Indian Journal of Otolaryngology and Head & Neck Surgery (2024) 76:3412–3417
https://doi.org/10.1007/s12070-024-04705-9

ORIGINAL ARTICLE

Role of Low-Level Laser Therapy in the Management of Temporomandibular Joint Arthralgia

Sravanthi Puvvada[1] · Muthubabu Kasiviswanathan[1] · P. Kishore[1] · Eliza chinna Jose[1] · P. Vigna Dutt[1] · A. Parameshwaran[1] · Ashwin Kumar[1] · Krishna Prasad[1] · G. Sangeetha[2]

Received: 25 March 2024 / Accepted: 12 April 2024 / Published online: 26 April 2024

Abstract

To study the efficacy of low-level laser therapy in the management of temporomandibular joint arthralgia. *Design* Interventional study (pre-post study), *Setting* Meenakshi Medical College And Hospital, Research Institute. *Subjects* 50 patients with temporomandibular joint arthralgia were evaluated for pain, mouth opening and clicking sound while mouth opening before and after treatment. *Method* Patients are subjected to undergo low-level laser therapy with Infrared and red rays with a therapeutic dosage ranging from 8 J/cm^2 to 15 J/cm^2 up to 3–5 sessions for a month each session lasts for 15–20 min. The patients are to be followed up regularly after 1, 3, 6 and 8 months in the study.The study measured the range of mouth opening in patients before and after undergoing low-level laser therapy. Before treatment, the range of mouth opening was from 2.78 to 3.97 cm, with a mean value of 2.78 cm and a standard deviation of 0.22. After treatment, the range of mouth opening was from 2.78 to 3.97 cm, with a mean value of 3.97 cm and a standard deviation of 0.24. The study also measured the VAS score for pain, with a mean and standard deviation of 7.9 ± 0.73 before treatment and 0.88 ± 0.718 after treatment. There was a significant difference between the pretreatment and post-treatment VAS scores, with a *P*-value of 0.05. Low-level laser therapy is an effective non invasive treatment modality for temporomandibular joint arthralgia. The patients who underwent this procedure had symptomatic relief and no remissions were observed.

Keywords Temporomandibular joint (TMJ) · Low-level laser therapy (LLLT) · Visual analogue scale (VAS) · TMJ arthralgia · Red laser

Introduction

Temporomandibular joint (TMJ) arthralgia is one of the most common causes of trismus. It is a progressive and degenerative disease involving the temporomandibular joint affecting the articular surfaces of the condyle of the mandible and temporomandibular fossa. It may be unilateral or bilateral with varied etiology. Various causative factors of temporomandibular joint arthralgia include trauma, bruxism, chewing hard foods, excessive use of chewing gums and dental causes like wearing down of teeth, malocclusion, arthritis and genetic predisposition.

The disease progresses to erode the articular cartilage, leading to thinning, fraying, and softening of the same. The condition also triggers reactive changes in the nearby tissues and leads to a reduction in the intraarticular fluid which smoothens the condyles. This may cause excruciating pain with limitations of joint function. Other TMJ arthritis symptoms may include muscular involvement and occluding difficulty. Muscular involvements are stiffness, loss of power and fibrosis.

Occluding difficulty is due to erosion of ascending rami, a tilt in occluding plane sometimes occurs with minimal deviation of the mentum on the involved side. In rare cases, an anterior open bite might occur.

The pathology of temporomandibular joint arthritis affects a variety of structures, including the cartilage, subchondral bone, and synovial membrane, among others. This

✉ Muthubabu Kasiviswanathan
muthubabu67@gmail.com

[1] Department of Otorhinolaryngology, Meenakshi Medical College and Research Institute, Meenakshi Academy of Higher Education and Research, Chennai, India

[2] Department of Physical Medicine and RehablitationMeenakshi Medical College and Research Institute, Meenakshi Academy of Higher Education and Research, Chennai, India

condition manifests in a range of changes, including but not limited to, TMJ remodelling, abrasion and deterioration of the articular cartilage, as well as alterations to other hard and soft tissues.

It has been hypothesized that the anabolic capacity of chondrocytes may be outmatched by the deleterious effects of catabolic processes, thereby resulting in a disquieting disruption of homeostasis and a gradual deterioration of the cartilage [1].

Articular cartilage can undergo degeneration due to mechanical overload at the molecular level. This can lead to several processes, including the proteolysis of extracellular matrix components by the plasminogen activator system and apoptosis of chondrocytes through endoplasmic reticulum stress-induced cell death.it is important to recognize that these degenerative processes are complex and multifactorial, involving multiple signalling pathways and cellular processes the aforementioned processes ultimately culminate in the gradual thinning of the condylar cartilage [2].

The various symptoms range from pain, swelling, clicking sound from the temporomandibular joint, restriction of mouth opening and difficulty in chewing.

Radiological changes in patients with temporomandibular arthritis are condylar flattening and articular surface erosion which are the most common changes. Other radiological changes include osteophytes and a less common change is sclerosis [3].

TMJ arthralgia is highly prevalent which significantly affects the quality of life. Despite the high prevalence of the disease, only 3–7% of the affected patients seek treatment [4].

Medical management with analgesics, anti-inflammatory drugs, muscle relaxants [5, 6], intraarticular injections with corticosteroids and sodium hyaluronate [7]; occlusal appliances [8], non-invasive methods in physiotherapy like application of moist heat, ultrasonography(USG),transcutaneous electrical nerve stimulation(TENS),low level laser therapy (LLLT) [9] are the various treatment options available. LLLT is considered effective and one of the non-invasive methods widely used in the treatment of temporomandibular joint arthralgia.

According to a few studies LLLT has been suggested as a potential adjuvant treatment option in the management of TMJ arthritis [10, 11].

LLLT causes bio stimulation by facilitating increased activity in mitochondria and sodium–potassium pump; angiogenesis and fibroblast formation which aids the process of tissue healing and further promotes recovery [12, 13].

Lasers are used as a treatment modality in various fields of medicine like dentistry, dermatology, ophthalmology, cardiology, urology, oncology, ENT, and orthopedics in this study, we are discussing about outcomes of LLLT in the management of TMJ arthralgia.

Materials & Methods

After obtaining informed consent, 50 patients presenting to the ent outpatient department with a clinical diagnosis of temporomandibular joint arthralgia based on history and examination findings were selected and enrolled for the study. The study was conducted between August 2022 to December 2023.

Patients with otitis externa, acute otitis media; oral lesions like ulcers, dental caries and submucous fibrosis were excluded from the study. Patients are evaluated for mandibular symmetry, dentition and occlusion. Patients with mandibular asymmetry and malocclusion were excluded from the study. Patients under 18 years of age, those receiving analgesic or anti-inflammatory medications for any other condition, and those under treatment or previously treated for temporomandibular arthralgia are omitted.

Every patient is categorised on pantomogramic view after the clinical diagnosis of temporomandibular joint arthralgia.

Pain, mouth opening and clicking sound while mouth opening are the three parameters evaluated before and after treatment. Quantitative pain assessment is done using a visual analogue scale consisting of a linear line calibrated from 0 to 10 where 0 indicates nil pain and 10 severe pain. Patient chooses his/her pain score between 0 to 10 based on the severity. Mouth opening is measured by inter incisal distance between upper and lower incisors using a divider and scale.

Patients are subjected to undergo low-level laser therapy with infrared and red rays with a therapeutic dosage ranging from 8 to 15 j/cm^2 up to 3–5 sessions for a month (Fig. 1). Each session lasts for 15 to 20 min. The patients are to be followed up regularly after 1st, 3rd, 6th and 8th month. By end of 8 months, the patients are evaluated clinically. The data was analyzed using IBM SPSS statistics version 21.

Results

Among the 50 patients put in to evaluation, 92% female, 8% male. Youngest patient aged 19 and eldest 57 and mean age being 44. 40% study population presented as right side temporomandibular joint arthritis, 58% presented as left side temporomandibular joint arthritis and 2% of the patients had bilateral temporomandibular joint arthritis.

The presence of clicking sound pretreatment was found in 88% of the patients while clicking sound was absent in 12% of the total patients. Clicking sound post treatment was absent in all patients.

The range of mouth opening in the patients before undergoing treatment was from 2.4 to 3.4 cm. The mean

Fig. 1 Laser device and patient undergoing laser therapy

Table 1 Descriptive statistics regarding mouth opening

	N	Minimum	Maximum	Mean	Std. Deviation
Mouth opening pretreatment	50	2.4	3.4	2.784	0.2289
Mouth opening posttreatment	50	3.2	4.5	3.978	0.2418

value of mouth opening in the patients before undergoing low-level laser therapy is 2.78 cm with a standard deviation of 0.22. The range of mouth opening in the patients after undergoing treatment was from 3.2 to 4.5 cm. The mean value of mouth opening in the patients after undergoing low-level laser therapy is 3.97 cm with a standard deviation of 0.24. (Table 1).

VISUAL ANALOGUE SCORE with MEAN and SD is 7.9 ± 0.73 for VAS score in pretreatment when compared with post treatment as 0.88 ± 0.718 (Table 2). There is a significant difference in the VAS score for pretreatment method and the post treatment method as the P-value is 0.05. Radiologically no changes were seen in the panoramic view.

VAS scores and mouth-opening measurements clearly show significant improvements from pre-treatment to post-treatment. The median, quartiles, and range of values are visibly different in the post-treatment measurements, indicating the effectiveness of the treatment. (Figs. 2 and 3).

The line plots illustrate individual changes in VAS scores and mouth opening measurements for each patient before and after treatment, demonstrating significant improvements. (Figs. 4 and 5).

Table 2 Descriptive statistics regarding VAS score

	N	Minimum	Maximum	Mean	Std. Deviation
VAS score pretreatment	50	7.0	9.0	7.940	0.7398
VAS score posttreatment	50	0	3.0	0.880	0.7183

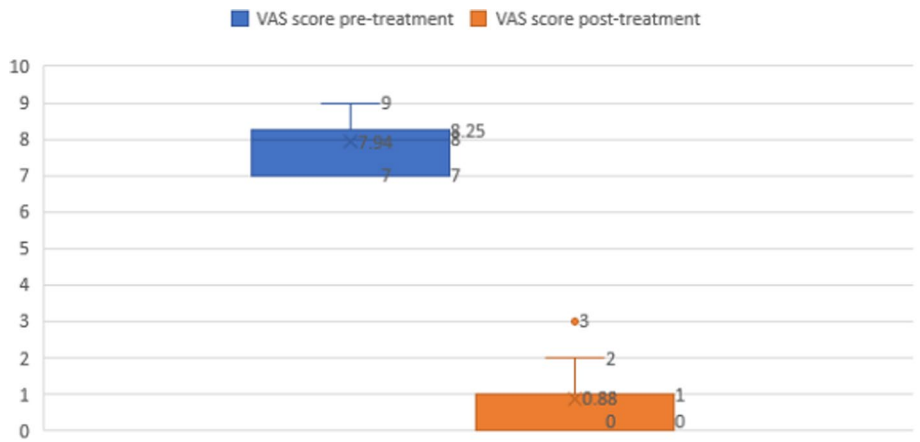

Fig. 2 VAS scores pre-treatment and post-treatment

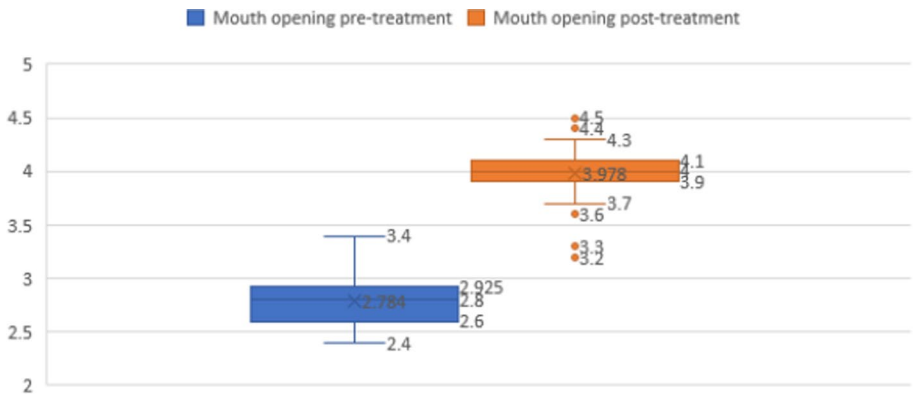

Fig. 3 Mouth opening in cms pre-treatment and post-treatment

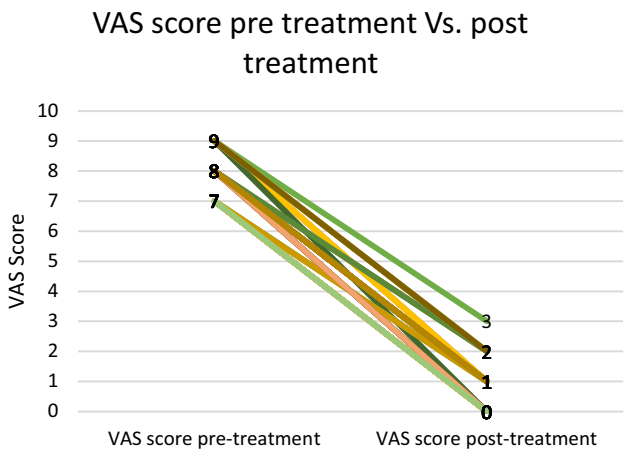

Fig. 4 Individual changes in VAS scores pretreatment and posttreatment

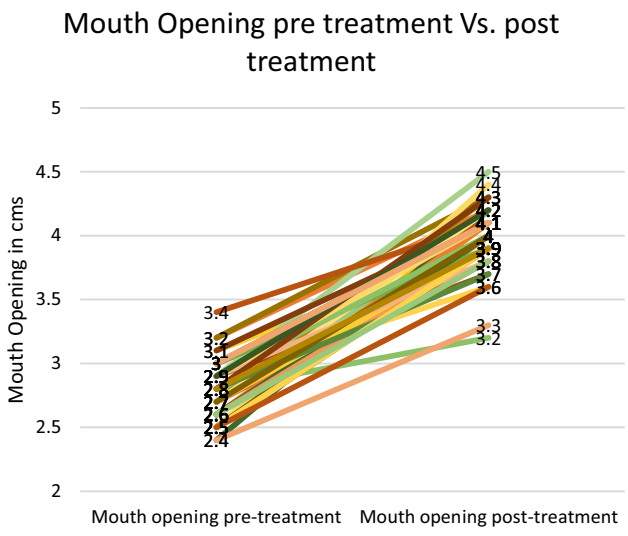

Fig. 5 Individual changes in mouth opening in pretreatment and post-treatment

The correlative coefficient-r value between the VAS score pre-treatment and post-treatment is 0.6 indicating a moderate to high positive correlation between them, indicating that patients with higher initial pain levels tend to have higher pain levels post-treatment as well, although much reduced.

Age shows a slight positive correlation with the VAS score pre-treatment as their r value is 0.26, suggesting older patients might experience slightly higher pain levels initially.

There is a moderate negative correlation between age and mouth opening pre-treatment as r is -0.36, indicating older patients may have slightly less mouth opening initially.

Discussion

The prevalence of TMJ arthritis in the general population is high. Symptomatology of temporomandibular joint arthritis ranges from clicking sound while opening the mouth, pain during chewing, pain while opening the mouth which results in restriction of mouth opening; some patients may experience referred otalgia, pain in the neck and shoulder muscles and occasionally repeated dislocation of the jaw [9]. This study will discuss pain score, mouth opening and clicking sounds while mouth opening. Different treatment options were evaluated in several studies conducted across the globe. Various treatment options that are widely used are conservative management by advising to avoid chewing of hard food, jaw rest of the affected side [14]; pharmacotherapy with analgesics, anti-inflammatory drugs, muscle relaxants [5, 6], intraarticular injections with corticosteroids and sodium hyaluronate [7]; Occlusal appliances [8], non-invasive methods in physiotherapy like application of moist heat, USG,TENS,LLLT[9]; TMJ arthroscopy with arthrocentesis can be considered in patients who does not show any improvement with the above mentioned treatment modalities [14].

LLLT can be considered a suitable alternative in patients who have undergone non-surgical interventions [15]. It is

one of the non-invasive methods which is found to be effective in the treatment of TMJ arthralgia symptomatically and in preventing recurrent attacks.

LLLT facilitates pain relief by stimulating the synthesis of endorphins and decreasing the release of bradykinin and histamine. LLLT has been shown to enhance the production of adenosine triphosphate, which could potentially lead to muscle relaxation [16].

Low-level laser therapy uses electromagnetic radiation which has a single wavelength infrared or red [9].

In a study done by shobha et al., the effect of LLLT in management of TMJ arthritis was compared with a placebo group and the mean difference in visual analogue score was found to be higher in the group who were subjected to laser therapy when compared to the group who underwent placebo therapy [17].

The efficacy of laser was compared with that of a control group in a study done by Thiago de Santana Santos et al. According to the results, control population reported a considerable improvement by 43.6%. In contrast to a 21.3% reduction in pain in the control group. A majority of patients, specifically 72% of the study group, exhibited a characteristic cracking sound upon opening their mouth prior to receiving treatment. Notably, the incidence of this symptom was observed to have significantly decreased post-treatment, with only 33% of patients continuing to report the same issue after undergoing laser therapy [18].

LLLT is believed to be treatment of choice.in initial stage, it can be tried as a first line of management and in the latent stage of the disease it is considered as a supportive measure. A research by Sayed N with a 6 month follow up period showed a significant pain free mouth opening with a mean increase of 6.35 mm and maximum possible mouth opening showed a mean increase of 3.8 mm. *P* value was less than 0.001 which suggested a statistically significant pain reduction [19].

Nunez et al. conducted a study in 2006 that proved that LLLT was found to be more potent than transcutaneous electrical neural stimulation in terms of improvement in mouth opening [9].

In 2003, Külekçiogˇlu et al. studied the potency of LLLT in arthrogenic and myogenic cases of temporomandibular disorder and good improvement in both mouth opening group was observed in the study population than placebo [20].

According to the study by GC Venezian, LLLT showed better improvement (assessed by VAS score) in the TMJ patients when compared to that of a placebo. This study yielded better results with the use of 25 j/cm^2 dosage when compared to the use of 60 j/cm^2. Electromyographic activity showed no change [21].

In a study done by mhcv catão, mouth opening was significantly improved in patients suffering from temporomandibular disorders and no variations were found between the two groups where the first group underwent infrared laser and the second group underwent red laser therapy [22].

In our study, before treatment, the range of mouth opening was from 2.78 to 3.97 cm, with a mean value of 2.78 cm and a standard deviation of 0.22. After treatment, the range of mouth opening was from 2.78 to 3.97 cm, with a mean value of 3.97 cm and a standard deviation of 0.24. VAS score for pain, with a mean and standard deviation is 7.9 ± 0.73 before treatment and 0.88 ± 0.718 after treatment. There was a significant difference between the pre-treatment and post-treatment VAS scores, with a *p*-value of 0.05.

Chronicity of the disease may undermine the potency of the procedure in pain relief and a study by Castillo-Madrigal J et al. opined that the probable reasons for the reported negative results regarding the therapeutic use of LLLT in the treatment of TMJ arthralgia may be due to the use of low doses in the therapeutic sessions. Appropriate number of therapeutic sessions in the treatment regimen also plays a vital role in the successful outcome [22, 23].

Conclusion

LLLT is a non surgical modality for management of TMJ arthralgia. The patients who underwent this procedure had symptomatic relief and no remissions were observed during the follow up period.

References

1. Al-Ani Z (2021) Temporomandibular joint osteoarthrosis: a review of clinical aspects and management. Prim Dent J 10(1):132–140. https://doi.org/10.1177/2050168420980977
2. Hye-Min Ju, Kim K-H, Jeong S-H et al (2021) Pathophysiology of temporomandibular joint arthritis: review. J Oral Med Pain 46:69–74. https://doi.org/10.14476/jomp.2021.46.3.69
3. Gaillard F, Elfeky M, Knipe H (2005) Osteoarthritis of the temporomandibular joint. Reference article. Radiopaedia org. https://doi.org/10.53347/rID-5524
4. Okeson JP, de Kanter RJ (1996) Temporomandibular disorders in the medical practice. J Fam Pract 43:347–356
5. Gauer RL, Semidey MJ (2015) Diagnosis and treatment of temporomandibular disorders. Am Fam Phys 91(6):378–386
6. Ouanounou A, Goldberg M, Haas DA (2017) Pharmacotherapy in temporomandibular disorders: a review. J Can Dent Assoc 83(7):1–8
7. Bjornland T, Gjærum AA, Moystad A (2007) Osteoarthritis of the temporomandibular joint: an evaluation of the effects and complications of corticosteroid injection compared with injection with sodium hyaluronate. J Oral Rehab 34:583–589
8. Madani AS, Ahrari F, Nasiri F, Abtahi M, Tunér J (2014) Low-level laser therapy for management of TMJ osteoarthritis. CRANIO® 32(1):38–44. https://doi.org/10.1179/0886963413Z.0000000004

9. Núñez SC, Garcez AS, Suzuki SS, Ribeiro MS (2006) Management of mouth opening in patients with temporomandibular disorders through low-level laser therapy and transcutaneous electrical neural stimulation. Photomed Laser Surg 24(1):45–49. https://doi.org/10.1089/pho.2006.24.45
10. Salmos-Brito JA, de Menezes RF, Teixeira CE, Gonzaga RK, Rodrigues BH, Braz R, Bessa-Nogueira RV, Gerbi ME (2013) Evaluation of low-level laser therapy in patients with acute and chronic temporomandibular disorders. Lasers Med Sci 28(1):57–64. https://doi.org/10.1007/s10103-012-1065-8
11. Vagishkumar LS (2014) Use of lasers in the management of temporomandibular disorders. Int J Laser Dent 4(2):43–48. https://doi.org/10.5005/jp-journals-10022-1054
12. Shukla D, Muthusekhar MR (2016) Efficacy of low-level laser therapy in temporomandibular disorders: a systematic review. Natl J Maxillofac Surg 7(1):62. https://doi.org/10.4103/0975-5950.196127
13. Maia MLDM, Bonjardim LR, Quintans JDSS, Ribeiro MAG, Maia LGM, Conti PCR (2012) Effect of low-level laser therapy on pain levels in patients with temporomandibular disorders: a systematic review. J Appl Oral Sci 20:594–602
14. Azadgoli B, Baker RY (2016) Laser applications in surgery. Ann Transl Med 4(23):452–452. https://doi.org/10.21037/atm.2016.11.51
15. Yanik S, Polat ME (2020) Effects of arthrocentesis and low-level laser therapy on patients with osteoarthritis of the temporomandibular joint. Br J Oral Maxillofac Surg. https://doi.org/10.1016/j.bjoms.2020.08.110
16. Simunovic Z (1996) Low-level laser therapy with trigger points technique: a clinical study on 243 patients. J Clin Laser Med Surg. https://doi.org/10.1089/clm.1996.14.163
17. Shobha R, VeenaS Narayanan BS, JagadishPai HP, Jaishankar MJJ (2017) Low-level laser therapy: a novel therapeutic approach to temporomandibular disorder—a randomized, double-blinded, placebo-controlled trial. Indian J Dent Res 28(4):380. https://doi.org/10.4103/ijdr.IJDR_345_15
18. Santos TDS, Piva MR, Ribeiro MH, Antunes AA, Melo AR, Silva EDDO (2010) Eficácia da laserterapia nas disfunções têmporo-mandibulares: estudo controle. Braz J Otorhinolaryngol 76:294–299
19. Nabeel Sayed C, Murugavel AG (2014) Management of temporomandibular disorders with low level laser therapy. J Maxillofac Oral Surg 13(4):444–450. https://doi.org/10.1007/s12663-013-0544-1
20. Kulekcioglu S, Sivrioglu K, Ozcan O, Parlak M (2003) Effectiveness of low-level laser therapy in temporomandibular disorder. Scand J Rheumatol 32(2):114–118. https://doi.org/10.1080/03009740310000139
21. Venezian GC, Rodrigues AM, da Silva M, Mazzetto RG, Oliveira Mazzetto M (2010) Low level laser effects on pain to palpation and electromyographic activity in TMD patients: a double-blind, randomized, placebo-controlled study. Cranio J Craniomandib Sleep Pract 28(2):84–91
22. Catão MHCDV, Oliveira PSD, Costa RDO, Carneiro VSM (2013) Evaluation of the efficacy of low-level laser therapy (LLLT) in the treatment of temporomandibular disorders: a randomized clinical trial. Rev CEFAC 15:1601–1608
23. Castillo-Madrigal J, Pozos-Guillén A, Gordillo-Moscoso A (2022) Effectiveness of the therapeutic laser in the syndrome of dysfunction of the temporomandibular joint of arthrogenic origin. Odovtos Int J Dent Sci. https://doi.org/10.15517/ijds.2022.49856