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## RESEARCH ARTICLE

# LOW LEVEL LASER THERAPY (LLLT) IN MANAGEMENT OF TEMPOROMANDIBULAR JOINT DISORDERS: A STEPWISE LITERATURE REVIEW

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### ABSTRACT

The American Academy of Orofacial Pain defined Temporomandibular Disorders as-“a collective term that embraces a number of clinical problems that involve the masticatory muscles, the temporomandibular joint and the associated structures.” The morbidity due to the temporomandibular disorders is 27% to 76% among patients who go for dental care. About 75% of the population has one sign and approximately 33% has at least one symptom of temporomandibular disorder. The Research Diagnostic Criteria for temporomandibular disorder is the first comprehensive assessment of reliability and validity of original Axis and . Low Level Laser Therapy is a conservative, non-invasive, quick and safe method that has been introduced for treatment from past few years. The purpose of this review article is for meta-analysis of the related investigations and application of Low Level Laser Therapy in patients of temporomandibular disorders of different ages and sexes and their positive results over a given period of time. It aimed at compiling literature searches for different articles that was performed using NCBI, Pubmed and Google Scholar by combining the terms: temporomandibular disorders, temporomandibular joint dysfunction, temporomandibular joint disc, TMD, TMJ, craniomandibular disorders, myofascial pain, myofascial pain syndrome, laser, low level laser therapy soft laser, LLLT. **Conclusion:** All the patients have shown positive results to this treatment with different degrees.

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## INTRODUCTION

Temporomandibular disorders are a major cause of pain of non-dental origin in orofacial region with 40% to 75% of non-patient adult population displaying atleast 1 sign and approximately 33% reporting atleast 1 symptom of TMJ dysfunction. Understanding the pathophysiology of TMJ disorders is important to find out the etiology, dysfunction, diagnosis and treatment of internal dysfunction and osteoarthritis of TMJ. It is diagnosed in patient who suffer from muscle/joint pain spontaneously by palpation or function and limited mandibular movement. Joint sounds are another symptom of Temporomandibular disorders. Mainly disorders of TMJ do not have an inflammatory origin . But a trauma to the TMJ leads to cellular destruction of articular capsule, resulting in an inflammatory process in subjacent connective tissue and painful episodes. Laser is an electromagnetic light which is non ionizing and highly concentrated which when in contact with tissues may result in various effects depending on parameters applied and optical properties of irradiated tissues. The special characteristic of this type of light as coherent,

monochromaticity and collimation have important therapeutic properties that modify cellular metabolism, increase tissue repair and decrease edema and inflammation. Laser can be divided into “soft lasers” and “hard lasers” according to the energy output. Hard lasers have higher energy output and are used to cut tissues specially during surgical procedures whereas the low level lasers have lower energy output and do not increase skin temperature; their main effect is not due to thermal effect but is based on light absorption. They typically use wavelength of range 630-1300nm.

**MECHANISM OF ACTION:** It has complex mechanism of action resulting in three main effects on tissues- effect through direct irradiation without causing a thermal response. Biostimulation occurs through metabolic activation and increased vascularization and fibroblast formation. The anti-inflammatory and analgesic effects of Low Level Laser Therapy are probably due to multiple actions. It increases the Beta-endorphin level in spinal liquor and increases the urinary excretion of glucocorticoids which are inhibitors of synthesis of Beta-endorphins. It also increases pressure-pain threshold through a complex electrolytic nerve fiber blocking mechanism and causes a

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decrease of release of histamine and acetylcholine and a decrease of synthesis of bradykinin. Low level laser therapy produces and increase of ATP production, improvement of local microcirculation, reduction of edema through an increase of lymphatic flow and decrease of prostaglan E2 and cyclooxygenase-2 levels.

## METHODOLOGY

This paper includes meta-analysis of 26 published research articles of different authors that are related to Low Level Laser Therapy in TMDs. The literature search for these articles was performed using NCBI, Pubmed and Google Scholar by combining the terms: temporomandibular disorders, temporomandibular joint dysfunction, temporomandibular joint disc, TMD, TMJ, craniomandibular disorders, myofascial pain, myofascial pain syndrome, laser, low level laser therapy soft laser, LLLT. The articles that are included are effectiveness of low level laser therapy in temporomandibular disorders: a systematic review and meta-analysis (Ambra petrucci, DDS *et al*), low level laser therapy for the treatment of temporomandibular disorders:

A systematic review of the literature (Marcello Melis, D.MD., R.Pharm), Application of low level laser therapy in temporomandibular disorders (Arash Rahimi *et al*), comparison of low level laser therapy and drug therapy in patient with temporomandibular disorders: A randomized clinical trial (Peimani *et al.*, 2011), management of temporomandibular disorders with low laser therapy (Nabeel Sayeed *et al*), Effectiveness of Low level laser therapy in temporomandibular disorders (Sevinc Kulekcioglu), Efficacy of red and infrared lasers in treatment of temporomandibular disorders- a double blind study, randomized clinical trial (T lio Silva Perua *et al*), Evaluation of low level laser therapy in temporomandibular disorder patient (Simel Ayyildiz *et al*), Low intensity laser therapy in Disc derangement disorders of Temporomandibular joint (Mubeen khan *et al*), Effectiveness of Low level laser therapy in Temporomandibular disorders:

A placebo controlled study (H. Fiká kov, M.D. *et al*), Low level laser therapy in Temporomandibular disorders: A phase double blind study (Marcelo O. Mazzeto, DDS, M.S., PhD *et al*), Measurement of jaw movements and TMJ pain intensity in patient treated with GaAl As laser (Marcelo oliveria MAZZETO *et al*), Low level laser therapy as an adjunctive technique in management of temporomandibular disorders (Marco Ant nio Moreira *et al*), Clinical assessment of efficacy of Low level laser therapy on muscle pain in women with TMD by electromyography (Ewerson Bertolini Shinozaki *et al*), and a meta-analysis of clinical effects of low level laser therapy on temporomandibular joint pain (Wen- Dien Chang, PhD *et al*), Comparative evaluation of low-level laser therapy and ultrasound heat therapy in reducing temporomandibular joint disorder pain (Sanyukta Khairnar *et al*).

A comparative evaluation of effectiveness of Low Level Laser Therapy, Ultrasound therapy and Transcutaneous electric nerve stimulation in patient with TMDs: a prospective study (Akansha Budakoti *et al*), A randomized clinical trial comparing the efficacy of low level laser

therapy (LLLTT) and acupuncture therapy (LAT) in patients with temporomandibular disorders (Azamsadat Madani *et al*), Effectiveness of low level laser therapy in the management of temporomandibular disorders (Sudhir R Varma *et al*), Low-level laser therapy:

A novel therapeutic approach to temporomandibular disorder- A randomized, double-blinded, placebo-controlled trial (R Shobha *et al*), Effect of Superpulsed Low Level Laser Therapy in Temporomandibular Joint Pain (Marini, Ida MD, DDS *et al.*), Efficacy of Low Level Laser Therapy in Temporomandibular Disorders:

A systematic review (Deepankar Shukla and M.R. Muthusekhar), Low intensity Laser Therapy in temporomandibular disorders: a Phase double blind study (Carrasaco TG *et al.*), Low Level Laser Effects On Pain to Palpation and Electromyographic Activity in TMD Patients: A Double-Blind, Randomized, Placebo-Controlled Study (Giovana Cherubini Venezian *et al.*), Efficacy of low level laser therapy in the treatment of temporomandibular disorders (da Cunha *et al.*), Low Level Laser Therapy for Temporomandibular Joint Pain: A double blind and placebo- controlled study (Rüdiger Emshoff *et al.*),

According to Arash Rahimi *et al* in the year 2011 (24), in his review article Application of Low Level Laser Therapy in Temporomandibular Disorders, LASER application can have many advantages in different ways for temporomandibular disorders problems and in many cases occlusal adjustment and taking impression for splint is necessary but the pain prevents conventional treatment. Similarly Petrucci A *et al* (25) has mentioned in the year 2011, in his systematic review of six randomized clinical trials that the primary outcome of interest was the change in pain from baseline to endpoint.

In another systematic review article by Deepankar Shukla and M. R. Muthusekhar in the year 2016 (26), the evidence from Randomized Clinical Trials regarding the efficacy of LLLT for TMDs has been examined. They concluded that low-level laser has no detrimental effect on the patients and could be an option for those patients who are interested in noninvasive therapy.

## RESULTS

Low level laser therapy gives positive result in reducing the pain intensity, number of tender points, clicking sounds of TMJ and improvement in the range of jaw motion. At the same time it'll be challenging for the patients to respond in the same way and by same pace to LLLT as no two individuals will have same level of pain threshold levels.

In spite of its non invasive nature, it is not very much popularized in temporomandibular disorder patients. In the future, it will be important to consider the Low level laser therapy as one of the several parameters to be incorporated into the treatment of disorders of TMJ.

Sl. No.	Authors	Journal and Year	Patient sample (age and sex)	Duration	Energy dose	Results
1.	Sanyukta Khairmar <i>et al.</i> (2019)	J Dent Anesth Pain Med. 2019 Oct;19(5):289-294	Total=42 Age= 25-45yrs GpA=21 GpB=21	NSAID twice a day for 5days to all pts GP A= 5sessions of LLLT Gp B= 5sessions of Ultrasound therapy	Gp A=660nm, 2.2Jper min Gp B= 1.8W/cmsq for 10min per session	LLLT was more effective than Ultrasound therapy
2.	Akansha Budakoti <i>et al.</i> (2019)	Lasers in Dental Science volume 3, page s257–267(2019)	Total=45 M=16 F=29 Age= 20-50yrs Randomly divided into 3gps	Gp = Twice a week for 4 weeks Gp =3 min/session (3 sessions of 3 min each in every visit Gp = 30min twice a week	Gp = IV A LLLT(indium gallium arsenide phosphide (InGaAsP)) 940 nm Gp =therapeutic ultrasound in continuous mode, 1 MHz, 1–1.25 W/cm <sup>2</sup> Gp = TENS therapy with low-intensity current, pulse rate of 0.11 Hz	Significantly more in pain, mouth opening
3.	Azamsadat Madani <i>et al.</i> (2019)	Published in Lasers in Medical Science 2019 DOI:10.1007/s10103-019-02837-x	Total=45 Gp= Expt gp for LLLT Gp= Expt gp for Accupuncture therapy Gp= Placebo gp	2times/week for 5 weeks	Gp -GaAlAs 810nm, 200mW, 30sec per point for LLLT Gaussian beam, spot size 0.28cmsq, 21J/cmsq Gp =Laser emitted bilaterally on acupuncture points with same settings	Overall pain intensity & pain degree in both Expt gps than Placebo gp excursive and protrusive mandibular movements
4.	Sudhir R Varma <i>et al.</i> (2018)	World Journal of Dentistry, July-August 2018;9(4):316-320	Total=24pts Expt Gp=16 Placebo gp=8	Average= 300sec for each patient	940 nm and a power of 6W	Significant amount of pain after LLLT on a short-term basis majority of patients reported a in clicking frequency, and a softer mandibular movement compared with the placebo gp
5.	Peimani A <i>et al.</i> (2018)	10.18875/2577-1485.2.205 JO - Journal of Oral Health and Dental Science	Total 72 patients 36 patients for LLLT 20-45yrs M=22 F=14	Twice a week for 4 weeks 10sec per point	Wavelength of 808nm, laser beam of 0.028cmsq, 50mW, 4J energy, power density of 1.78W/cmsq	in symptoms and in mandible movements
6.	R Shobha <i>et al.</i> (2017)	Shobha R, Narayanan VS, Jagadish Pai B S, Jaishankar H P, Jijin M J. Low-level laser therapy: A novel therapeutic approach to temporomandibular disorder – A randomized, double-blinded, placebo-controlled trial. Indian J Dent Res 2017;28:380-7	Group 1 (n=20) Group 2 (n=20)	2–3 treatments per week for 8 sessions of active LILT	Diode laser (gallium aluminum arsenide, 810 nm, 0.1 W).	pain observed in both active LLLT and placebo groups improvement in clicking
7.	Simel Ayyildiz <i>et al.</i> (2015)	CRANIO®, 32:1, 51-56, DOI: 10.1179/0886963413Z.0000000005	Total=2 M=18 Yrs old F=25yrs old	Thrice a week for 1 month, duration-30 seconds	BTL-2000 685 nm, 25 mW, 30 s, 0.02 Hz, and 6.2 J/cm <sup>2</sup>	mouth opening and reduced pain at TMJ
8.	Túlio Silva Pereira <i>et al.</i> (2014)	CRANIO®, 32:1, 51-56, DOI: 10.1179/0886963413Z.0000000005	Each hemiface of 19 subjects	3 sessions	4J/cmsq at TMJ and 8J/cmsq in muscles	Improvement in 24hrs which extended upto 180days in both gps
9.	Nabeel Sayed <i>et al.</i> (2013)	J Maxillofac Oral Surg 2014 Dec; 13(4): 444–450	Total=20 M=11 F=9 19-47yrs	1, 2weeks, 1, 3 and 6 months.	CDHC DenLase 980/7 Diode Laser Therapy System(class laser) 0.6W, 60sec 4J/cmsq.	joint sounds, pain intensity, no. of tender joints and improvement in the range of jaw motion.
10.	Da Silva MA <i>et al.</i> (2012)	Cranio. 2012 Oct;30(4):264-71.	Total=45 Gp =15 Gp = 15 Gp = 15	2 weekly sessions for 5 weeks	Gp = 52.5J/cmsq. Gp = 105.0J/cmsq Gp =0J/cmsq.	mean mandibular range of motion and painful symptoms in Gp and but no effect in Gp .

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11.	Marini I <i>et al.</i> (2010)	The Clinical Journal of Pain: September 2010 - Volume 26 - Issue 7 - p 611-616 doi: 10.1097/AJP.0b013e3181e0190d	Total=99 Gp =39 for Superpulsed LLLT Gp =30 For drug Ibuprofen Gp =sham Laser	10 sessions for 2weeks	Ibuprofen-800mg	Mandibular function improved in all LLLT pt
12.	Ewerson Bertolini Shinozaki (2010)	Bra J Oral sci 2010 Vol 9-Number 4	13 women 18 to 36yrs	Before, immediately after 5minutes and 20minutes after laser application.	Diode Laser GaAlAs at 790nm 1.5J/cmsq at 4 different points of TMJ and 3J/cmsq at 3 different points in temporal muscles	Temporal muscle showed a higher EMG activity than masseter muscle at all evaluation times.
13.	Marcelo Oliveira Mazzetto <i>et al.</i> (2010)	Measurements of jaw movements and TMJ pain intensity in patients treated with GaAlAs laser MO Mazzetto, TH Hotta, RCA Pizzo - Brazilian dental journal, 2010	Total=40 Gp =20 Gp =20	Twice a week for 4weeks	Gp =GaAlAs Laser, 830nm, 40mW, 5J/cmsq Gp =0J/cmsq	mandibular movements, pain in Gp than placebo gp
14.	Shiranii AM (2009)	Lasers Med Sci. 2009 Sep;24(5):715-20. doi: 10.1007/s10103-008-0624-5. Epub 2008 Nov 12	Total=16 Gp= Laser gp Gp= Control gp	Twice a week for 3weeks for 6min	660nm, 17.3Hz, 6.2J/cmsq continuous wave	of pain before and after the treatment was meaningful but LLLT was more effective
15.	Carrasaco TG (2008)	Cranio. 2008;26:274-281	Total= 14 Divided into Active and Placebo group	2 appointments /week for 4weeks for 60seconds	780nm, 70mW, 105J/cmsq	Considerable TMJ pain improvement and masticatory efficiency in Active gp
16.	Giovana Cherubini Venezian <i>et al.</i> (2008)	The Journal of Craniomandibular & Sleep Practice Volume 28, 2010 - Issue 2	Total=48	Twice a week for 4 weeks	25J/cmsq and 60 J/cmsq	Only the active doses showed statistically significant in pain level in all regions of palpated ms
17.	Da Cunha LA <i>et al.</i> (2008)	International Dental Journal Vol 58, Issue 4	Total=40 2Gps- G1- Experimental G2- Placebo	Once a week for 4 consecutive weeks	Infrared laser 830nm, 500mW, 20s, 4J/point	Pain and TMD symptoms were significantly lower in both the gps
18.	Rüdiger Emshoff <i>et al.</i> (2008)	April 2008 Volume 105, Issue 4, Pages 452-456	Total=52 Gp =26 in Active gp Gp =26in Placebo gp	2-3 appointments for 8weeks for 2+2min	632.8nm, 30mW, 1.5J/cmsq,	Same results in both the gps
19.	Marcelo Oliveira Mazzetto <i>et al.</i> (2007)	Cranio: The Journal of Craniomandibular practice 25(3):186-192 · August 2007	Total=48 patients Gp -Experimental gp Gp - Placebo gp	Twice a week, for 4 weeks	Infrared laser (780 nm, 70 mW, 10 s, 89.7 J/cm <sup>2</sup> )	in pain level
20.	de Abreu VenancioR <i>et al.</i> (2005)	J.ofOralRehabilitation Volume32, Issue11 November 2005 Pages 800-807	Total=30 Gp expt gp=15 Gp placebo gp=15	2appointment s/week for 3weeks For 10sec×3	780nm, 30mW, 6.3J/cmsq	Same results in both the gps
21.	Kogawa EM <i>et al.</i> (2005)	J. Appl. Oral Sci. vol.13 no.3 Bauru July/Sept. 2005	Total=19 women Gp = 9 pts for LLLT Gp = 10 pts for MENS	10 sessions, 3 times a week, for 1month	Ga-Al-As wavelength of 830 to 904nm, 4J/cmsq, s100mW	in maxm mouth opening and in tenderness to palpation for both gps
22.	Kulekcioglu S <i>et al.</i> (2003)	Scandinavian Journal of Rheumatology	Total=35 Active t/t gp=20 Placebo gp=15	15 sessions of LLLT for 3min	904nm, 1000Hz, 17mW, 3J/cmsq	Significant in pain in both active and placebo t/t gp Active and passive maximum mouth opening, lateral motion & no. of tender points in Active t/t gp only
23.	Sevinc Kulekcioglu <i>et al.</i> (2003)	Scandinavian Journal of Rheumatology, 32:2, 114 - 118, DOI: 10.1080/03009740310000139	Total patients-35 Gp = 15(placebo) Gp =20(active t/t) 20-59yrs	15 sessions of LLLT for 180sec	GaAs at 904nm, 17mW mean output, 1000Hz frequency, energy 3J/cmsq	Significant improvement in no. of tender points, maximal active and passive mouth opening, right and left lateral jaw motion in active treatment gp

## ABBREVIATIONS

- 1.Pt/ Pts = Patient/ Patients
- 2.TMJ = Temporomandibular Joint
- 3.TMD = Temporomandibular Disorders
- 4.Yr = Year
5. = Increase
6. = Decrease
- 7.Gps = Groups
- 8.Hrs = Hours
- 9.Ms = Muscle

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