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Review Article,

Comparative Effects of Occlusal Splints Therapy and Low-Level Laser Therapy in Patients with TMD

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Abstract:

Background: Temporomandibular joint are two joints connecting the temporal bone and mandible. Temporomandibular disorders are clinical disorders involving the temporomandibular joint, muscles of mastication, and associated structures. Manifestations of TMD include limitation in jaw movement, joint sound (clicking), and pain around the TMJ. About 60–70% of the general population has at least one sign of TMD, but only 5% seek treatment. The management of TMD consists of reversible treatment and irreversible treatment. In this study, we will discuss occlusal splint therapy and low-level laser therapy, which are part of reversible treatment.
Purpose: This study was designed to determine the effect of occlusal splint therapy and low-level laser therapy for reducing pain and dysfunction in patients with TMD.
Methods: Systematic literature review used literature search methods in electronic databases: PubMed, ProQuest and Google Scholar. The keywords were "(occlusal splints therapy OR occlusal stabilisation) AND (low-level laser therapy OR laser therapy) AND (temporomandibular joint disorder)." The inclusion criteria for selecting scientific articles were publication from 2012-2022, published in English and full paper available.
Results: 6 articles have been included in this review. Occlusal splint therapy and low-level laser therapy produced similar results in the treatment of TMD. The results demonstrated a reduction in pain level, joint sound, and improvement in muscle function and mouth opening for both groups.
Conclusion: It can be concluded that occlusal splint therapy was as effective as low-level laser therapy.

Keywords: temporomandibular disorders, occlusal splint therapy, low-level laser therapy

Introduction:

The temporomandibular joint is formed by the articulation of the temporal bone of the cranium and the mandible, located in the anterior tragus, at the lateral aspect of the face. Temporomandibular joint is a complex joint that can move in all directions in the physiological movement of the mandible. Temporomandibular has an essential role in mastication, phonetics, and swallowing.[1] The components of this joint are bone, ligament, articular disk, and muscles.[2]

Temporomandibular disorders (TMD) are changes and disorders that affect the temporomandibular joint and/or the masticatory muscles and associated structures.[3,4] The aetiology of temporomandibular disorders is complex and multifactorial. There are three factors that can contribute to TMD. Causing factors of TMD are called "initiating factors", factors that increase the risk are called "predisposing factors", and factors that interfere with healing are called "perpetuating factors."[5,6] Pain and dysfunction are the main sign and symptoms of TMD. Pain assessment tools for TMD are the visual analogue scale (VAS), numerical rating scale (NRS), verbal rating scale (VRS), and others. The visual analogue scale is most commonly used for TMD.[7,8] Symptoms of dysfunction are joint sound (clicking and crepitus) and limitation in jaw movement.[9]

Diagnosis of TMD through examination of the patient's history, clinical examination, and

radiographic examination. Radiographs that can be done are panoramic, bilateral TMJ, MRI, and CT.[10] The diagnosis of TMD can be established by carrying out procedures according to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). DC/TMD divides TMD into two physical diagnostic categories, pain-related temporomandibular disorder and intra-articular temporomandibular disorder.[11]

About 60–70% of the general population has at least one sign of TMD, but only 5% seek treatment. According to Sachdeva et al. (2020), the age prevalence of TMD is: 30% of patients were 12-26 years old, 22.8% of patients were aged 27–36 years, 23.6% of patients were aged 37–46 years, 16.5% patients were aged 47–56 years, and 6.3% patients were aged 57–70 years. It also showed that 50.4% of patients were female, and 49.6% were male. Several factors, such as hormones, stress levels, and genetics, influence the intensity of temporomandibular disorder in females.[12] The management of TMD consists of reversible and irreversible treatment. Reversible treatment is divided into occlusal splint therapy, pharmacotherapy, and physical therapy. Irreversible treatment is divided into orthodontic treatment, occlusal adjustment, and surgical.[7]

According to the glossary of prosthodontic terms, occlusal splint therapy is defined as any removable artificial occlusal surface used for diagnosis or therapy affecting the relationship of the mandible to the maxilla. The occlusal splint is a reversible and noninvasive treatment, which is most important in treating temporomandibular disorders (TMD) with many causative factors involved. [13] Occlusal splint therapy can protect the TMJ disc from dysfunctional force, improve jaw muscle function, and promote jaw muscle relaxation in stressed patients. Occlusal splint therapy consists of hard occlusal splints and soft occlusal splints. Occlusal splints are the most commonly used conservative alternatives through which approximately 90% of cases can be successfully treated.[14] Occlusal splint therapy decreased pain symptoms between 70% and 90% in myofascial pain.[15] Occlusal splint therapy is effective in disc displacement disorders, reduces pain, and restores dysfunctional discs.[16]

Low-level Laser Therapy is a modality that is easy to apply, safe, and affordable. Laser therapy has an analgesic, antiinflammatory, antiedematous, and biostimulatory effect, which has proven to be effective in reducing pain and dysfunction. Laser therapy can release endogenous opioids, reduction in the production of COX-2 and prostaglandin, lymphocyte metabolism and the secretion of histamine and cytokines, such as TNF-α, IL-β, IL-6, and TGF-β. There was a reduction in pain during 30 days of laser application. Lasers have a positive impact on the reduction of pain of muscle, reduction of clicking sound, and limitation of mouth opening.[15,17]

Materials and Methods:

Study Design:

We conduct a systematic literature review method. Systematic review is a systematic way to collect, evaluate, integrate, and report findings from several studies about a topic or question. The systematic review provides a way to examine the quality of data on a topic or question

Data Collect:

A literature search was carried out by applying key terms, including and relating to occlusal splint therapy and low-level laser therapy, to appropriate data sources; PubMed, ProQuest, and Google Scholar. These search terms were applied to searches selected from 2012 to 2022. The reporting of this systematic literature review is based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). There are four stages in PRISMA, identification, screening, eligibility, and inclusion.[18] In identification, the terms included "(occlusal splint therapy OR occlusal stabilisation) AND (low-level laser therapy OR laser therapy) AND (temporomandibular joint disorder)."

Screening is done by filtering articles according to PICOS. The eligibility stage was carried out to examine the eligibility; the article discusses the comparison effect of occlusal splint therapy and low-level laser therapy in patients with temporomandibular disorder according to PICOS, inclusion criteria, and available in full text in the English language. (Table 1)

Articles were also checked for duplication using the Mendeley application. After that, articles that have passed all these stages are assessed for quality based on each study. For the randomised controlled trial using the Jadad criteria, the cohort

Used the New Castle-Ottawa criteria, and the cross-sectional using the CEBM (Centre of Evidence-Based Medicine) criteria. The last step is to extract and synthesise data.

Table1: Inclusion and exclusion criteria

	Inclusion	Exclusion
Language	English	Others
Population	Management of TMD with occlusal splint therapy and low-level laser therapy	Others
Intervention	Patient treatment with low-level laser therapy	Others
Comparison	Patient treatment with occlusal splint therapy	
Outcome	Reduction of pain and dysfunction in the patient with occlusal splint therapy and low-level laser therapy treatment	Reduction of pain and dysfunction in patients besides occlusal splint therapy and low-level laser therapy treatment
Studies	Clinical trial (randomized controlled trial, cohort study, cross-sectional study)	Others
Publication Type	Article	Others

Results:

The results of the identification process through the PubMed, ProQuest and Google Scholar databases use predefined keywords and apply filters contained in the database according to the inclusion and exclusion criteria based on PICOS. There were four articles from PubMed, 18 articles from ProQuest, and 894 articles from Google Scholar, making a total of 916 articles.

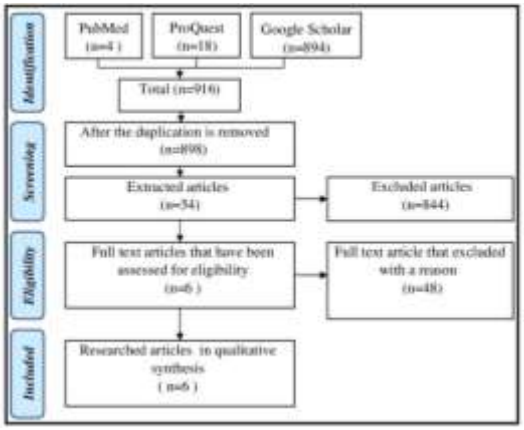

Figure 1. PRISMA stages[19]

In the screening process, there were 18 duplications, leaving 898 articles. The screening was continued by reading the article abstracts, and there were 54 relevant articles. The screening was continued by searching for the full text and the six articles corresponding to the inclusion criteria. In this study, six articles were obtained from randomised controlled trials, 0 from a cohort study, and 0 from a cross-sectional study, so six articles were assessed for quality using the Jadad criteria. The result is that all articles are high quality. The remaining articles were also extracted, and the data were synthesised. Characteristics of the article to be extracted were writer and year, research title, study, sample, country, measurement type, and conclusion. (Table 2).

Table II. Data extraction characteristics

No	Writer and Year	Tittle	Study	Sample	Country	Measurement type	Conclusion
1.	Abdelhay LM et al. (2021)[20]	Effectiveness of Occlusal Splints with Low-Level Laser Therapy on Anterior Disc Displacement of The Temporomandibular Joint	Randomized Controlled Trial	18	Egypt	Pain, joint sound, and mouth opening	Combination of occlusal splints therapy and low-level laser therapy are effective
2.	Khiavi HA et al. (2020)[21]	Efficacy of Low-Level Laser, Hard Occlusal Appliance and Conventional Pharmacotherapy in the Management of Myofascial Pain Dysfunction Syndrome	Randomized Controlled Trial	16	Iran	Pain, mouth opening, and muscle of function	Occlusal splints therapy was as effective as low-level laser therapy
3.	Rodrigues MDF et al. (2019)[22]	Effects of Low Power Laser Auriculotherapy on the Physical and Emotional Aspects in Patients with Temporomandibular Disorders	Randomized Controlled Trial	21	Brazil	Pain, mouth opening, and muscle of function	Occlusal splints therapy was as effective as low-level laser therapy
4.	Demirkol N et al. (2014)[23]	Effectiveness of Occlusal Splint and Low-Level Laser Therapy on Myofascial Pain	Randomized Controlled Trial	30	Great Britain	Pain	Occlusal splint therapy was as effective as low-level laser therapy

No	Writer and Year	Tittle	Study	Sample	Country	Measurement type	Conclusion
5.	Shousha T et al. (2021)[24]	Effects of Low-Level Laser Therapy Versus Soft Occlusive Splint on Mouth Opening and Surface Electromyography in Females with Temporo mandibular Dysfunction	Randomized Controlled Trial	112	Saudi Arabia	Pain, mouth opening, and muscle function	Occlusal splint therapy was as effective as low-level laser therapy
6.	Torres GM et al. (2016)[17]	Laser Therapy and Occlusal Stabilisation Splint for Temporomandibular Disorders in Patients With Fibromyalgia Syndrome	Randomized Controlled Trial	55	Spain	Pain, mouth opening, joint sound	Occlusal splint therapy was as effective as low-level laser therapy

Discussion:

In this study, six articles discuss pain, five measure mouth opening, three measure muscle function, and two measure jaw sounds. The subjective criteria for measuring pain intensity in all articles are the visual analogue scale (VAS). The visual analogue scale is more sensitive in measuring pain intensity than other measurement scales. Statistically, the visual analogue scale has the strongest ratio because it can present data in ratio form. According to Demirkol N et al. (2014), low-level laser therapy (power of 0,25 W, a dose of 8 J/cm^2, wavelength 1064 nm was as effective as occlusal splint therapy (12 h/day for three weeks) for pain reduction in patients with myofascial pain dysfunction syndrome. There were no adverse side effects reported under the conditions of this study.[23] Khiavi HA et al.

(2020) stated that there was a reduction of pain in the group receiving treatment with occlusal splint therapy (12h/day for four weeks) and low-level laser therapy (dose 2,5 J/cm^2, wavelength 940 nm) after 30 days of treatment. There was no significant change in mouth opening after the patient completed the treatment. Masseter, temporalis, medial pterygoids, and lateral pterygoids were examined for muscle tenderness. The highest and lowest muscular involvement was noted in the masseter and temporalis, respectively.[21] Torres GM et al. (2016) showed that low-level laser therapy (power 0,05 W, dose 3 J/cm^2) and occlusal splint therapy (8h/day for 12 weeks) could be alternative treatments to reduce symptoms of pain and jaw sounds. The results found no statistical differences between both modalities in pain scores and jaw sounds. There were significant changes in maximal active mouth opening and maximal passive mouth opening in the occlusal splint therapy group and low-level laser therapy after 90 days of treatment, but the increase in mouth opening was more visible in occlusal splint therapy.[17] Abdelhay LM et al. (2021) stated that there were changes in jaw sounds, pain, and mouth opening after 30 days of treatment in the low-level laser therapy group (power 0,6 W, dose 4 J/cm^2, wavelength 904 nm) and 60 days in the occlusal splint therapy group (12h/day). The results will be more significant when occlusal splint therapy is combined with low-level laser therapy.[20] Shousha T et al. (2021) showed a significant reduction in pain scores, jaw sounds, and mouth opening after 30 days of treatment.[24] Rodrigues MDF et al. (2019) showed that after treatment with occlusal splint therapy (8h/day for eight weeks), there was a significant improvement in right temporal muscle pain, right and left masseter muscle pain, left joint pain, and left intraoral pain. Improvement in jaw functioning, left masseter muscle pain, right and left joint pain, and right and left intraoral pain was observed in the low-level laser therapy group (dose 4 J/cm^2, power 0,05 W, dan wavelength 904 nm).[22]

Tsuga et al. (1989) stated that 87% of cases of dysfunction of TMD with two or more symptoms were successfully treated with an occlusal splint. Okeson et al. (1998) found that 70-90% of occlusal splint therapy can reduce a symptom of dysfunction of temporomandibular disorders.[13] Short-term (less than three months) occlusal splint therapy was more effective than long-term treatment. There was a reduction in pain in the lateral and posterior muscles of the temporomandibular joint, jaw sounds, and increased mouth opening after occlusal splint therapy.[25] As in the selected article in this study, the length of treatment using occlusal splint therapy ranged from 30 to 90 days, so treatment within that time range could decrease pain scores. Ferreira et al. (2015) found that occlusal splint therapy can significantly reduce muscle pain intensity. Huhtela et al. (2020) showed that occlusal splint therapy is ineffective for TMD. However, applied relaxation was shown to benefit psychologically. Oz S et al. (2010) reported that an occlusal splint could improve mandibular movements, reduce overall muscle pain and tenderness upon palpation, and significantly increase pressure pain threshold (PPT).[26]

Low-level laser therapy is an effective treatment to reduce pain in patients with TMD. However, no standardisation for low-level laser therapy procedures regarding dose, power, session, frequency, and time of use of the laser has not been determined. The wavelength of 830-904 nm is recommended and effective for treating TMD. The current study shows that a wavelength of 1064 nm has been tried and is effective in treating myofascial pain.[27] A significant decrease in pain scores occurred after ten sessions of laser treatment, and a significant increase in pain was not observed after six sessions. There was an increase in mouth opening after 12 sessions of laser application. Oz S, et al (2010) reported that low-level laser therapy was as effective as occlusal splints in treating myofascial pain dysfunction syndrome. There was a significant reduction in muscle pain after the last session of laser application and a reduction in clicking. [28]

Devocht JW et al. (2005) found different results and recommended low-level laser therapy because it has analgesic, anti-inflammatory, antiedematous, tissue healing, and biostimulating effects that effectively reduce muscle pain and pressure in patients with temporomandibular disorders. Different results were also shown by Melis M et al. (2012) that low-level laser therapy is more effective than occlusal splint therapy in reducing pain in patients because of the biostimulating effect. The stimulation of low-level laser therapy affects the cellular respiratory chain in the mitochondria, which induces

increased vascularisation and fibroblast formation. Low-level laser therapy affects blood microcirculation and increases ATP production. Low-level laser therapy is recommended for chronic temporomandibular disorders. Low-level laser therapy increases lymphatic flow, reducing oedema and decreasing prostaglandin E2 and cyclooxygenase-2.[29] However, the mechanism of action of occlusal splint therapy is not completely clear. Occlusal changes can occur after occlusal splint therapy for one month or short term, and there is no change after long-term use. It could be caused by silicone material, which cannot be maintained for a long time due to the adaptive mechanism of the muscles. Thus, the benefit of occlusal splint therapy treatment appears only temporary.[26] Low-level laser therapy is a time-saving method for both clinician and patient and has a rapid effect that can be felt by the patient after the application, while occlusal splint therapy takes a long time and must be used on patients within a certain period to get the results. During TMD treatment with low-level laser therapy, laser type variability, frequency, dosage, exposure time, application area, number of laser sessions, and duration of therapy can increase the heterogeneity of the treatment effect. However, further research is needed to look at different laser parameters of type, treatment regimen, evaluation time, and outcome measures so that they can be used better. [30]

This systematic study has limitations, such as the limited number of studies that discuss the comparison effects of occlusal splint therapy and low-level laser therapy on patients with temporomandibular disorders. The database in this study is still limited; therefore, the number of articles studied is also limited. No cohort study design compares the effect of occlusal splint therapy and low-level laser therapy on patients with temporomandibular disorders. More studies are needed to analyse the effect of occlusal splint therapy and low-level laser therapy in patients with temporomandibular disorders.

Conclusion:

The result of this study showed that there was no significant difference in the effect of occlusal splint therapy and low-level laser therapy in patients with temporomandibular disorders. Occlusal splint therapy is recommended for disc displacement disorders and patients who want lower cost, and low-level laser therapy is recommended for muscle disorders and patients who want faster treatment at a higher cost.

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