapy ensured by use of ketoprofen.

US is primarily used for the purpose of warming up joint structures, muscles and deep muscle-skeleton tissues. Therapeutic US finds application in the treatment of TMD (TÜRKÇESİ:TMD tedavisinde US uygulanabilir because of its ability to increase joint range of motion, to promote tissue healing, to encourage blood flow and extensibility of collagen tissue, to relieve pain, and to help resolve chronic inflammation (33,34,35,36). US is believed to modify cell permeability and metabolism (33,36). US therapy was applied by Esposito et al. in an uncontrolled study on patients with TMD. The authors found a significant improvement in the symptoms of especially the patients with myofascial pain, whereas US was found to be least effective in reducing symptoms associated with the disc (36). The evidence that therapeutic ultrasound alone is useful for the treatment of TMD is lacking. However, it is effective when combined with other forms of physical treatment modalities (37). In fact, US supported LLLT+HEP treatment provided marked increases in VMO and PO values compared to group-3 and 4, which did not receive US (Figure 1-2). However, the improvement could be due to the treatment effect of US or to the placebo effect related to use of apparatus since sham US treatment was not used in

Table 3: Mean (SD) values (mm) of vertical mouth opening (VMO), protrusion opening (PO), VAS rest and mobility scores of treatment groups before treatment (BT), after treatment (AT), and at post-treatment 30th and 90th day

	BT	AT	30 th day AT	90 th day AT
Group-1				
VMO (mm)	37.20±9.07	41.60±7.03	41.40±6.53	42.46±7.26
PO (mm)	3.63±1.71	4.66±1.87	5.00±1.65	6.40±1.8
VAS rest	22.53±18.52	13.20±9.84	3.33±2.60	3.06±2.11
VAS mobility	70.60±17.35	34.53±22.60	16.66±11.58	13.6±9.74
Group-2				
VMO (mm)	33.06±6.99	38.25±5.25	38.0±5.54	41.43±6.49
PO (mm)	3.78±1.63	4.28±2.05	4.87±1.98	6.37±2.18
VAS rest	26.93±13.35	19.62±14.5	13.62±9.91	13.56±9.45
VAS mobility	68.19±20.71	46.25±21.56	35.62±21.05	32.81±19.44
Group-3				
VMO (mm)	34.06±6.52	35.43±5.36	37.25±5.68	37.43±5.29
PO (mm)	3.59±1.78	4.00±1.53	4.25±1.72	4.81±1.72
VAS rest	31.37±16.10	20.5±17.15	14.37±9.04	15.06±8.05
VAS mobility	68.0±24.6	50.62±23.15	40.50±19.54	37.25±18.29
Group-4				
VMO (mm)	33.87±6.02	34.62±5.46	36.125±5.38	35.37±5.53
PO (mm)	3.34±1.27	3.43±1.13	3.59±1.15	3.68±1.30
VAS rest	30.37±14.99	24.43±15.72	20.1±12.04	20.05±12.88
VAS mobility	64.25±21.6	59.68±11.61	56.87±6.41	52.62±8.69

Group-3 and Group-4. Similarly, LLLT combined with US in Group-1 and Group-2 may have increased the effect of US. If there were a group who received only US, clearer data could be obtained with respect to effectiveness of US. Nevertheless, our patient group was consisted of patients with chronic TMD who did not respond to previous treatments. When planning the study we wanted to find out which combined physical therapy approach would be more beneficial for the patient. Therefore, we used combined US/phonophoresis and LLLT in Group-1 and Group-2.

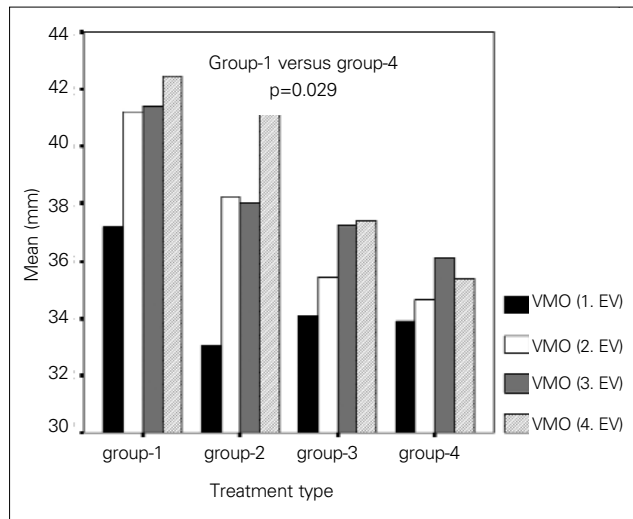


Figure 1. Changes observed by time in vertical mouth opening (VMO) values in the treatment groups. 1. EV: Before treatment, 2. EV: After treatment, 3. EV: 30th day after treatment, 4. EV: 90th day after treatment (Significance levels and direction of arithmetic mean of the parameters found to be significant regarding the time course in multi-comparison tests. 1. EV<2. EV*, 1. EV<3. EV*, 1. EV<4. EV*, 2. EV<4. EV). *: p<0.001, **: p<0.01**

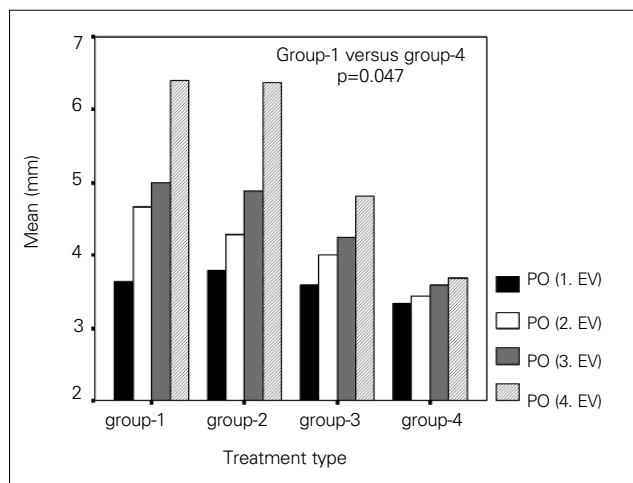


Figure 2. Changes observed by time in protrusion opening (PO) values in the treatment groups. Significance levels and direction of arithmetic mean of the parameters found to be significant regarding the time course in multi-comparison tests. 1. EV<2. EV*, 1. EV<3. EV*, 1. EV<4. EV*, 2. EV<4. EV*, 3. EV<4. EV*). *: p<0.001

Phonophoresis is the procedure whereby skin absorption and deep-tissue penetration of local anesthetics and non-steroidal anti-inflammatory drugs are promoted by means of US. Phonophoresis has been used for about 50 years. Despite this, the drug to be used for phonophoresis and the method to administer it have not yet to be defined clearly (33,38,39). There are only a few studies in the literature that compare US and phonophoresis (14,40). In a study carried out by Özerbil et al. on 24 TMD patients, there was a significant reduction in spontaneous pain and motion-related pain in the group that received phonophoresis involving hydrocortisone, compared with the group that received only US therapy (40). We were unable to determine any significant difference between the combined treatment approach involving phonophoresis (group-1) and the combined treatment supplemented by US (group-2).

LLLT is suggested to have bio-stimulating and analgesic effects through direct irradiation without causing thermal response (41). LLLT modifies cellular metabolism, increases tissue repair, and reduces edema and inflammation (15). However, in the literature there are contradicting findings on the effectiveness of LLLT. Bertolucci et al. have obtained significant improvements in pain and mouth opening with mid-laser method in patients with degenerative TMD, compared with the placebo. (16). Mazzetto et al. have achieved reduction in pain level with LLLT incorporating an acupuncture tip, again compared with placebo in patients with painful disc displacements with reduction and capsulitis/synovitis. (15). On the other hand, Venancio et al., applying LLLT to patients with chronic painful disc displacements with reduction, did not determine any significant improvement with respect to mouth openings and pressure pain threshold of TMJ in the group administered with LLLT as compared to the placebo group, while both groups had a significant effect on VAS (17). Emshoff et al. have found that LLLT and placebo are effective on TMJ pain in patients with TMJ pain and that LLLT is not better (19). Studies conducted in this field present wide variations regarding the applied dose and duration of application, which may be the reason why researchers obtain different results. Bjordal et al. state that LLLT reduces pain and increases health status when used at an appropriate dose to provide anti-inflammatory effects (42). Although LLLT+HEP combination provided a little more improvement in the pain and mouth openings compared with HEP alone, the two groups were not found to be any different with respect to main effects of the treatment type.

Although exercise therapy has been used in musculoskeletal disorders for a long time and it is claimed to be effective in TMD, it would be difficult to conclude on its effectiveness due to inadequacies in the methodology (21). Nicolakis et al., in two different studies on chronic patients

with disc displacement, determined a significant improvement in pain and joint motion opening following exercise treatment (20,21). Ismail et al. have found that manual therapy intended for mobilization of TMJ in addition to splint therapy in patients with arthrogenic TMD provides significantly higher improvement in active jaw opening when compared to splint application alone (43). Figure 1-4 shows some improvements by time in mouth opening and VAS values in the group receiving HEP alone. Though the improvement observed in these parameters are less than those obtained with group-2 and group-3, it was not found

to be statistically different from these groups. It would have been more proper if the members of group 4 had had access to the same 10 sessions of the other groups, with the same time of consultation and been submitted to the placebo-procedures that simulated the application of the LLTT, phonophoresis and US. However, the ethic committee of the hospital did not approve placebo treatment. We also think that placebo effect is minimal since we worked with a patient group with a high level of education. Lack of interaction between the patient and the professional in Group-4 like that seen during 10 sessions in other groups could make us think that the patients' adaptation and belief in the treatment in this group would be decreased. However, these patients were patients with a high level of education who were seeking a treatment since long. Even those in Group-4 who regularly presented for control had a good adaptation to the exercises like that other treatment groups. Furthermore, patients in Groups-1, 2 and 3 were trained on the exercises in the first 2 days as done with Group-4. The other days they received LLLT, US or phonophoresis treatments which only lasted for 9 minutes. They were not given separate reinformation for HEP treatment.

When the main effect of the time course was analyzed, an improvement was observed in all parameters, which started immediately after the treatment and continued later on (Figures 1-4). However, a spontaneous improvement in patient complaints may occur during the first months after the onset of the symptoms. In order to minimize the effect of this spontaneous improvement, patients with chronic pain with at least 6-month duration and who failed to obtain satisfactory pain relief despite application of initial treatment protocol were included in the study. Sato et al. in a retrospective study where patients with disc displacement with reduction who did not undergo treatment were followed for an average of 25.8 months, reported that range of movement remains unchanged over time though reciprocal clicking and TMJ pain tend to remain (44). In a large-scale, multi-side prospective clinical study, Brown et al. reported that untreated TMD patients do not improve spontaneously over time and that patients treated with a variety of active modalities achieve clinically and statistically significant levels of improvement with no evidence of symptom relapse after completion of the treatment. Six months later, when TMJ scale was used to evaluate the changes in symptoms, significant improvements were found in all symptoms of 1426 treated patients with internal derangement, while no significant improvement was found in symptoms of 120 untreated patients compared to the initial evaluation (45). Significant improvements determined in mouth opening and in pain parameters even in the first evaluation made after the treatment support the view that these improvements do not result from the natural course

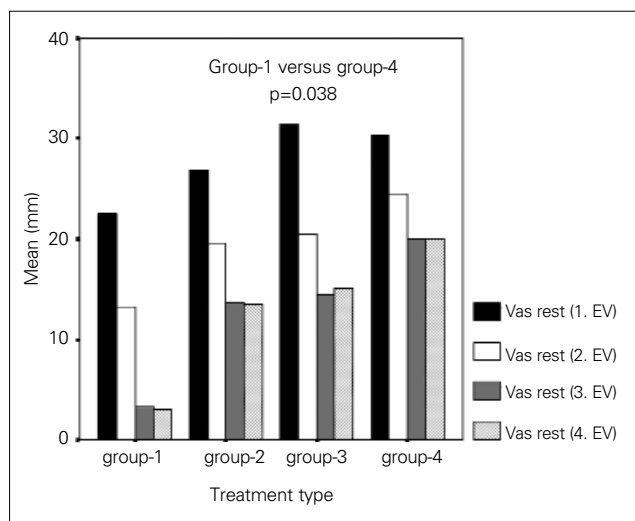


Figure 3. Changes observed by time in visual analogue scale (VAS) rest values in the treatment groups. Significance levels and direction of arithmetic mean of the parameters found to be significant regarding the time course in multi-comparison tests. 1. EV>2. EV*, 1. EV>3. EV*, 1. EV>4. EV*, 2. EV>3. EV***, 2. EV>4. EV***). ***: p<0.05, *: p<0.001**

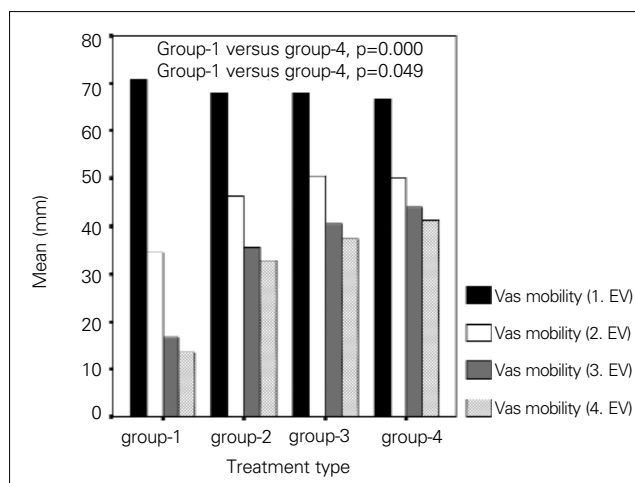


Figure 4. Changes observed by time in visual analogue scale (VAS) mobility values in the treatment groups. Significance levels and direction of arithmetic mean of the parameters found to be significant regarding the time course in multi-comparison tests 1. EV>2. EV*, 1. EV>3. EV*, 1. EV>4. EV*, 2. EV>3. EV*, 2. EV>4. EV*). *: p<0.001

of the disease. We further observed that functional improvements in combined treatment groups, were better. Therefore, we think that improvements are not so much associated with natural course. If we could set up a negative control group we could get clearer data in this respect. However, we considered that it would not be ethical to leave untreated this group of patients who were followed by a dentist since long and who could not get an effective response from other treatments.

The drawback of our study is that it does not include control groups like placebo or negative control groups. The favorable results obtained in Group 1, 2 and 3 may be associated with the induced placebo effect due to the interaction between the patient and the professional, the clinical environment where the 10 sessions had been carried though, belief apparatus used. Therefore, comparative placebo studies in which individual treatment modalities are applied must be made.

In conclusion, combined application of phonophoresis+LLLT+HEP was determined to be the most effective treatment method though other therapy groups were found to be effective in mouth openings and pain parameters. Phonophoresis should be preferred instead of US, especially with patients who suffer from pain during eating, speaking and similar activities. Combined physiotherapy modalities involving pharmacology also in patients with chronic TMD could be suggested as an alternative therapy method without side effects; however, studies with larger groups comparing combined physiotherapy with other known treatment modalities (pharmacology in combination with home exercise or the classic treatment with occlusal splints) are needed in this respect.

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