

A Pilot Study on The Use of Low Level Laser Therapy in Treatment of Temporomandibular Disorder

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Abstract

Temporomandibular disorders (TMDs) is a collective term that embracing a number of clinical problems that involve the masticatory muscles, Temporomandibular Joint (TMJs), and the associated structures. It characterized by facial pain in the area of TMJ and muscle of mastication, restriction and sound during mandibular movement. Recently physical therapy such as Low Level Laser Therapy (LLLT) is used as one of the treatment modalities and it is believed to promote wound healing, tissue repair and induce analgesia.

Convenience sampling was used which consist of 22 volunteered patients, 14 were treated with conventional treatment and 8 were treated with combination of LLLT and conventional therapy. Laser machine used was Waterlase/Biolase © 2007 with irradiation 0.5 W- 30 Hz daily for three consecutive days, then once a week review treatment for two weeks. The space between laser beam and skin is 3 cm, applied as small circles for 2-3 minutes. Pain intensity before and after the treatment was recorded by using numerical rating scale (NRS). Statistical data analysis was conducted using SPSS software. Wilcoxon-sign ranked-test and Mann-Whitney U test were used.

Pain intensity was reduced significantly in patients whom treated by combination of LLLT and conventional therapy. ($p < 0.05$). Pain intensity after treatment for female were higher ($M = 1.20$, $SD = 1.10$) than for male ($M = 0.00$, $SD = 0.00$). Younger patients have higher pain intensity than older patients.

LLLT is effective to be used as adjunct to the current conventional treatment in relieving pain in TMDs.

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Introduction

Temporomandibular disorder (TMD) are described as a number of clinical problems that affecting the masticatory muscles, the temporomandibular joints, and associated structures, characterized by facial pain in the region of TMJ and muscle of mastication, restricted or deviation in mandibular movement, and TMJ sounds during jaw movement and function.¹

Etiology of TMD is currently known to be

multifactorial, as evidenced by the combination of psychological, physiological, structural, postural and genetic factors, modifying the functional balance between the fundamental elements of stomatognathic system.²³

According to Leeuw et al in 2008 functional disorder of TMJ in the contemporary population is the third most frequent dental disease after caries and periodontal problem.⁴ TMDs are most prevalent between the ages of 20 and 40 years and more frequently affect women, the reason why women make up the majority of patients presenting for treatment is still unclear.⁵

The most important feature of TMDS is pain, pain may be present at rest, may be continuous or intermittent, and characteristically increases with jaw functions such as chewing or opening wide, other common findings include a restricted range of mandibular movement or uncoordinated

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movements, and irregularities in the joints during mouth movements, characterized by clicking or grating sounds. Myofascial pain is the most common TMD and may present with or without restricted mouth opening.⁶

Treatment goals for TMDs are to control pain, improve mandibular motion, and restore function as close to normal as possible, clinical case studies suggest that the majority of individuals with TMD respond to conservative non-invasive therapy, making the use of invasive procedures unwarranted as initial therapy. No one treatment has emerged as superior, although many of the treatments studied have shown beneficial effect.

Currently, the use of laser therapy is gaining their popularity in healthcare industry. Since 1994, laser has been used in dentistry to treat variety of dental problem for both hard and soft tissues. For TMDs, Low Level Laser Therapy (LLLT) is a treatment that utilizes specific wavelengths of light to interact with tissue and is thought to help accelerate the healing process. However, there are some research show this therapy only can be used as an adjunct to the current conventional treatment, while others found no slight difference with the use of LLLT.

The mechanism of action of LLLT is not yet well established, but it is clinically proven that it shows positive result in alleviate the pain as reviewed in research done by Maia et al which reported 9 out 14 studies showed a significant reduction of pain whereby 4 studies showed similar result in both placebo and laser group and only one group showed negative result in both placebo and laser group.

In other research done by Chung et al (2012) proposed that LLLT is used for three main purpose which to promote wound healing, tissue repair, and the prevention of tissue death.⁷ Besides, it also reported by Verma et al in which LLLT has analgesic effect on soft tissues.⁸ However, there are some studies as reviewed by Fabre et al which found that only certain wavelength will result in positive effect of bio stimulation.⁹ It is supported by studies done by Chung et al (2012) which reported these therapy is still debatable based on two principles which are poorly understood underlying biochemical mechanism and great variability of parameter including wavelength, power density, duration of each treatment for every patient groups. The effectiveness could be reduced, or even no

therapeutic outcome will be produced as a result of dosage is not precise.⁷

In a study reviewed by Wen Dien Chang et al (2014) it was found that low-level laser could block the synthesis of cyclooxygenase (COX-2), therefore blocking the change of arachidonic acid to prostaglandins (PGE₂, PGF_{2α}) and thromboxane. It was inferred that the analgesia was produced by the reduction in production of those precursors. It was also indicated that a low-level laser could infiltrate tendons or the joint capsule to reduce the prostaglandin (PGE₂) level in vivo and inflammation.¹⁰

In another study also reviewed by Wen Dien Chang et al proposed that LLLT could increase the production of urine glucocorticoid, a synthetic inhibitor of endorphin, to cause an analgesic effect. It was also thought that the local irradiation of LLLT could induce the microcirculation of peripheral nerve tissues and inhibit the pain sensation to achieve the analgesic effect in another study reviewed by them. Other than that, also in another study it was found that LLLT could result in a higher production of adenosine triphosphate in the mitochondrion. This reaction manufacture energy for local catabolism and anabolism hence block the production of endogenous pain-producing substances, histamine, acetylcholine and bradykinin, to reduce the production of pain factors.¹⁰

There are few research done on the effects of low level laser therapy on TMD. Those studies have controversial results. In present study, we will compare the effect of treatment of combination therapy of low level laser therapy and conventional therapy and conventional therapy alone to treat TMD pain. The data to be gathered will help clinicians decide on the usage of low level laser therapy in the future.

The aim of the present research is to analyse the results of treatment of TMDs patients with low level laser therapy (LLLT) and to evaluate the response of patient with TMD to combined conservative non-invasive and low level laser therapy (LLLT) and compare it with conservative non-invasive treatment of TMD.

Material and Methods

Ethical approval from IIUM ethical committee was gained on 28 March 2017 with ID number IREC 706. Data collection was then carried out

after the approval, starting from March 2017 to December 2017. Patients need to be medically fit and healthy in order to be selected. This study excluded patients with systemic diseases, patients with bone pathology, patients with hormonal disturbances, and patient with history of migraine. Patients received a full disclosure of the nature of the study with an extended opportunity to ask questions. They were ensured to participate in this study voluntarily and informed consents were obtained from them. The confidentiality and anonymity of research participants were respected. Any possible harm was best avoided.

Diagnosis (mainly disk anterior disk displacement, posterior disk displacement and myalgia) was made based on the complaints of patients who came to IIUM Dental Polyclinic, history taking and physical examination. Treatment plans included in this study were subdivided into several categories to aid the data analysis as seen in Table 1.

Treatment	Content
1	-Self-care instruction -Medication -Mouth guard -Review
2	-Self-care instruction -Review
3	-Self-care instruction -Mouth guard -Review
4	-Self-care instruction -Medication -Review
5	-Self-care instruction -Medication -Mouth guard + laser Review
6	-Self-care instruction + laser -Review
7	-Self-care instruction -Mouth guard + laser -Review
8	-Self-care instruction -Medication + laser -Review

Table 1. Treatment Plans.

The study consists of two groups of patients.
 - Group 1 treated with irradiation of low level laser, 0.5 W- 30 Hz daily for three consecutive days then once a week treatment for two weeks, space between laser beam and skin is 3 cm applies as small circles for 2-3 minutes (Waterlase/Biolase © 2007), combined with conservative non-invasive and reversible therapies.

- Group 2 treated with conservative non-invasive and reversible therapies alone. Conservative non-invasive therapy will include self-care instruction, analgesic and night guard. Analgesic and night guard only will be given if required only.

Patients of group 1 and 2 will be called at 1 and 2 weeks intervals after the last session of treatment. Assessment of the treatment outcomes were guided by the treatment outcome measures by International Association of Oral and Maxillofacial Surgeons (IAOMS) as seen in Table 2.

1. Pain absent or so mild that it does not concern the patient; pain is significantly reduced in intensity and frequency
2. Mandibular range of motion of at least 35 mm inter-incisal and 6 mm lateral and protrusive
3. Absence or reduction of TMJ sound
4. Regular diet that, at worst avoids hard foods- patient minimally inconvenienced by diet
5. Return of normal imaging appearance of the TMJ, or stabilization of the degenerative changes noted in the imaging studies
6. Absence of significant complications
7. Absence of symptoms for at least 2 years

Table 2. Treatment outcome measures recommended by the International Association of Oral and Maxillofacial Surgeons for the assessment of treatment success.

Case sheet consisting of information regarding the demographic parameters, signs and symptoms, diagnosis, treatments, prognosis and follow up part was used for data collection.

The data were analysed using IBM Statistical Package for Social Science (IBM SPSSv23; SPSS Inc). Statistical methods such as Wilcoxon-signed rank test and Mann Whitney tests were used to analyse the data. Tables and pie charts were constructed based on the results.

Results

Out of 22 TMD patients who participate in this research, 10 of them are male (45.5%) and 12 are female (54.6%). The age range was between 18 years old to 68 years old and they were divided into 2 group according to their preferences to participate in this research:

Group 1: 8 patients treated with conventional and LLLT therapies

Group 2: 14 patients treated with conventional therapies.

Figure 1 shows the distribution of patients according to clinical diagnosis. Majority of the patient presented themselves with ADD while the PDD with myalgia was the least diagnosed condition. In this study, it can be seen in both group that most of the participant are from the young-adult group while only 1 (9.5%) patient each from middle-adult group and older-adult group.

Based on table 4, pain score after treatment for female were higher (M=1.20, SD=1.10) than for male (M=0.00, SD=0.00. Pain score after treatment for female was higher than for male. However, there are likely due to the number of female more than number of male.

The differences of pain score before and after treatment of TMD's patients treated with combination of conservative and LLLT was done. 5 patients show absent of pain during review session while 3 patients show reduction of pain as stated in table 4.

The non-parametric test was used which is Mann Whitney u-test. From the table 5, it indicates group 2 can be considered has higher pain score. In the next table, there is significance difference of pain score when compare between the two groups (P<0.05). Group 1 show more successful outcome of the treatment evidence by least mean rank of pain score after treatment.

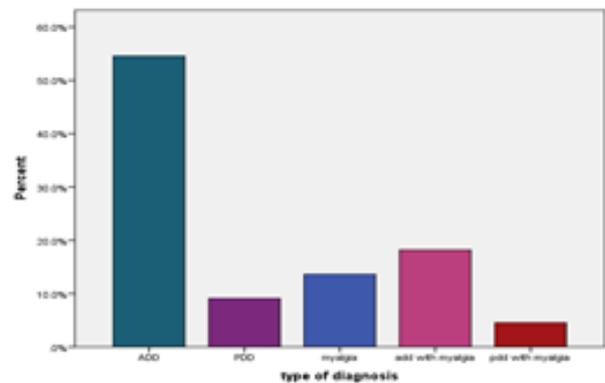


Figure 1. Diagnosis of patients.

Group Statistics

gender	N	Mean	Std. Deviation	Std. Error Mean
Pain score aftermale	3	.0000	.00000	.00000
treatment female	5	1.2000	1.09545	.48990

Table 4. Showing pain score after treatment for male and gender for group 1.

	pain score after treatment
Mann-Whitney U	25.000
Wilcoxon W	61.000
Z	-2.212
Asymp. Sig. (2-tailed)	.027
Exact Sig. [2*(1-tailed Sig.)]	.035 ^b

Table 5. Pain score after treatment. a. Grouping Variable: group, b. Not corrected for ties.

Discussions

Management of TMD is quite challenging and controversial due to difficulty in identifying the exact causes and the multifactorial nature of the disease. There is a wide variation of the severity and the treatment are varied in term of length and invasiveness. However, the management is intended to reduce pain, improvement of dysfunction and slowing the progression of internal derangement according to guideline approved by American Society of Temporomandibular Joint Surgeons.

The purpose of our research is to evaluate the effectiveness of LLLT as a supplementary treatment to the existing conservative therapy. The power density used in this research is 0.5 W-30 Hz daily for three consecutive days with the space between laser beam and skin about 3 cm applied as small circles for 2-3 minutes. It is

accordance to research done by Rahimi et al in 2015 which proposed the usual power output for a low level laser device is amid 10 – 500 mW, and the duration can last from a few seconds up to 15 min. The wavelength used in LLLT have poor absorption capacity in water. In hard and soft tissue, the depth of penetration is about 3mm to 15mm approximately. It is supported by other studies which suggest the therapeutic doses and output power are less than 35 J/cm² and 500 mW, respectively).^{10,11}

Based on our research, there is a significant difference in the pain score before and after the treatment with conservative and low-level laser therapy. 62% patients show absent of pain during review session while 38% patients show reduction of pain.

The evaluation of patient during review visit was assessed and guided by the treatment outcome measures by International Association of Oral and Maxillofacial Surgeons (IAOMS). According to this guideline, all patients meet the first criteria since the pain are reduce significantly in intensity and frequency until it does not concern the patient.¹² In this research, the assessment of pain intensity before and after treatment was done by using numerical rating scale-11.¹³ This scale was used as it has better compliance and ease of use according to research done by Hjermstard et al., they also reported in their study that this scale is the best recommended as the first step because it has lower error rate in elderly and cognitive impaired patient when compared to the other scales.¹⁴

The results of our study show that most of the patients are from young-adult group. This is probably due to the high incidence of TMD problem as stated in studies by Robert et al which it is high prevalence in age groups between 20 to 40 years of age.¹⁵ Hertling et al also showed similar result in which TMD is a prevalent disease that is most common among 20 to 40 year-olds.¹⁶ Mazetto in 2014 found that the higher prevalence of TMD problems among this age group is due to stress and greater work load which decrease in elderly group since adaptive mechanism to the such environment has been developed.^{17,18} However, Nardini et al. 2010 identified at least two distinct age peaks within patient population one at about age 30 to 35 years, with disk displacement, and another at about age 50 to 55 years, which is in controversy with our study.¹⁹ Nevertheless, a study in

Malaysia showed that there were no statistical significant correlation between age and TMDs.²⁰

The results of the current study didn't show a significant relationship between genders and pain score of patient after treatment. However, it can be shown that the pain score after treatment for female were higher than for male. This is based on the mean pain score after treatment of female patients which are 1.20 and mean pain score of male patients after treatment which is 0.00. This coincide with research cross-sectional study conducted by Johansson et al., 2002 that shows female have a higher percentage of TMJ pain than male.²¹ Wright et al in 2010 in their study proposed that TMD is most dominant among female patients and female patients demand treatment more than men.²² Another study done by Velly et al was reported that women are more likely to have the risk of myofascial pain than men approximately by three times.²³ This was further supported by Murrieta et al, in which it was concluded that women were associated to high risk of TMDs most probably due to influence of hormonal factors, morphological characteristic and emotional status.²⁴ However, the most frequent complaint reported by both genders was pain including headache, earache, pain in the temporal muscle and limited mouth opening which covered more than 80% of the TMDs patients.²⁵ In Malaysia, there is one research done in urban community in Kuala Lumpur showing there is no significant difference between male and female.²⁰

According to World Association of Laser Therapy in 2004, it has been proposed that clinical trial with LLLT should include placebo group as a part of the study design. It can be seen in most of the studies reviewed by Maia et al, which reported of using placebo group in their research. However, this research only includes conservative treatment as a control group to access the effectiveness of laser as an adjunct to the current conservative treatment since conservative treatment is still the treatment of choice. Based on studies done by Wieckiewicz et al, it was suggested that treatment of TMDs can be classified into four categories which are conservative, pharmacotherapy, minimally invasive and invasive treatment.²⁶ Among all of these treatments, it was found that conservative treatment including consultation, exercises, occlusal splint therapy, and physical therapy become the first choice of treatment. It was

further supported by guideline practiced by Royal College of Dental Surgeon of Ontario which propose the use of conservative treatment is needed as initial treatment and acceptable as it does not cause any irreversible changes. From the current study, combination therapy was found to be more effective than conservative treatment per se.

Conclusions

This study had successfully proven the significant differences in pain score of patients treated with combination of low level laser therapy and conservative before and after treatment of temporomandibular disorder (TMD). Most of the patients treated with combination therapy experienced absent of pain after treatment. Next, this study has also proven that combination of conservative and laser therapy is better than conservative therapy alone. There is significant differences of pain score before and after treatment of TMD between conservative group and combination (conservative and LLLT) group. Last but not least, this study proved that younger people have higher pain score than older people after treatment of TMD, hence younger people have a higher prevalence in TMD. Therefore, there is a relationship proven between age and pain score although not significant.

An in depth knowledge of the mechanism of the low level laser therapy is needed to understand the most efficient method of performing the low level laser therapy. This is to ensure an effective low level laser therapy delivered to the patient. Furthermore, there is a need of understanding of the properties of the low level laser therapy also to have a proper application of the laser therapy. For examples, the poor absorption of low level laser therapy in water. A wrong application of the laser therapy will affect the result, resulting in an ineffective treatment. A specific wavelength of laser had to be applied on specific size of skin area and on a specific duration of time.

For future studies, a much larger sample size should be needed for future studies. This includes a wider age range of patients and larger numbers of patients. Next, more parameters to evaluate the effectiveness of the treatment can be added in the future such as evaluation of loudness of clicking and evaluation of mandibular range of motion. This can assess the

effectiveness of low level laser therapy in other ways other than only assessing the pain score. This can prove the comparison of the effectiveness of combination therapy and conservative therapy conclusively and stronger evidently. More detailed classification can also be used in the future such as American Academy of Orofacial Pain (AAOP) classification. Other ways that future studies can improve are by improving the diagnosis of the TMD in their studies. To diagnose specifically between Anterior Disk Displacement and Posterior Disk Displacement, the usage of Magnetic Resonance Imaging (MRI) as a diagnostic tool is required.

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References

1. Rifa Astari Gumay¹, Ira Tanti², H. K. The Relationship Between Temporomandibular Disorders and Quality-of-Life-Related Orofacial Pain. *J. Int. Dent. Med. Res.* 2017;**10**: 677–682.
2. Amita Aditya, Shailesh Lele, P. A. Prevalence of Symptoms Associated With Temporomandibular Disorders In Patients With Psychosocial Disorders. *J. Int. Dent. Med. Res.* 2012;**5**(1), 26–29.
3. Tanti, I., Himawan, L. S. & Kusdhany, L. Etiology of temporomandibular disorders index. *J. Int. Dent. Med. Res.* 2016;**9**: 299–305.
4. Lobbezoo, F. et al. Bruxism defined and graded: An international consensus. *J. Oral Rehabil.* 2013;**40**(1), 2–4.
5. Jezukaitis, P. & Kapur, D. Management of occupation-related musculoskeletal disorders. *Best Pract. Res. Clin. Rheumatol.* 2011;**25**(1): 117–129.
6. FAULIN, E. F., GUEDES, C. G., FELTRIN, P. P. & JOFFILEY, C. M. M. S. C. Association between temporomandibular disorders and abnormal head postures. *Braz. Oral Res.* 2015;**29**(1), 1–6.
7. Chung, H. et al. The Nuts and Bolts of Low-level Laser (Light) Therapy. *Ann. Biomed Eng.* 2012;**40**(2), 516–533.
8. Verma, S., Chaudhari, P., Maheshwari, S. & Singh, R. Laser in dentistry: An innovative tool in modern dental practice. *Natl. J. Maxillofac. Surg.* 2012;**3**(2), 124.
9. Fabre, H. S. C. et al. Anti-inflammatory and analgesic effects of low-level laser therapy on the postoperative healing process. *J. Phys. Ther. Sci.* 2015;**27**(6), 1645–8.
10. Chang, W.-D. et al. A Meta-analysis of Clinical Effects of Low-level Laser Therapy on Temporomandibular Joint Pain. *J. Phys. Ther. Sci.* 2014;**26**(8), 1297–1300.
11. Rahimi, Arash; Rabiei, Sepideh; Mojahedi, Seyed Masood; Kosarieh, E. Application of Low Level Laser in Temporomandibular Disorders. *J. Lasers Med. Sci.* 2011;**2**(4): 165.
12. Schiffman, E. L. et al. Effects of four treatment strategies for temporomandibular joint closed lock. *Int. J. Oral Maxillofac. Surg.* 2014;**43**(2), 217–226.
13. Oono, Y. et al. Conditioned pain modulation in temporomandibular disorders (TMD) pain patients. *Exp. Brain Res.* 2014;**232**(10): 3111–3119.

14. Hjermstad, M. J. et al. Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: A systematic literature review. *Journal of Pain and Symptom Management* 2011;**41(6)**: 1073–1093.
15. Dym, H. & Israel, H. Diagnosis and Treatment of Temporomandibular Disorders. *Dental Clinics of North America* 2012;**56(1)**: 149–161.
16. D Hertling, R. K. Management of common musculoskeletal disorders: physical therapy principles and methods No Title. (2006).
17. Mazzetto, M. O., Rodrigues, C. A., Magri, L. V., Melchior, M. O. & Paiva, G. Severity of TMD related to age, sex and electromyographic analysis. *Braz. Dent. J.* 2014;**25(1)**: 54–58.
18. Tanti, I., Himawan, L. S., Kusdhany, L., Bachtiar, A. & Ismail, R. I. Validation of stress screening questionnaire in temporomandibular disorders patient. *J. Int. Dent. Med. Res.* 2016;**9**: 272–276.
19. Kijak, E., Lietz-Kijak, D., Frączak, B., Tiwiński, Z. & Margielewicz, J. Assessment of the TMJ dysfunction using the computerized facebow analysis of selected parameters. *Biomed Res. Int.* **2015**.
20. Jaafar, N. et al. Is the burden of oral diseases higher in urban disadvantaged community compared to the national prevalence? in *BMC Public Health* 2014;**14(3)**.
21. Feteih, R. M. Signs and symptoms of temporomandibular disorders and oral parafunctions in urban Saudi arabian adolescents: a research report. *Head Face Med.* 2006;**25(2)**: 1-7.
22. Merrill, R. L. Manual of Temporomandibular Disorders, Second Edition. *J. Orofac. Pain* 2010;**24**: 210.
23. Velly, A. M., Gornitsky, M. & Philippe, P. Contributing factors to chronic myofascial pain: A case-control study. *Pain* 2003;**104(3)**, 491–499.
24. José Francisco Murrieta, Emma Laura Alvarado, Manuel Tomas Valdez, Leticia Orozco, Julieta del Carmen Meza, M. L. J. Prevalence of temporomandibular joint disorders in a Mexican elderly group. *J. Oral Res.* 2016;**5(1)**, 13–18.
25. Bagis, B., Ayaz, E. A., Turgut, S., Durkan, R. & Özcan, M. Gender difference in prevalence of signs and symptoms of temporomandibular joint disorders: A retrospective study on 243 consecutive patients. *Int. J. Med. Sci.* 2012;**9(7)**: 539–544.
26. Wieckiewicz, M., Boening, K., Wiland, P., Shiau, Y.-Y. & Paradowska-Stolarz, A. Reported concepts for the treatment modalities and pain management of temporomandibular disorders. *J. Headache Pain* 2015;**16**: 106.