

# Effect of low-level laser on controlling temporomandibular disorders

*Efecto del láser de bajo nivel en el control de los trastornos temporomandibulares*

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## Abstract

**Background:** Temporomandibular disorders (TMD) are characterized with associated headache and facial pains to induce common complaints in the temporomandibular joint, ears, and masticatory muscles, as well as both or one side of the jaw pain after biting down. present work was designed to study on the efficacy of low-level laser therapy (LLLT) for controlling temporomandibular disorders.

**Materials and Method:** Based on the previous studies, 40 patients were selected based on the protocol for evaluation tools of temporomandibular disorders. All subjects were exposed to LLLT in 6 sessions ( $\lambda=810$  nm, power output: 0.6-watt, application time: 60 s, dose: 4 J/cm<sup>2</sup>).

**Results:** The data analysis determined that pain intensity, the number of tender points, joint sound, the maximum mouth opening, the maximal pain-free, and finally right and left lateral movements reduced during a 6-month therapy. The t-test analysis showed that the measured changes were significant statistically after first session ( $p<0.05$ ). Additionally, ANOVA results proved the significant changes during the first month of therapy, but after that, all measured parameters did not vary significantly ( $p>0.05$ ).

**Conclusion:** The low-level laser therapy can induce some improvement in the pain intensity, the number of tender points, joint sound, the maximum mouth opening, the maximal pain-free, and also right and left lateral movements during one-month treatment. Therefore, it is concluded that LLLT is a beneficial alternative option for controlling the temporomandibular disorders appropriately.

**Key words:** Low-level laser therapy, temporomandibular disorders, TMD, LLLT.

## Resumen

**Antecedentes:** Los trastornos temporomandibulares (TMD) se caracterizan con dolor de cabeza asociado y dolores faciales para inducir quejas comunes en la articulación temporomandibular, los oídos y los músculos masticatorios, así como en ambos o en un lado del dolor de la mandíbula después de morder. El presente trabajo fue diseñado para estudiar la eficacia de la terapia con láser de bajo nivel (LLLT) para controlar los trastornos temporomandibulares.

**Materiales y método:** según los estudios previos, se seleccionaron 40 pacientes según el protocolo para las herramientas de evaluación de trastornos temporomandibulares. Todos los sujetos fueron expuestos a LLLT en 6 sesiones ( $\lambda = 810$  nm, potencia de salida: 0.6 vatios, tiempo de aplicación: 60 s, dosis: 4 J / cm<sup>2</sup>).

**Resultados:** El análisis de datos determinó que la intensidad del dolor, la cantidad de puntos sensibles, el sonido articular, la apertura máxima de la boca, la máxima sin dolor y, finalmente, los movimientos laterales derecho e izquierdo se redujeron durante una terapia de 6 meses. El análisis de la prueba t mostró que los cambios medidos fueron estadísticamente significativos después de la primera sesión ( $p<0.05$ ). Además, los resultados de ANOVA demostraron los cambios significativos durante el primer mes de terapia, pero después de eso, todos los parámetros medidos no variaron significativamente ( $p>0.05$ ).

**Conclusión:** La terapia con láser de bajo nivel puede inducir alguna mejora en la intensidad del dolor, la cantidad de puntos sensibles, el sonido articular, la apertura máxima de la boca, la máxima sin dolor y también los movimientos laterales derecho e izquierdo durante el tratamiento de un mes. Por lo tanto, se concluye que LLLT es una opción alternativa beneficiosa para controlar los trastornos temporomandibulares de manera adecuada.

**Palabras clave:** terapia con láser de bajo nivel, trastornos temporomandibulares, TMD, LLLT.

**A**ccording to International Association for the Study of Pain, the standard definition of temporomandibular joint disease is associated with headache or facial pains due to painful complaints developed in the temporomandibular joint, ears, masticatory muscles, as well as both or one side of the jaw pain when biting down. Also, this disorder might induce some sounds in the joint, limited mouth opening, or mandibular deviation. The muscle pain is a common related symptom of the mentioned conditions. The main etiological factors of TMD can be involved with trauma, chronic Repetitive microtraumas, non-habitual use of the mandible, and finally stress among other significant factors for the TMD.

Given that nearly 20% of people are affected by the temporomandibular disorders, and only 10-20% of patients seek the appropriate therapeutic solution, dentists and physiotherapists can consider a phototherapeutic alternative method, like the low-level laser, as an effective source for stimulating the anti-pain signals in the tissues due to their low-level waves and energies.

The low-level lasers might cause the increased beta-endorphin content, decreased both bradykinin and histamine levels, and increased lymphatic flow<sup>12</sup>. Generally, LLLT can result in the decreased inflammatory factors and the decreased pain-related factors. The literature review revealed this alternative therapeutic option has been studied with different wavelengths, but there was not found any study to employ LLLT at 810-nm for the treatment of TMD disorders. Moreover, no follow-up studies to date have examined long term efficacy of LLLT for TMD disorders.

The sensitivity of work environment, responsibilities, and work tasks level to be completed, all together determine the stress level imposed on the work. The military settings with unique conditions, provide the chronic stressful involvement even in peace time, and are associated with a range of health-related complaints in employees. In the armed forces, the stress level is remarkably recorded higher than the average level in the society due to heavy duties and sensitive tasks<sup>1-2</sup>.

The situations of stress might result in the increased physiological activities of the body, activated sympathetic system, and especially increased heart rate. Generally, those people being under such a condition, are reported more frequently affected by TMD<sup>3-4</sup>. Also, the psychological stress can result in some structural changes in the condylar cartilage (TMJ), associated with the increased levels of IL-1 $\beta$ , or TNF- $\alpha$ . If the stress condition continues, the involved process induces TMJ disorders<sup>5</sup>.

Some studies suggested that TMD, as a psychophysical disorder, can develop associated with the changes made

in the central nervous system when controlling feelings, psychological aspects and neuro-endocrines secreted by psychophysical stimuli<sup>6-7</sup>. The prevalence of post-traumatic stress disorder was reported to range from 20 percent in normal people to 61 percent in the armed force in the war according to different studies<sup>8,9</sup>. Therefore, one of the important tasks in State Health Department is related to the surveillance of psychophysical situations in the armed forces of any country.

The present study aims to evaluate the efficacy of 810-nm laser therapy on pain and muscular activity (the masseter and temporal muscles), and the joint movement in patients with temporomandibular disorders.

**T**he present study evaluated the efficacy of low-level laser therapy at 810-nm on the temporomandibular disorders in a controlled trial. Based on the previous studies, 40 patients (21 males, 19 female) were selected with an age range of 19-47 years old (mean age=28.55 years). The sample recruitment was performed based on the protocol for evaluation tools of temporomandibular disorders. All subjects received the detailed explanation and signed the written. Consents all patients were exposed to LLLT for 6 sessions. LLLT was radiated to the determined tender points ( $\lambda$ =810 nm, power output: 0.6 watt, application time: 60 s, dose: 4 J/cm<sup>2</sup>).

Some parameters were determined, including pain intensity, the number of tender points, joint sound, maximal pain-free, and the maximum mouth opening, and right and left lateral movement, before and immediately after each therapy session, and after 1 week, 2 weeks, 1 month, 3, and 6 months of the first session.

Pain intensity was recorded in millimetres on a 100 mm Visual Analogue Scale (VAS). Number of tender points were assessed by palpation of the following 10 points on both facial sides: preauricular lymph nodes, masseter, temporalis, medial and lateral pterygoid, sternocleidomastoid, trapezius and back of the neck.

Joint sounds were determined by auscultation of TMJ during mouth opening and closing, listening for the presence of opening and closing clicks as well as fine and coarse crepitation. The total number of sounds on both sides was recorded.

The maximal pain-free and maximum mouth opening were recorded. The vertical interincisal distance between the midpoints of upper and lower central incisors was measured by a ruler and recorded in mm. The obtained data were analyzed using SPSS, version 12. The descrip-

tive statistics, t-test, and ANOVA test were performed in order to assess the study data. Any p value <0.05 was considered significant.

Results: The descriptive statistics of the study variables were represented in the Table 1 before and immediately after each therapy session, and after 1 week, 2 weeks and 3 and 6 months of the first session.

The highest pain intensity was recorded before the first session (mean=66.23), and it decreased after the first session, and continued to decrease along time, as after 6 months of LLLT the related parameter decreased to 3.22 (Figure 1). The significant reduction was observed in the pain intensity after 1 week, 2 weeks, and one month of the first session (P<0.05), but in the third and sixth months, no significant differences were reported (p>0.05).

Pain intensity before and after therapy session

Table 1-Descriptive values of the study variables (Mean±STD)							
Mean±STD							
6 month after therapy session	3 month after therapy session	1 month after therapy session	2 week after therapy session	1 week after therapy session	immediately after therapy session	Before therapy session	
87.8 ± 22.3	09.9 ± 93.4	28.9 ± 3.5	76.1 ± 65.13	53.15 ± 5.33	13.15 ± 85.48	15.63±23.66	Pain intensity
93.1 ± 05.1	61.2 ± 2.1	87.2 ± 4.1	07.3 ± 5.2	93.2 ± 25.4	66.3 ± 02.7	29.3 ± 55.9	Number of tender points
5.02± 43.45	4.26± 43.3	5.08± 43.25	5.57± 42.15	6.5 ± 40.05	7.66 ± 38.05	03.8 ± 10.37	Maximum pain free mouth opening
4.32 ± 44.20	4.34 ± 44.15	4.34 ± 44.10	4.53± 43.60	5.83 ± 42.40	6.05± 41.32	6.93 ± 40.40	Maximum possible mouth opening
1.1 ± 1.03	1.05 ± 1.06	1.01 ± 1.06	1.22 ± 1.53	1.49± 2.01	1.44 ± 2.37	1.44 ± 2.48	Number of joint sounds
1.21± 8.75	1.23 ± 8.75	1.23 ± 8.65	1.23 ± 8.75	1.62±7.85	1.89 ± 7.05	2.16 ± 6.8	Right lateral excursion
1.16± 9.15	1.18 ± 9.1	1.07 ± 9.2	1.07 ± 9.2	1.51 ± 8.55	1.43 ± 8.15	1.64± 7.25	Left lateral excursion

Figure 1. The measured pain intensity before and after therapy session

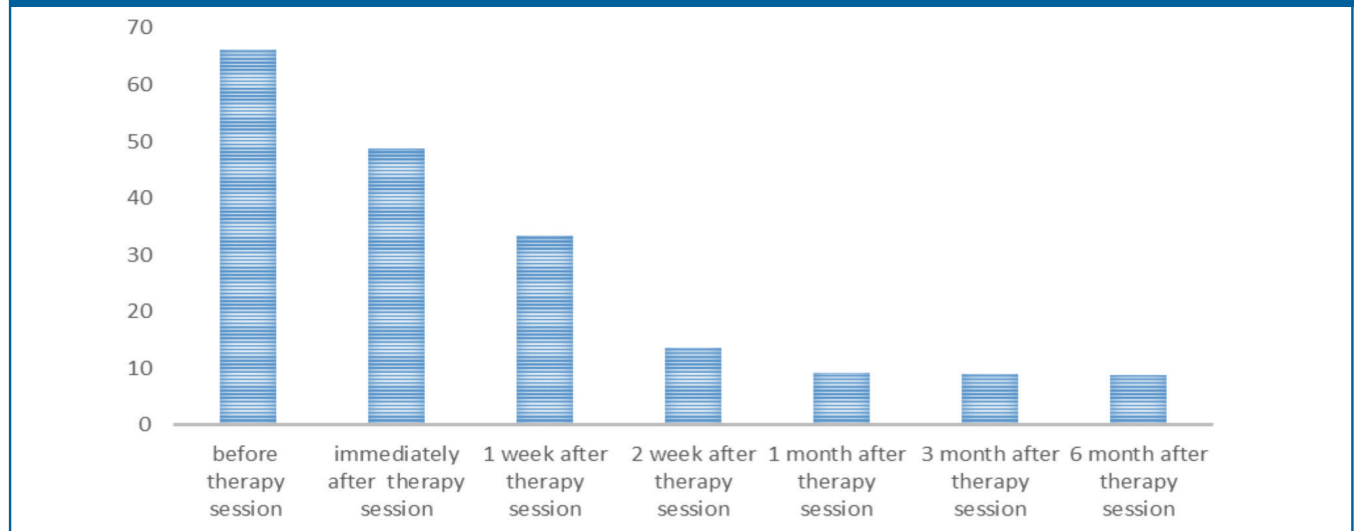
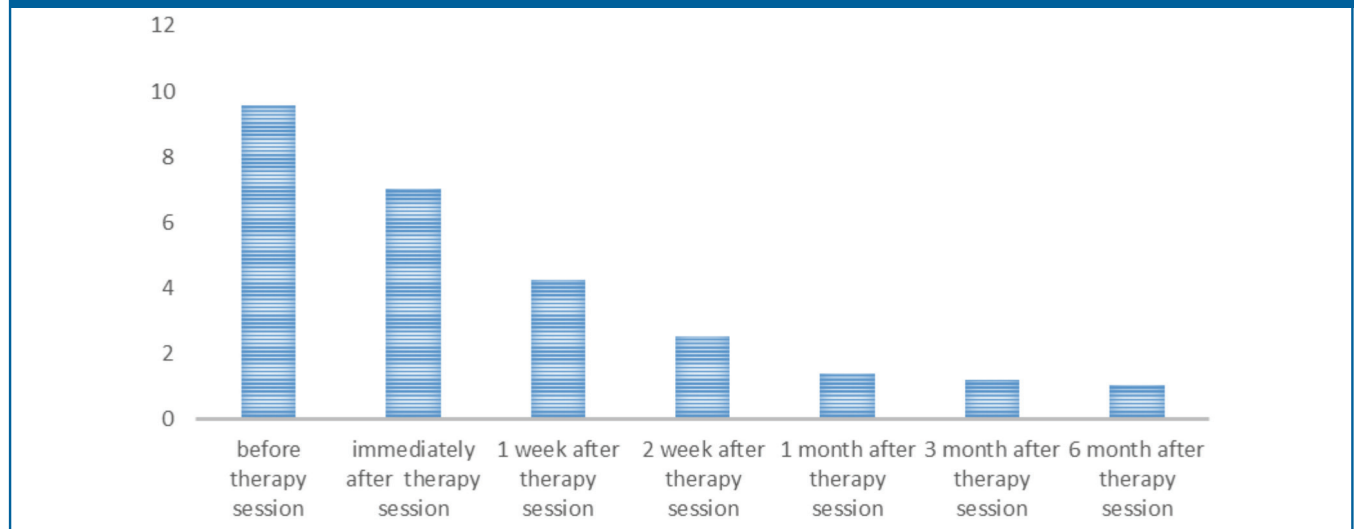


Figure 2. The number of tender points before and after therapy session



**Number of tender points before and after therapy session**

The highest number of tender points was recorded before the first session (mean=9.55), but it decreased significantly after the first session ( $p<0.05$ ) and continued to decrease along time, as after 6 months of LLLT decreased to 1.05 (Figure 2). The significant reduction was observed in the number of tender points after 1 week, 2 weeks, and one month of the first session ( $P<0.05$ ), but in the third and sixth months, no significant differences were reported ( $p>0.05$ ).

**Maximum mouth opening before and after therapy session**

Before the first session, the maximum mouth opening and maximal pain-free showed the least levels, but after the first session, statistically significant results were achieved in the mentioned study parameters as the related values increased and continued to be raised, and finally, after 6 months of the first session, they approached to the maximal limits (Figure 3). The raised levels for the mentioned

parameters were significant statistically immediately after 1 week, 2 weeks, and 1 month of the first session ( $p<0.05$ ), but after three and six months, no significant differences were reported for these parameters ( $p<0.05$ ).

**Joint sound before and after therapy session**

The joint sound reached to the maximum value (mean value= 2.48) before the first therapy session, and it decreased significantly after the first session and continued the decreasing trend to one month ( $p<0.05$ ). In third and sixth months, a little non-significant decrease was reported ( $p>0.05$ ), as the value approached to 1.03 after 6 months of the first session (Figure 4).

**Right and left lateral movements before and after therapy session**

The mean values of right and left lateral movements were at the least limit before the first therapy session, but after that, the mentioned levels significantly decreased ( $p<0.05$ ) and continued to increase non-significantly during sessions (Figure 5).

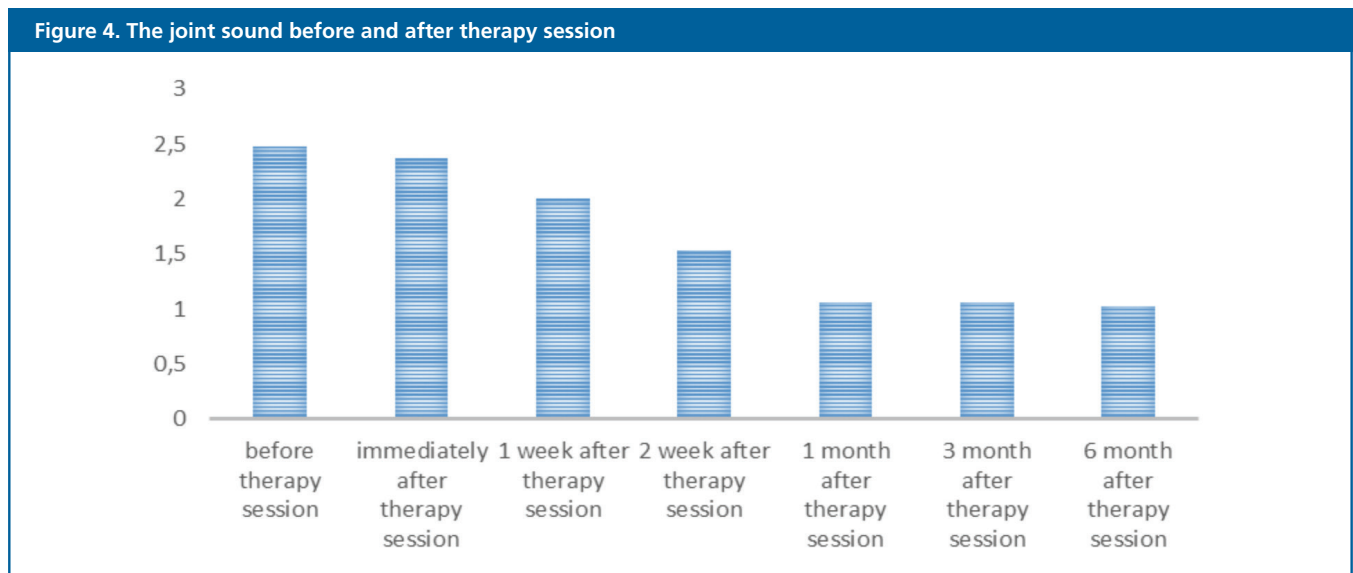
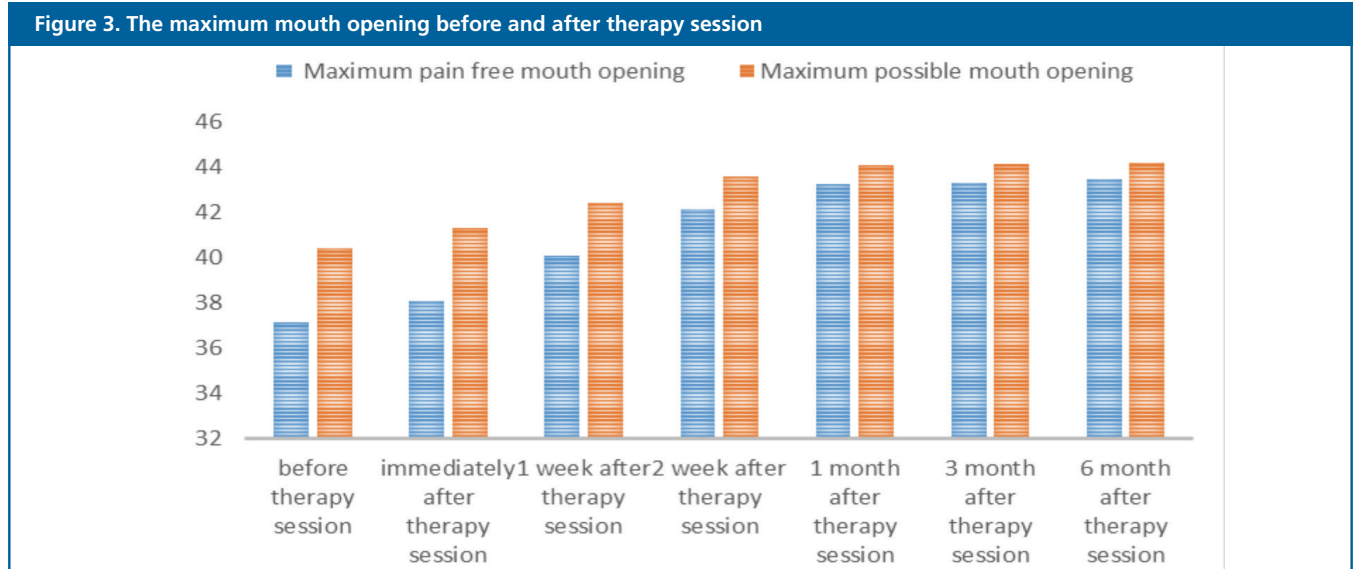
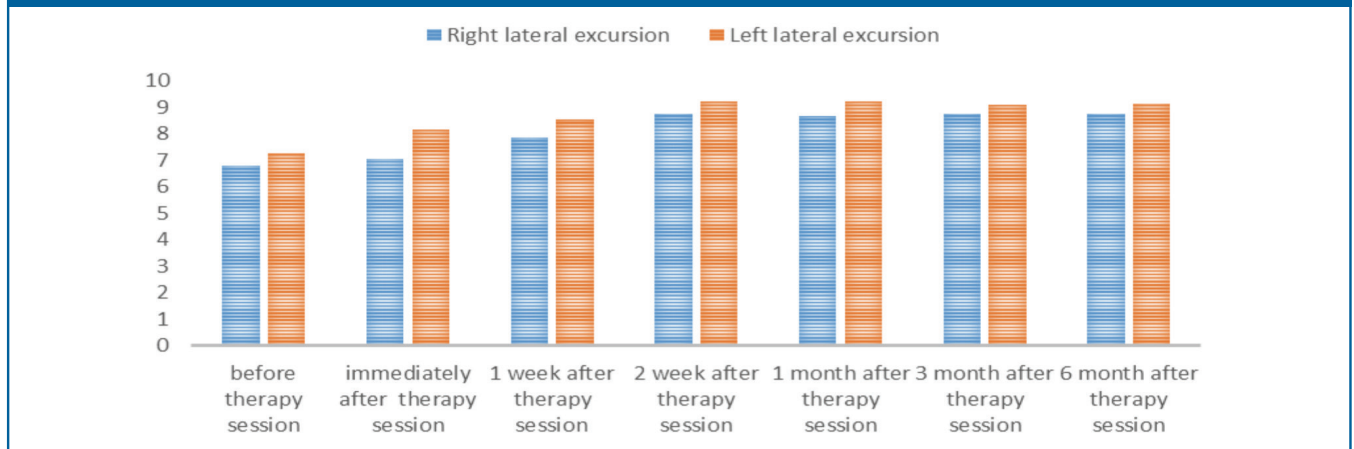


Figure 5. The right and left lateral movements before and after therapy session



**T**emporomandibular disorders (TMD) is a collective term that is recognized with the pains of the temporomandibular joint, masticatory muscles, the limited and deviated mandibular movements, with or without clicking sound when the temporomandibular joint functions<sup>10-11</sup>. Today, interest in TMD increased widely due to the raised affected patients in dentistry researches<sup>10</sup>. Although several assumptions have been proposed regarding to the temporomandibular disorders, the real etiological factors still remain unknown. Given the etiology of TMD, different therapeutic modalities have been presented. But in some cases, these disorders have not responded to the conventional treatment techniques, and the surgical operation may be the last step in the therapeutic process. Therefore, many investigators aim to propose an effective technique with less side effects and aggressive intervention.

The obtained results in our study showed that pain intensity decreased after the first session and continue to decrease significantly during each session, as it reached to 5.3 after one month. After that, we observed little changes until six months. In a study by Posten et al, the pain level achieved to a significant decrease after the completed treatment compared to the values recorded before LLLT<sup>12</sup>. But there was a difference in the number of sessions (12 sessions) and unknown intervals between sessions. Also, Magri<sup>13</sup>, Kulekcioglu<sup>14</sup>, Shukla<sup>15</sup>, and Khalighi<sup>16</sup> obtained the similar results. Moreover, in our study, the number of tender points were averaged as 9.55 before the treatment, and decreased after the first session, and during the one next month, it continued to be recorded after each therapy session reached at 1.4. Also, after that in third and sixth months of therapy, a little decrease was recorded, as it was not reported significantly. In addition, Sayed, et al.<sup>17</sup> proved that LLLT might cause a decrease in the number of tender points. But there was a difference between the results of Sayed's study and our

findings, and the observed decrease was reported significantly after the 6-month therapy. However, the present work could observe a significant difference until one month, and after that, there was no significant decrease until six months. These observed different results across studies may be attributed to race and age differences of the evaluated samples.

The maximum mouth opening showed the significant increase in the studied subjects after the first LLLT session. After one and two weeks, and one month, the increased values continued to be recorded significantly. But when measured in third and sixth months, no difference was observed in the mentioned parameter. Regarding to the maximal pain-free, the similar situation was observed. Cetiner, et al.<sup>18</sup> evaluated LLLT on the TMD, indicated that the maximum mouth opening improved after one month of treatment. In his study with similar findings to the present study, the measurement was performed before, after, and one month of the first session. In addition, according to the study by Khoshnevis<sup>12</sup>, the maximum mouth opening increased significantly. It should be mentioned that the duration and number of sessions were different from the present work. Ahrari, et al.<sup>19</sup> showed that LLLT might cause the increased maximum mouth opening, and the decreased pain intensity in TMD patients. Madani<sup>20</sup> and Khalighi (160 studies achieved the similar mentioned results, too.

It was noticed that in the TMD-affected patients there was a significant decrease in joint sounds after the first session of LLLT, and till one month in the next sessions, it continued to show significant decrease, but after that, there was no reported significant decrease in this parameter. A study designed by Sayed indicated that LLLT resulted in a decreased joint sound<sup>17</sup>. In the mentioned study, the parameters were recorded during 6 months with significant changes, but in our work, there was a significant decrease

only to one month of the first session. The difference observed in these two studies can be attributed to the race and age differences in the statistical samples evaluated in both works.

In addition, the study results indicated that the right and left lateral movement increased significantly after the first session, and continued to rise to one month of the first session. But after that, there was a non-significant decrease. Also, a systematic review study by Petrucci<sup>21</sup> about the efficacy of LLLT on the temporomandibular disorders confirmed the increased value of right and left lateral movement during the therapy.

Chen reviewed data gathered about the efficacy of low-level laser (LLL) on 545 patients during 1990 to 2012. This study concluded that LLLT can improve the situation of the mouth and maxilla with reduced pain<sup>22,24</sup>. One of the evaluated components was right and left lateral excursion with a significant increase after treatment and is consistent with the findings obtained in this study. The treatment duration was not the same for each patient in this review study.

## Conclusions

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inally, according to the results of the evaluation of the test data, it can be said that low-level laser during 1 month improves the pain relief, the number of painful parts, joint sound, maximal oral opening, maximum pain opening, left lateral movement to the right and therefore the result is that LLLT is a useful method in the proper control of temporomandibular disorders within a month of the first session.

## References

- Lurie O, Zadik Y, Einy S, Tarrasch R, Raviv G, Goldstein L. Bruxism in military pilots and non-pilots: tooth wear and psychological stress. *Aviation, space, and environmental medicine*. 2007;78<sup>2</sup>:137-9.
- Unwin C, Blatchley N, Coker W, Ferry S, Hotopf M, Hull L, et al. Health of UK servicemen who served in Persian Gulf War. *The Lancet*. 1999;353(9148):169-78.
- Woda A, L'heveder G, Ouchchane L, Bodéré C. Effect of experimental stress in 2 different pain conditions affecting the facial muscles. *The Journal of Pain*. 2013;14<sup>5</sup>:455-66.
- Schmidt JE, Carlson CR. A controlled comparison of emotional reactivity and physiological response in masticatory muscle pain patients. *Journal of orofacial pain*. 2009;23<sup>3</sup>
- Lv X, Li Q, Wu S, Sun J, Zhang M, Chen Y-J. Psychological stress alters the ultrastructure and increases IL-1 $\beta$  and TNF- $\alpha$  in mandibular condylar cartilage. *Brazilian Journal of Medical and Biological Research*. 2012;45<sup>10</sup>:968-76.
- GAMEIRO GH, NOUER DF, MAGNANI MBBDA, NOVAES PD, AMBROSANO GMB, ANDRADE ADS, et al. Evaluation of root resorption associated with orthodontic movement in stressed rats. *O EFEITO DE FÁRMACOS E FATORES SISTÊMICOS NO MOVIMENTO DENTÁRIO ORTODÔNTICO*. 2008:47.
- Maixner W, Fillingim R, Booker D, Sigurdsson A. Sensitivity of patients with painful temporomandibular disorders to experimentally evoked pain. *Pain*. 1995;63<sup>3</sup>:341-51.
- Goodwin L, Ben-Zion I, Fear NT, Hotopf M, Stansfeld SA, Wessely S. Are reports of psychological stress higher in occupational studies? A systematic review across occupational and population based studies. *PLoS One*. 2013;8<sup>11</sup>:e78693.
- Jones M, Rona RJ, Hooper R, Wessely S. The burden of psychological symptoms in UK Armed Forces. *Occupational medicine*. 2006;56<sup>5</sup>:322-8.
- Tabatabaian F, Saboury A, Kaseb Ghane H. The Prevalence of Temporomandibular Disorders in Patients Referred to the Prosthodontics Department of Shahid Beheshti Dental School in Fall 2010. *Shahid Beheshti University Dental Journal*. 2013;31(1):52-9.
- Casanova-Rosado JF, Medina-Solís CE, Vallejos-Sánchez AA, Casanova-Rosado AJ, Hernández-Prado B, Ávila-Burgos L. Prevalence and associated factors for temporomandibular disorders in a group of Mexican adolescents and youth adults. *Clinical oral investigations*. 2006;10(1):42-9.
- Posten W, Wrone DA, Dover JS, Arndt KA, Silapunt S, Alam M. Low-level laser therapy for wound healing: mechanism and efficacy. *Dermatologic surgery*. 2005 Mar;31(3):334-40.
- Magri LV, Carvalho VA, Rodrigues FCC, Bataglion C, Leite-Panissi CRA. Effectiveness of low-level laser therapy on pain intensity, pressure pain threshold, and SF-MPQ indexes of women with myofascial pain. *Lasers in medical science*. 2017;32(2):419-28.
- de Santana Santos T, Piva MR, Ribeiro MH, Antunes AA, Melo AR, e Silva EDdO. Lasertherapy efficacy in temporomandibular disorders: control study. *Brazilian journal of otorhinolaryngology*. 2010;76(3):294-9.
- Shukla D, Muthusekhar M. Efficacy of low-level laser therapy in temporomandibular disorders: A systematic review. *National journal of maxillofacial surgery*. 2016;7(1):62.
- Khalighi HR, Mortazavi H, Mojahedi SM, Azari-Marhabi S, Abbasabadi FM. Low level laser therapy versus pharmacotherapy in improving myofascial pain disorder syndrome. *Journal of lasers in medical sciences*. 2016;7(1):45.
- Sayed N, Murugavel C, Gnanam A. Management of temporomandibular disorders with low level laser therapy. *Journal of maxillofacial and oral surgery*. 2014;13(4):444-50.
- Çetiner S, Kahraman SA, Yüçetas Ş. Evaluation of low-level laser therapy in the treatment of temporomandibular disorders. *Photomedicine and Laser Therapy*. 2006;24(5):637-41.
- Ahrari F, Madani AS, Ghafouri ZS, Tunér J. The efficacy of low-level laser therapy for the treatment of myogenous temporomandibular joint disorder. *Lasers in medical science*. 2014;29(2):551-7.
- Madani AS, Ahrari F, Nasiri F, Abtahi M, Tunér J. Low-level laser therapy for management of TMJ osteoarthritis. *CRANIO®*. 2014;32(1):38-44.
- Petrucci A, Sgolastra F, Gatto R, Mattei A, Monaco A. Effectiveness of low-level laser therapy in temporomandibular disorders: a systematic review and meta-analysis. *Journal of orofacial pain*. 2011;25(4):298.
- Chen J, Huang Z, Ge M, Gao M. Efficacy of low-level laser therapy in the treatment of TMD s: a meta-analysis of 14 randomised controlled trials. *Journal of oral rehabilitation*. 2015;42(4):291-9.
- Nikbakht-Dastjerdi, M., Rashidi, I., Valiani, A., & Khanahmad, H. Belinostat effects on expression of RBM5 tumor suppressor gene and inhibits prostate cancer cell line (PC3) proliferation. *European Journal of General Medicine*. 2018;15(3).
- Günay T, Yardımcı OD, Polat M, Sandal K, Şeneldir H. Evaluation of Malignancy Risk in Patients Who Underwent Hysteroscopy for Preliminary Diagnosis of Endometrial Polyp. *J Clin Exp Invest*. 2018;9(2):95-9. <https://doi.org/10.5799/jcei.433819>