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EVALUATION OF TWO REGIMENS OF LOW INTENSITY LASER THERAPY VERSUS ROUTINE EXERCISE IN THE MANAGEMENT OF MYOFASCIAL PAIN DYSFUNCTION SYNDROME: A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Objective: To evaluate the efficacy of low intensity laser therapy (LILT) as a monotherapy in two different regimens with exercise therapy in comparison to only exercise in the treatment of Myofascial Pain Dysfunction Syndrome (MPDS)

Subjects and Methods: A total of 60 patients with MPDS were included in the study and were randomly divided into three groups: The routine exercise was assigned for the first group (Control).The other two groups received LILT applied to the predetermined five most painful trigger points using two different protocols of parameters. The following parameters were used for the second group (Group II): wavelength = 870 nm, power = 60 mw for 40 seconds., spot size = 0.55 cm^2 and energy density = 4.36 J/cm^2 per point, In the third group (Group III) the following parameters were used: wavelength = 870 nm, power = 60 mw for 90 seconds, spot size = 0.55 cm^2 and energy density = 9.82 J/cm^2 per point.

Results: Significant reduction in pain at rest and pain on movement was observed with all three types of treatment modalities. Pain reduction was significantly higher in those patients who received the regimen applied in Group III, with statistically significant decrease in the muscle tenderness and increase in maximum mouth opening with the same test group compared to the other two groups by the end of the experiment.

Conclusion: Application of LILT using these parameters: wavelength = 870 nm, power = 60 mw, spot size = 0.55 cm^2 and energy density = 9.82 J/cm^2 per point; for 90 sec. can be efficiently used as a monotherapy for the treatment of MPDS.

KEYWORDS: myofascial pain dysfunction syndrome, exercise, low intensity laser therapy.

INTRODUCTION

Temporomandibular disorder (TMD) is a set of clinical conditions that includes disorders of the temporomandibular joint (TMJ) and/or the masticatory muscles [1]. Myofascial pain dysfunction syndrome (MPDS) is one of the most common causes of chronic oro-facial pain [2]. It is the most common form of temporomandibular disorders that primarily involves the muscles of mastication. MPDS is currently thought to be multifactorial which may include the presence of parafunctional habits, stress, depression, and occlusal factors. There are other systemic factors such as nutritional inadequacies, poor physical conditioning, and fatigue. The exact psychophysiological mechanism underlying the production of pain in MPDS is unknown. The tenderness, pain, and discomfort experienced in this condition have often been attributed to muscle hyperactivity [3, 4].

Management of MPDS is based on certain principles that include the recognition of symptoms leading to an accurate diagnosis followed by appropriate treatment. Based on the multifactorial etiology of such problems, the treatment usually involves more than one modality in order to obtain complementary effects and that includes counseling, drug therapy, and physical therapy. For long-term effect, treatments such as exercise therapy, anti-

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inflammatory drugs and local anesthetics injections, stretching therapy, occlusal splint, psychotherapy, ultrasound, biofeedback, and Transcutaneous Electrical Nerve Stimulation (TENS) are used, but every treatment modality has its own pros and cons [5]. Principles of biostimulation via therapeutic lasers were introduced more than 20 years ago when they were used in dermatology for wound healing. According to Genovese, biological effects caused by low level lasers are due to low energy deposited into tissues where deposited energy results in primary, secondary and general therapeutic effects. This results in the analgesic and anti-inflammatory effects as well as in healing improvement [6]

Modern dentistry utilizes low-level Lasers in tissue healing, pain alleviation, reducing inflammation in the orofacial region. Low-intensity laser therapy (LILT) is non-invasive modality and has been safely used in the treatment of myofascial pain due to its analgesic, myorelaxant, tissue healing, and biostimulation effects through direct irradiation without causing thermal response[7-9]. On reviewing the literature, various authors also reported that the effect of LILT is no longer empirical and no universally accepted treatment protocols have been addressed [10, 11]. This study was therefore designed to evaluate LILT in two different protocols versus exercises in the management of MPDS.

SUBJECTS AND METHODS

This study was carried out in the Department of Dentistry, Banha Teaching Hospital, Banha, Qalubia, Egypt (June 2016 - May 2017).

In this study, patients were divided into three different groups. In each groups, twenty patients were included with minimum follow-up of 2 months. The study included 38 females and 22 males in the age range of 15-60 years with a history of MPDS for at least 1 year ago. Patients were properly screened to rule out any patient with local or systemic cause for TMD. Only those patients who fulfilled the following criteria were included in the present study:

1. Unilateral or bilateral pain in preauricular region,
2. Tenderness of one or more muscles of mastication on palpation.
3. Limitation or deviation of mandible on opening.

Patients with congenital anomalies of TMJ, history of trauma, and any other diseases causing TMJ pain were excluded from the study. After obtaining informed consent, patient's clinical examination was carried out and trigger points were determined for every patient by the same expert well trained person. Patients were randomly divided into three groups of 20 patients each.

- Group I (The Control): Patients were advised to do TMJ exercises for 31 days. The TMJ exercises included opening, protrusion, and lateral excursion movement against resistance. Patients were advised to perform each type of exercise 10 times and twice a day. All the patients were guided and taught exercises.
- Group II: In this group, patients were treated with LILT, which was given in 10 sessions from day 0 till day 31, 2 sessions per week [12] wavelength = 870 nm, power = 60 mw for 40 seconds per trigger point, spot size = 0.55 cm^2 and energy density = 4.36 J/cm^2 per trigger point.
- Group III: It was assigned for patients who were treated LILT, which was given in 10 sessions from day 0 to day 31, 2 sessions per week [12] wavelength = 870 nm, power = 60 mw for 90 seconds per trigger point, spot size = 0.55 cm^2 and energy density =9.82 J/cm^2 per trigger point.
- All the patients were evaluated for the following parameters before, during, and after treatment - Intensity of pain, palpation of muscles, maximum mouth opening (MMO). Measurement of MMO was done on the 0, 15^{th}, 31^{st}, and 60^{th} days using digital vernier caliper. Observation of pain at rest, on movement of jaw and the grade of tenderness in various muscles were noted on the 0, 15^{th}, 31^{st}, and 60^{th} days. Intensity of pain was evaluated on the visual analog scale (VAS) on the 0, 15^{th}, 31^{st}, and 60^{th} days.

Laser set up

In both groups (II and III), the trigger points were irradiated using Ga–Al–As diode, semiconductor laser (Soft Laser SL–202, 870 nm PETROLASER, RUSSIA), in continuous wave mode (CW) with special probe of spot size = 0.55 cm^2 and power (P) = 60 mw; in direct contact to the tissue. The time of exposure was 40 seconds per trigger point for group II and 90 seconds per trigger point for group III.

No complications occurred in any of the patients after therapy. Statistical analysis was carried out by using Wilcoxon Sign Rank test, paired t-test, Kruskal–Wallis test, Chi-square test, and Z-test

RESULTS

Comparison of pain severity according to Tables (1), the scores on VAS scale (mean value) at the end of experiment (2 months) compared to that of day 0 for pain at rest and on movement showed statistically significant pain reduction in all the three groups ($P < 0.05$). Similarly, both Grade of tenderness and ROM of mouth opening showed statistically significant improvement by the end of the follow up period in all the three groups ($P < 0.05$).

Concerning pain reduction both at rest and during movement in addition to grade of tenderness there was a significant improvement in patients who received laser therapy (Groups II and III) compared to those who received exercise therapy (Group I) throughout the experiment time ($P < 0.05$). At two months period, group III showed significant pain reduction at rest as well as during movement and lower grade of tenderness compared to the other groups (I and II) ($P < 0.05$) (Table 1).

Comparison of mean values of the ROM of mouth opening between the three groups showed significant increase in the two laser groups compared to the exercise group throughout the study period ($P < 0.05$). By the end of the two months, there was a statistically significant increase in ROM of mouth opening in group III compared to groups II ($P > 0.05$) (Table 1).

TABLE (1) Mean, standard deviation, p-values of four parameters in three study groups.

Assessment Parameter	Duration	Group I		Group II		Group III		P- Value
		Mean	SD	Mean	SD	Mean	SD	
Pain on VAS at rest	Day 0	4.85	1.82	4.75	1.46	5.2	1.22	>0.05
	2 Weeks	3.41[a]	1.60	2.50[b]	1.30	2.45[b]	1.6	<0.05
	One month	2.9[a]	1.8	1.8[b]	1.4	1.7[b]	1.2	<0.05
	Two months	1.8[a]	1.66	0.9[b]	1.1	0.5[c]	0.9	<0.05
	P- Value between day 0 and 2 month	<0.05		<0.05		<0.05		
Pain on VAS during movement	Day 0	6.8	1.2	6.7	1.3	6.85	1.4	>0.05
	2 Weeks	5.6[a]	1.8	4.1[b]	1.1	4.15[b]	1.6	<0.05
	One month	4.1[a]	2.2	2.85[b]	1.6	2.3[b]	1.3	<0.05
	Two months	2.8[a]	2.1	1.2[b]	1.7	0.8[c]	1.2	<0.05
	P- Value between day 0 and 2 month	<0.05		<0.05		<0.05		
Grade of tenderness	Day 0	1.6	0.62	1.58	0.6	1.58	0.59	>0.05
	2 Weeks	0.7[a]	0.62	0.3[b]	0.53	0.3[b]	0.45	<0.05
	One month	0.5[a]	0.56	0.18[b]	0.45	0.1[b]	0.35	<0.05
	Two months	0.35[a]	0.32	0.15[b]	0.27	0.0[c]	0.0	<0.05
	P- Value between day 0 and 2 month	<0.05		<0.05		<0.05		
ROM of mouth opening	Day 0	27.65	6.52	28.55	6.5	28.7	7.1	>0.05
	2 Weeks	28.2[a]	6.3	31.3[b]	5.85	31.9[b]	6.9	<0.05
	One month	30.4[a]	5.7	32.6[b]	5.7	35.7[b]	5.3	<0.05
	Two months	30.1[a]	6.1	35.1[b]	5.2	41.3[c]	5.1	<0.05
	P- Value between day 0 and 2 month	<0.05		<0.05		<0.05		

Significance at $p \leq 0.05$, Means with different letters are statistically significantly different. VAS= Visual analog scale, ROM= Range of motion, SD= Standard deviation.

DISCUSSION

MPDS causes mandibular dysfunction that generally leads to limitation in jaw opening along with deviation, presence of pain, and clicking or popping noises in the joints[3]. Varieties of therapeutic modalities offered to individuals include mechanical, like orthopedic stabilization and intraoral appliances; physiological, like behavioral therapy; psychological, like counseling; and pharmacological such as analgesics, muscle relaxants, and antidepressants drugs [12]. Laser is one of the most recent treatment modalities in the field of physiotherapy. It seems that LILT act analgesically since they improve endorphin release and therefore inhibit nociceptive signals and control pain mediators [13]. They can also inhibit pain signals which partially leads to the transient varicosities along the neurons which decrease impulse transmission. These lasers act on cellular reduction-oxidative potential. Cells are acidic in a lowered redox state, but after laser irradiation they become alkaline and afterwards they can act in an optimal way [13, 14]. It was also indicated that inflammation in superficial muscles, tendons, and ligaments can be alleviated by irradiation of affected areas by laser [15].

In Group I, where exercise was the modality of treatment, 62.9% decreases in pain at rest, 58.8% decrease in pain during motion, 78.1% decrease in grade of muscle tenderness and 8.9% increase in ROM of mouth opening were observed by the end of 60th day, which were statistically significant. The efficacy of exercise therapy in reducing pain in MPDS observed in the present study is in harmony with the observations made by Nicolakis et al. [16, 17]. The authors reported that exercise therapy was intended to improve coordination of the muscles of mastication, reduce muscle spasm, and correct the jaw closure pattern.

In Group II, where LILT was applied, a statistically significant results compared to group I were recorded throughout the study periods. A decrease in pain at rest (81.1%), decrease in pain during motion (82.1%), decrease in grade of muscle tenderness (90.5%) and increase in ROM of mouth opening (22.9%) were recorded by the end of the 60th day, which were statistically significant. Our results were in line with Marini et al, [18]. and Fikackova et al. [19] who efficiently treated patients suffering from MPDS by the use of Ga-Al-As laser.

According to Emshoff et al., [20] no reduction in pain over TMJ following use of laser of 632 nm wavelength and 1.5 J/cm ^{2} intensity was seen and, therefore, they suggested that LILT was not useful for joint disorder but may be useful in musculoskeletal pain. However, this confliction could be attributed to the difference between their parameters and ours; wavelength = 870 nm, and energy density = 4.36 J/cm^2. In support of our selected energy density, Goulart et al., [21] have concluded that a dose of 5.3 J/cm^2 resulted in significant reduction of pain secondary to orthodontic tooth movement. Moreover, Tunér and Hode [22] suggested that the appropriate energy density in management of TMD should be in the range of 4 to10 J/cm^2.

In Group III, LILT was used with the same parameters as in group II (same wavelength, power and spot size) with increasing the exposure time to 90 seconds per trigger point which led to the production of higher energy density (9.82 J/cm^2) per trigger point. Increasing time while fixing the other parameters resulted in 90.4% decrease in pain at rest, 88.3% decrease in pain during motion, 100% decrease in grade of muscle tenderness and 43.9% increase in ROM of mouth opening by the end of the 60th day, which were statistically significant. Compared to group I, group III showed statistically significant improvement in all parameters throughout the study periods. In addition, group III showed a statistically significant improvement in all parameters compared to group II by the end of the follow up period. Our results were in accordance with that of Da Silva [23] who reported that increasing the energy density by increasing the laser exposure time

with keeping both power and spot size unchanged in TMD patients resulted in a statistically significant reduction of painful symptoms and increase of the mean MMO compared to the other laser group with lesser exposure time as well as the control group.

Laser could provide analgesia by decreasing the spasm in muscle arterioles which is essential for tissue oxygenation and by increasing adenosine triphosphate formation with a consequent normalization in metabolic rate of the tissues with diminished energy levels. The other mechanism may be related to its effect on endorphin levels, which may reduce pain, and exercise is also known to affect endorphin levels and hence can control pain. Improvement of TMJ functions in patients can be explained by both the analgesic and biostimulating effects of laser therapy [24].

CONCLUSION

Application of LILT using these parameters: wavelength = 870 nm, power = 60 mw, spot size = 0.55 cm^2 and energy density = 9.82 J/cm^2 per trigger point; for 90 sec. can be efficiently used as a monotherapy for the treatment of MPDS.

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