AUCTORES
Globalize your Research

Journal of Clinical Research and Reports

Hassan Abdulwahab Al-Shamahy*

Open Access

Research Article

Effect of Low-Level Laser Therapy (LLLT) in Management anterior disc displacement with reduction with an occlusal splint

Taghreed Ahmed Mohammad Al Kibsi [1], Ammar Qasem Hasan Al-Muntaser [1], Mohammed Lutf Mohammed Al-Anesi [6,7], Omar Ahmed Ismael Al-dossary [4], Rassam Abdo Saleh Alsubari [5], Fatima Mohammed Abdullal Al-Rohmi [3], Ahmed Abdullah Howilah [5], Adel Saleh Ali Sulaiman [1], Hassan Abdulwahab Al-Shamahy [2,3]*

[1]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Sana'a University, Republic of Yemen.

[2]Departement of Basic Sciences, Faculty of Dentistry, Sana'a University, Republic of Yemen.

[3]Medical Microbiology and Clinical Immunology Department, Faculty of Medicine and Health Sciences, Sana'a University, Republic of Yemen.

[4]Faculty of Dentistry, 21 September University, Republic of Yemen.

[5]Prosthodontics Department, Faculty of Dentistry, Sana'a University, Yemen.

[6]Department of prosthodontics, Faculty of Dentistry, Emirates International University, Yemen.

[7]Department of Restorative and Esthetic Dentistry, Faculty of Dentistry, Sana'a University, Republic of Yemen.

***Corresponding Author:** Hassan A. Al-Shamahy, Faculty of Medicine and Heath Sciences, Sana'a University.

Received date: June 18, 2025; **Accepted date:** July 02, 2025; **Published date:** July 16, 2025

Citation: Mohammad Al Kibsi TA, Hasan Al-Muntaser AQ, Mohammed Al-Anesi ML, Ismael Al-dossary OA, Saleh Alsubari RA, et al., (2025), Effect of Low-Level Laser Therapy (LLLT) in Management anterior disc displacement with reduction with an occlusal splint, *J Clinical Research and Reports*, 20(3); **DOI:10.31579/2690-1919/550**

Abstract

Background and aims: Temporomandibular disorders (TMD) are conditions that can affect the temporomandibular joint (TMJ), masticatory muscles, and associated structures and can clinically manifest as craniofacial pain, limitation of mouth opening, and joint noises. The present study was carried out to evaluate the efficacy of low-level laser therapy (LLLT) combined therapy with occlusal splint in management of anterior disc displacement with reduction (ADDWR) in patients with temporomandibular disorders (TMD).

Methods: The present study was conducted on forty patients (n=40) with ADDwR, aged 18-50 years. The patients were randomly divided into two equal groups. In group A, all patients were a stabilization splint, while in group B (The laser group), They received low level laser therapy (LLLT) as an adjunctive treatment alongside the stabilization Splint.

Results: Regarding to maximum mouth opening Group A achieved greater improvements in both maximum mouth opening and lateral excursion at all follow up time intervals than group B, the measurements of mandibular range of motion showed statistically significant improvement in the group A more than group B ($p = 0.03$). VAS scores decreased progressively throughout the follow up periods and the difference was statistically significant after treatment in all groups ($P < 0.001$).

Conclusions: The present study concluded that the low-level laser therapy, a non-invasive treatment, gives effective results in a short time, and it has the superiority to decrease the signs and symptoms of TMD through a combination of LLLT and an occlusal splint.

Keywords: low-level laser therapy (lllt); temporomandibular joint (tmj) disorders; anterior disc displacement with reduction (addwr); occlusal splint

Introduction

Clinical manifestations of temporomandibular disorders (TMD) include craniofacial discomfort, difficulty opening the mouth, and joint sounds. These problems can impact the temporomandibular joint (TMJ), masticatory muscles, and related tissues [1, 2]. Internal derangement (ID) are the most common disorder of (TMJ), it is an intra-articular condition characterized by disruption in the normal relationship of the articular disc to the articular eminence and the condyle when the joint is at rest or in function. It's characterized with progressive slipping or anterior displacement of articular Patients with ID of the TMJ often complain of pain, joint clicks and limitation of mouth opening [3, 4].

Various conservative treatment strategies for disc derangement disorders includes pharmacologic therapy, psychological counselling, treatment of

parafunctional habits, use of occlusal splints and acupuncture which gives short term relief only. Recently, a non-traumatic introduction to dentistry can be represented by low level laser therapy or ultrasound therapy [4]. Low-level laser therapy (LLLT) has gained prominence for its noninvasive nature, bio stimulative effects, and ability to reduce pain and inflammation through photobiomodulation (PBM), though its efficacy compared to traditional methods [5]. The results demonstrated effectiveness of treating both disc displacement and myofascial pain combination between low-level laser therapy (LLLT) and inter-occlusal splints to improvement of the mouth opening and function it has been introduced as a noninvasive physical method that offers greater improvement compared to inter-occlusal splints alone pain [6].

In Yemen, there are recent studies on oral and dental diseases, only one of which addressed the effects of low-level laser in treating myofascial pain dysfunction in the temporomandibular joint in a sample of Yemeni patients [7. However, there were many studies that addressed other topics, such as: the effect of 3D printing in the reconstruction of maxillofacial bone defects [8], the evaluation of fixed prosthetic failure factors in a sample of Yemeni dental patients [9], the sensitivity of Candida albicans to antifungal agents isolated from Yemeni patients with denture-associated stomatitis [10], knowledge, attitudes, and practices related to health care ethics among undergraduate students and recent graduates of the Faculty of Dentistry [11], temporomandibular dystonia: prevalence, clinical and demographic data, and results of therapeutic strategies for hundreds of patients [12], the prevalence of signs of temporomandibular joint disorders in healthy, completely edentulous individuals without symptoms, and the effect of dentures on temporomandibular joint disorders [13], and levels of interleukin-1 beta in the human gingival sulcus: rates. Factors affecting its levels in healthy individuals [14], the effect of intermaxillary fixation on biochemical and hematological markers in a sample of Yemeni adults [15], three-dimensional assessment of the shape of the first cervical vertebra in skeletal malocclusion of Class I and III in Yemeni patients, the validity of the Ponnet analysis in a group of Yemeni population, as well as assessment of the anatomical structure of the sinus canal in the anterior maxilla to avoid surgical complications [16,17,18]. Therefore, the primary objective of this study was to compare the efficacy of low-level laser therapy (LLLT) with an occlusal splint, compared to occlusal splint alone, in alleviating the symptoms of anterior disc displacement. More specifically, the study evaluated the effect of LLLT on pain relief in patients with patellofemoral hypermobility disorder (ADDwR), maximal mouth opening ability, lateral deviation, and temporomandibular joint (TMJ) cracking; and this is one of the first studies in this field in Yemen.

Materials And Methods

Study Design: A prospective clinical trial study.

Study Area: This study was conducted at oral surgery clinics Faculty of Dentistry, Sana'a University.

Study Population: This study was included forty patients who had diagnosed with Anterior Disc Displacement with reduction.

Inclusion criteria: The inclusion criteria were that the patient be aged 18-50 years, suffer from: deviation of the lower midline during mouth opening, clicking sounds during mandibular movements, pain when palpating the TMJ or during its movement, TMJ dysfunction with ADDwR, and have Wilk's internal TMJ disorder of stage II or III [19]. Selected patients were also clinically evaluated for ASA classification [20].

Exclusion criteria: Patients with facial or jaw injuries or a history of temporomandibular joint surgery, cysts, tumors, or infections in the temporomandibular joint area, a known connective tissue or autoimmune disease, degenerative diseases, osteoarthritis, or neurological conditions affecting joint function were excluded.

Preoperative clinical examination: The personal data of all patients included: Name, age, sex, address and telephone number were taken, medical and dental histories were taken, and clinical examination: Include intra-oral and extra-oral examination.

Preoperative assessment:

1- Pain scores (VAS): Tenderness or pain in TMJ was determined by placing the fingertips over the lateral aspect of both joints areas simultaneously. The lateral poles of condyles were felt by examiners fingertips, then passing downward and forward across the articular eminences once the position of fingers over the joint had been verified, the patient was asked to relax and medial force was applied to the joint areas and the patient was asked to report any pain. Pain assessed by visual analogue scale (VAS), was graduated from 0 to 10 with two endpoints marked score 0 (no pain) and 10 (worst pain ever experienced).

Maximal mouth opening (MMO): Measurement of maximum mouth opening was done utilizing Vernier-calibrated sliding caliper which measures the inter-incisal distance between the upper and lower incisors at maximum opening. This was considered as baseline which was compared to postoperative measurements.

lateral movements of mandible: The patients were asked to separate the teeth and shift the mandible laterally as far as possible first to the right and then to the left. The distance between the midlines of maxillary and mandibular Central Incisors was measured for each movement.

Clicking sounds: Joint sounds were evaluated preoperatively by finger palpation or used a stethoscope.

Operative procedure: The selected patients were divided into two equal groups: Group A (study group) (LLLT + Occlusal Splint): 20 patients. The application of laser device was applied to four points on each TMJ region (anterior, superior, lateral, posterior) and to temporalis, masseter, lateral pterygoid muscles bilaterally and the duration was for 25 seconds per point, the sessions was three times weekly for four weeks (12 sessions) then patients were instructed to wear the occlusal splint during night time for two months. **Figure (3.1)**

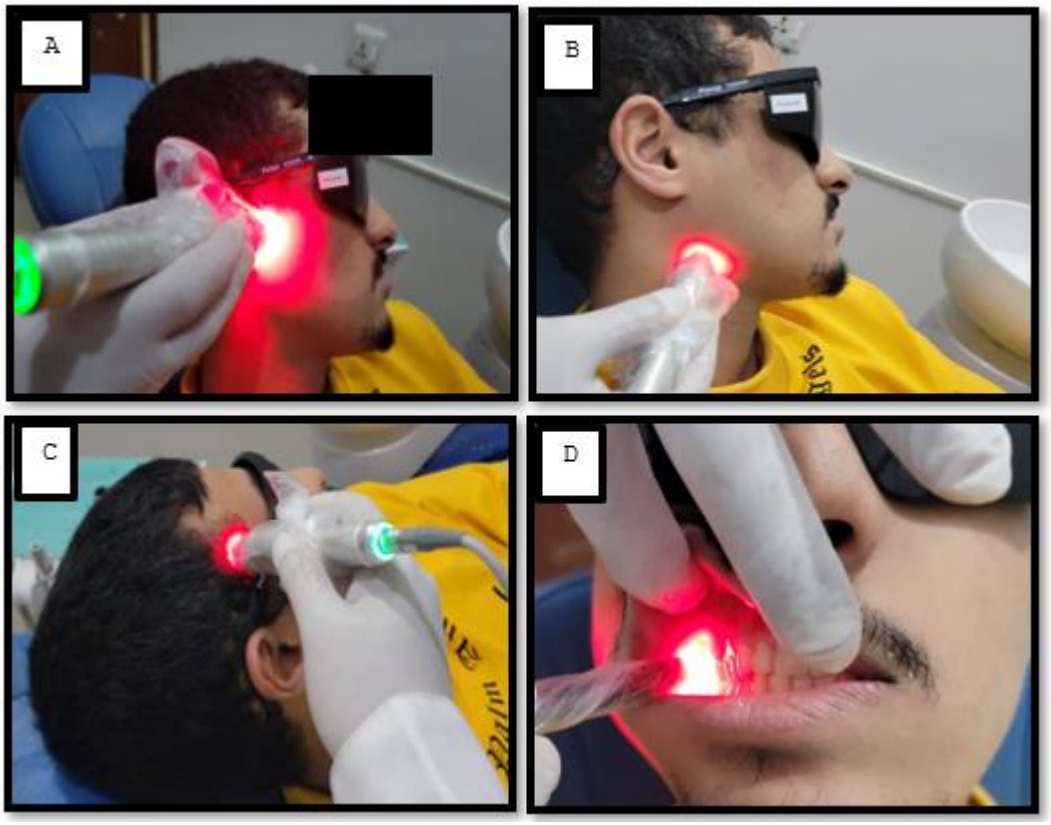

Figure 3.1: the points of application the laser beam at the effect joint

Group B (Control group) (Occlusal Splint only): 20 patients. The Patients were instructed to wear the occlusal splint at night time for two months (same design).

Instructions for patients: Also, patients were instructed to eat soft foods at least one week, to avoid widely opening the mouth to avoid anything that causes psychological stress as much as possible and use a night guard at night for two months.

Follow-Up Assessments: Clinical assessments for two groups were carried out at one week, one month and three months postoperatively for assessment of pain, measurement of maximum mouth opening, Measurement the lateral jaw movement and Clicking sound.

Data Collection: Data were recorded in structured sheets for each patient. Pre and follow-up data were used to assess changes within and between two groups.

Ethical Considerations: An ethical approval was received from the medical ethical committee of the Faculty of Dentistry, at Sana'a University, and all participating patients signed informed consent at the beginning of the study.

Results

Figure 1 and 2 show the sex and age group of the patients participate in the study. Females counting 60% and males counting 40%, most of the patients were in age group 21-30 years followed by 15-20 years.

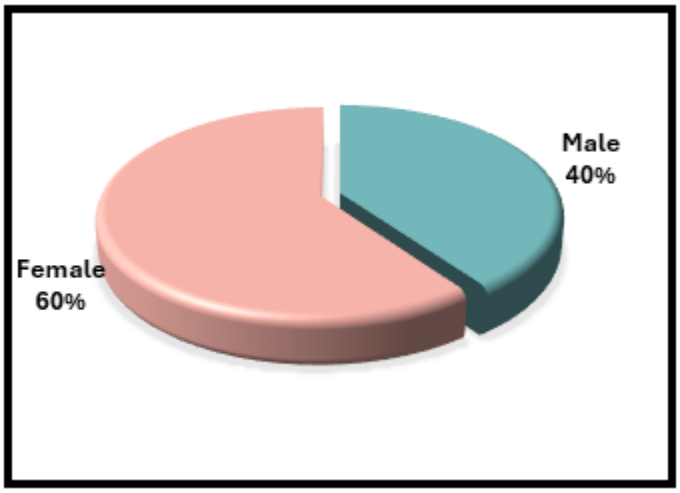

Figure 1: Gender Distribution 12

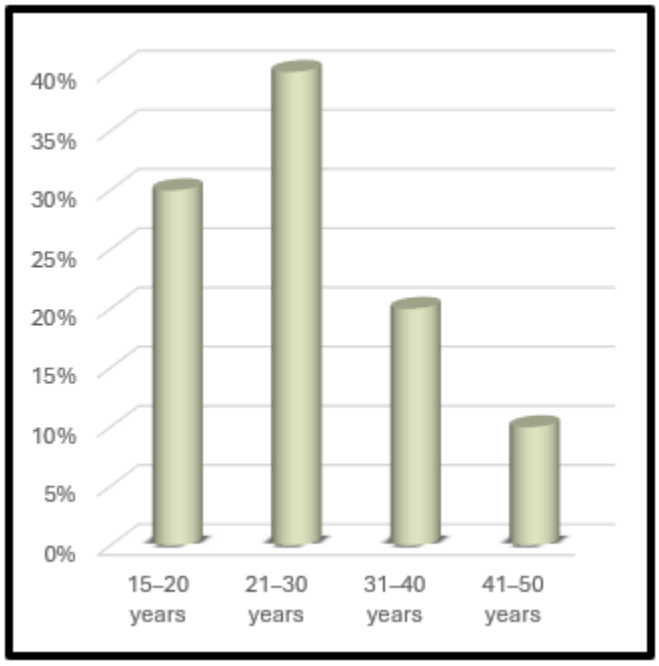

Figure 2: Age Groups Distribution 13

Pain Intensity (VAS) at Pre and Follow-Up:

In summary, the findings from Table 1 demonstrate that while both treatment modalities resulted in a reduction in pain intensity over time, group A (LLLT + occlusal splint) achieved significantly greater improvements at the 1-week, 1-month, and 3-months follow-ups compared to group B (occlusal splint only). These results highlight the therapeutic advantage of combining low-level laser therapy with splint therapy for more effective and sustained pain relief in TMJ disorders.

Table 1: Pain Intensity (VAS) at Pre and Follow-Up

Time Point	Group A (LLLT + Splint) (Mean ± SD)	Group B (Splint Only) (Mean ± SD)	p-value	Sig.
Pre	8.7 ± 1.1	8.9 ± 1.2	0.82	NS
1 week	5.6 ± 1.4	7.1 ± 1.8	0.03	S
1 month	3.4 ± 1.9	6.0 ± 2.3	0.01	S
3 Months Follow-Up	2.2 ± 1.7	5.1 ± 2.6	<0.001	HS

Table 1: Pain Intensity (VAS) at Pre and Follow-Up

Maximum Mouth Opening (MMO):At pre, the mean maximum mouth opening was 30.1 ± 7.2 mm in group A and 29.5 ± 6.8 mm in group B with no statistically significant difference between the groups ($p > 0.05$).After the 1-week of follow-up, group A exhibited a significant increase in maximum mouth opening to 32.8 ± 6.3 mm, while After the 1-week of follow-up, group A exhibited a significant increase in maximum mouth opening to 32.8 ± 6.3 mm, while group B showed a more modest improvement to 31.2 ± 6.5 mm. This difference between the groups was significant ($p < 0.05$). After the 1-month of follow-up, the improvement in group A continued, with maximum mouth opening reaching 35.5 ± 5.8 mm, compared to 32.4 ± 6.1 mm in group B. The difference remained significant ($p <0.05$). After the 3-month of follow-up, group A achieved a maximum mouth opening of 37.2 ± 5.5 mm, while group B reached 33.8 ± 6.0 mm. The difference between the groups was significant ($p < 0.05$) (Table 2).

Lateral Excursion: At pre, the mean lateral excursion was 7.2 ± 1.0 mm in group A and 7.3 ± 0.9 mm in group B, with no significant difference between the groups ($p = 0.88$). After the 1-week of follow-up, group A demonstrated a significant improvement in lateral excursion, reaching 8.1 ± 1.1 mm, compared to 7.5 ± 1.5 mm in group B. This difference was significant ($p = 0.03$). After the 1-month of follow-up, group A showed further improvement in lateral excursion to 9.5 ± 0.8 mm, while group B reached 8.1 ± 1.1 mm. The difference remained significant ($p = 0.01$). After the 3-months of follow-up, group A achieved a lateral excursion of 11.2 ± 0.7 mm, compared to 9.0 ± 1.0 mm in group B. The difference was significant ($p = 0.02$) (Table 2). The findings from Table 2 demonstrate that both treatment modalities improved mandibular range of motion over time. However, group A (LLLT + occlusal splint) achieved significantly greater improvements in both maximum mouth opening and lateral excursion at the 1-week, 1-month, and 3-month follow-ups compared to group B (occlusal splint only). These results highlight the added benefit of low-level laser therapy in enhancing functional outcomes for patients with temporomandibular joint (TMJ) disorders, with noticeable improvements observed as early as one-week post-intervention.

Table 2: Maximum Mouth Opening (MMO) and Lateral Excursion at Pre and Follow-Up					
Measurements	Time Point	Group A (LLLT + occlusal Splint) (Mean ± SD)	Group B (occlusal Splint Only) (Mean ± SD)	p-value	Sig.
Maximum Mouth Opening	Pre	30.1 ± 7.2 mm	29.5 ± 6.8 mm	0.91	NS
	1 week	32.8 ± 6.3 mm	31.2 ± 6.5 mm	0.04	S
	1 month	35.5 ± 5.8 mm	32.4 ± 6.1 mm	0.02	S
	3 Months Follow-Up	37.2 ± 5.5 mm	33.8 ± 6.0 mm	0.01	S
Lateral Excursion	Pre	7.2 ± 1.0 mm	7.3 ± 0.9 mm	0.88	NS
	1 week	8.1 ± 1.1 mm	7.5 ± 1.5 mm	0.03	S
	1 month	9.5 ± 0.8 mm	8.1 ± 1.1 mm	0.01	S
	3 Months Follow-Up	11.2 ± 0.7 mm	9.0 ± 1.0 mm	0.02	S

Table 2: Maximum Mouth Opening (MMO) and Lateral Excursion at Pre and Follow-Up

TMJ Clicking (Presence and Severity) at Pre and Follow-Up: At pre, TMJ clicking was observed in 18 participants (90%) in group A, with 12 participants reporting severe clicking. In group B, TMJ clicking was present in 17 participants (85%), with 11 participants suffering severe clicking. The difference in the presence and severity of clicking between the two groups at pre was statistically significant (p = 0.75). After the 1-week of follow-up, group A showed a reduction in TMJ clicking, with 7 participants (35%) still suffering clicking, including 3 participants with severe clicking. In group B, TMJ clicking persisted in 9 participants (45%), with 5 participants reporting severe clicking. Although group A demonstrated a greater reduction in clicking, the difference between the groups at this time point was statistically significant (p = 0.04). After 1 month of follow-up, group A exhibited further improvement, with only 4 participants (20%) suffering TMJ clicking, and none reporting severe clicking. In contrast, group B showed less improvement, with 8 participants (40 %) still suffering clicking, including 3 participants with severe clicking. The difference between the groups at this time point was statistically significant (p = 0.02). After the 3-months of follow-up, group A demonstrated continued improvement, with only 2 participants (10%) still suffering TMJ clicking, and none reporting severe clicking. In group B, TMJ clicking persisted in 10 participants (50%), with 5 participants suffering severe clicking. The difference between the two groups at 3 months was statistically significant (p = 0.01) (Table 3).

Table 3: TMJ Clicking (Presence and Severity) at Pre and Follow-Up				
Time Point Follow-Up	Group A (LLLT + occlusal Splint)	Group B (occlusal Splint Only)	p-value	Sig.
Pre	Present: 18 (90%); Severe: 12	Present: 17 (85%); Severe: 11	0.75	NS
1 week	Present: 7 (35%); Severe: 3	Present: 9 (45%); Severe: 5	0.04	S
1 month	Present: 4 (20%); Severe: 0	Present: 8 (40%); Severe: 3	0.02	S
3 Months	Present: 2 (10%); Severe: 0	Present: 10 (50%); Severe: 5	0.01	S

Table 3: TMJ Clicking (Presence and Severity) at Pre and Follow-Up

Patient Satisfaction Scores (Likert Scale) at Follow-Up: After the 1-week of follow-up, both groups reported low satisfaction scores, with group A recording a mean score of 3.5 ± 0.6 and group B reporting a mean score of 2.8 ± 0.5. The difference between the groups at this time point was not statistically significant (p = 0.03). After the 1-month of follow-up, group A (LLLT + occlusal splint) demonstrated a significant increase in satisfaction, with a mean score of 4.5 ± 0.5, reflecting a high level of patient satisfaction. In contrast, group B reported a mean score of 3.2 ± 0.7, indicating moderate satisfaction. The difference between the groups at this time point was significant (p = 0.01).

After the 3-month of follow-up, Group A's satisfaction further improved, achieving a mean score of 4.8 ± 0.3, which reflects very high satisfaction. Group B also showed improvement, with a mean score of 3.5 ± 0.6, but this remained lower than Group A. The difference between the groups at this time point was highly significant (p < 0.001) **(Table 4).**

Time Point Follow up	Group A (LLLT + occlusal Splint) (Mean ± SD)	Group B (occlusal Splint Only) (Mean ± SD)	p-value	Sig.
1 week	3.5 ± 0.6	2.8 ± 0.5	0.03	NS
1 Months	4.5 ± 0.5	3.2 ± 0.7	0.01	S
3 Months	4.8 ± 0.3	3.5 ± 0.6	<0.001	HS

Table 4: Patient Satisfaction Scores (Likert Scale)

Comparative Analysis of Treatment Outcomes Between Two Groups: A demonstrated superior improvements across all outcomes, with the most notable improvement in pain intensity (VAS), where the percentage improvement was 76% compared to 45% in group B, with a statistically highly significant difference (p = 0.002).

In terms of maximum mouth opening, group A showed a 33% improvement, while group B had a 12% improvement, with a statistically significant difference (p = 0.01). For lateral excursion, group A experienced a 55% improvement, whereas group B had a 23% improvement, with the difference between the groups being statistically

significant (p = 0.02). group A also showed a greater reduction in TMJ clicking, with an improvement of 80%, compared to 41% in group B, and this difference was statistically highly significant (p = 0.001) (Table 5).

Table 5: Comparative Analysis of Treatment Outcomes Between Groups				
Outcome	% Improvement (Group A)	% Improvement (Group B)	p-value	Sig.
Pain Intensity (VAS)	76%	45%	0.002	HS
Maximum Mouth Opening	33%	12%	0.01	S
Lateral Excursion	55%	23%	0.02	S
TMJ Clicking Reduction	80%	41%	0.001	HS
Patient Satisfaction	92%	70%	0.003	HS

Table 5: Comparative Analysis of Treatment Outcomes Between Groups

Discussion

Low-level laser therapy (LLLT) has become popular in dental practice and introduced as a noninvasive nonsurgical physical method but has positive outcomes, in recent years the LLLT has been used widely for management of myofascial pain and disc displacement of TMJ. LLLT is a form of phototherapy that produces biostimulation and analgesia without causing temperature changes. It is considered a successful, simple, and short-term therapeutic approach that has gained popularity as an alternative treatment for TMD due to its analgesic, anti-inflammatory, and regenerative properties [5, 21, 22, 23].

In general, the treatment with occlusal splint aims to realign the articular disc between the mandibular condyle and the articular fossa to reduce TMJ pain and the stress muscles activity of TMJ. Although there is still much disagreement over the form of occlusal splints and how they should be worn and their mechanism of action stabilization splints and anterior repositioning splints which constructed of acrylic resin and designed to cover most or all of the teeth in the maxillary or the mandibular arch are the most commonly used.

In the present study, there was a highly statistically significant decrease in pain score at time an interval; one week, one month and three months in group A (LLLT with splint) compared to group B (splint only). When comparing the changes between two groups there was market improvement in group A emphasizing the efficacy of LLLT in combination with the use of an occlusal splint. The mechanism of LLLT is still not clear until now however, previous studies suggest that the mechanism of LLLT many reduce pain by increasing production of endogenous opiates, increasing glucocorticoids excretion by the kidneys, improving the quality of local circulation, decreasing edema by improving the flow of lymphatics, lowering the nerve membrane permeability. Maixner et al 2011 [24] found also that the use of LLLT decreased the intensity of the painful symptoms but in the immediate treatment phase. Also, these results were accordance with Abdelhay L M et al [25] and Khan et al, [4], and Salmos-Brito et al. [6], who concluded that a significant reduction in pain in all the patients of them research of effectiveness of occlusal splints with low-level laser therapy on anterior disc displacement of the temporomandibular join.

The results of our study on pain management and increased ability to open the mouth were consistent with Lomas. [26], who concluded that there was a significant improvement in VAS and MMO at most assessment times compared to pre-treatment clinical scores in the efficacy of splinting and low-level laser therapy for patients with chronic closed locking of irreducibly displaced TMJ discs. Mandibular range of motion measurements showed statistical significance at follow-up periods, with significantly improved maximal mouth opening at one and three months in group A (LLLT with splint treatment) compared to group B (splint only) in our study. The relationship between improved maximal mouth opening and LLLT is controversial, as the non-thermal type of LLLT is an attractive treatment modality with analgesic, anti-inflammatory, biostimulatory, and muscle relaxant properties reported in several previous studies [27,28,29].

The stabilization splint alone yielded acceptable results, but was even superior when used in combination with low-level laser therapy. This is consistent with Hosgor et al., who compared the efficacy of non-surgical treatment methods for ADDwR and reported a significant improvement in maximum mouth opening after occlusal splint therapy and LLLT [30]. The present findings were also consistent with Bakry S A et al [19]. and Khan et al., [4] who concluded that LLLT was effective in painless maximum mouth opening in TMD patients at one and three-month follow-up periods. LLLT induces a reduction in inflammation by inhibiting PEG2 synthesis, suppressing cyclooxygenase 2, and neurotransmitter conduction in myelinated and unmyelinated C-fibers, reducing pain and muscle spasms, which may be the cause of the improvement in jaw movements [31-34].

Conclusions: In conclusion, from the previous researches and the present study concluded the efficacy management of ADDWR by the splint alone but the combination between the stabilization splints with low-level laser therapy give us the superiority to decrease the signs and symptom of TMD.

Data Availability

The empirical data used to support the study's results can be obtained upon request from the corresponding author.

Acknowledgments

The authors express their gratitude to Yemen and the Sana'a University Faculty of Dentistry for their cooperative efforts.

A Dispute of Interest

Regarding this project, there are no conflicts of interest.

Author's Contributions

Ammar Qasem Hasan Al-Muntaser, Master's student: Writing the original draft, methodology, investigation. The rest of authors: Writing, review and editing, and Formal analysis, data processing.

References

1. Wurm CM et al., (2018). "Correlation between pain and MRI findings in TMD patients," Journal of Cranio-Maxillofacial Surgery, vol. 46, no. 8, pp. 1167-1171.
2. Carvalho CM, J. A. de Lacerda, F. P. dos Santos Neto, M. C. T. Cangussu, A. M. Marques, and A. L. Pinheiro, (2010), "Wavelength effect in temporomandibular joint pain: a clinical experience," Lasers in medical science, vol. 25, pp. 229-232.
3. Carlson CR, J. P. Okeson, D. A. Falace, A. J. Nitz, S. L. Curran, and D. Anderson, (1993). "Comparison of psychologic and physiologic functioning between patients with masticatory muscle pain and matched controls," Journal of orofacial pain, vol. 7, no. 1.
4. Khan M, K. Vijayalakshmi, and N. Gupta (2013). "Low intensity laser therapy in disc derangement disorders of

temporomandibular joint: A review article," Int J Odontostomat, vol. 7, no. 2, pp. 235-239.
5. Jing G et al., (2021). "Effects of different energy density low-level laser therapies for temporomandibular joint disorders patients: a systematic review and network meta-analysis of parallel randomized controlled trials," Lasers in Medical Science, vol. 36, pp. 1101-1108.
6. Salmos-Brito JAL et al., (2013). "Evaluation of low-level laser therapy in patients with acute and chronic temporomandibular disorders," Lasers in medical science, vol. 28, pp. 57-64.
7. Sulaiman ASA, Abbas AMA, Majid ALAA, AlRohmi FMA, Al-Muntaser AQH, Al-Moyed KA, Al-Shamahy HA, Al-dossary OAI, AlKhorasani MAM, Alsubari RAS (2025). Effects of low-level laser in the treatment of myofascial pain dysfunction temporomandibular joint in sample of Yemeni patient. Universal Journal of Pharmaceutical Research; 10(2): 40-47.
8. Al-Rahbi LM, Mohammed Setten HH, Al-Shamahy HA, (2025), Impact of 3D Printing in Reconstruction of Maxillofacial Bone Defects Experimental Study in A Military Hospital in Sana'a city Yemen, J Clinical Research and Reports, 19(2);
9. Mohsen Ali Al-Hamzi, Samah Nabil Al-Hammadi, Abdulwahab Ismail Al-kholani, Ibrahim Zaid Al-Shami, (2024), Evaluation of Failure Factors of Fixed Prosthesis in a Sample of Yemeni Dental Patients - Sana'a City, J Clinical Research and Reports, 16(5);
10. Mohammed M. A, Mohammed A. A, Khaled A. A, Hassan A A, Mohammed M. (2022). In Vitro Antifungal Susceptibility of Candida Albicans Isolated from Yemeni Patients with Denture Stomatitis. J Dentistry and Oral Maxillofacial Surgery, 5(3);
11. Mohammed M A Alsamhari, Abdulwahab I M Al-Kholani, Mohammed Ali Al-Najhi, Hassan A Al-Shamahy, Omar A I Al-dossary, et al. (2022). Health Ethics Education: Knowledge, Attitudes, and Practices of Health Care Ethics among Undergraduates and Recent Graduates of the Faculty of Dentistry, Sana'a University, Yemen. Dentistry and Oral Maxillofacial Surgery. 5(2);
12. Aldeen HMAS., Abbas AKM, Al-Kibsi TAM, Al-Shamahy HA, Jahaf SHA, and AL-Kaff RHSO (2023). "Oromandibular dystonia: prevalence, clinical and demographic data, therapeutic strategies out-come for hundred patients in Sana'a city, Yemen".
13. Al-Khorasani MAM., Al-Kebsi AM, Al-Hammadi MS, Al-hamzi AHW, Al-Sanabani NF, AL-Haddad KA, Al-Najhi MMA, Al-Shamahy HA, and Al-Kibsi TMA (2023). "Prevalence of signs of temporomandibular disorders in healthy asymptomatic completely edentulous individuals and the effect of denture on temporomandibular disorders".
14. Al-dossary, O. A. I., A. I. M. Al-Kholani, K. A. AL-Haddad, M. M. A. Al-Najhi, H. A. Al-Shamahy, I. A. A. Al-adhami, and K. Aldhorae (2022). "Interleukin-1β levels in the human gingival sulcus: rates and factors affecting its levels in healthy subjects".
15. Homaid, W. A. H. A., A. T. Nasher, H. A. Al-Shamahy, S. T. A. Ahmed, A. N. A. Mabkhout, B. S. M. Khalid, and A. A. M. Al-Ankoshy (2024). "Effect of intermaxillary fixation on biochemical and blood markers in a sample of Yemeni adults".
16. Etehad Al-Ghola, Ghamdan Al-Harazi, and Hassan Abdulwahab Al-Shamahy (2025). "Three-dimensional evaluation of the first cervical vertebral morphology in skeletal class i and iii malocclusions in Yemeni patients".
17. Ahlam Mohammed Ali Awath, Fuad Lutf Almotareb, and Hassan Abdulwahab Al-Shamahy (2025). "Validity of pont's analysis in a group of Yemeni population". Universal J Pharm Res, vol. 10,
18. Ahmed ST. A., S. A. A. Da'er, W. A. H. A. Homaid, H. A. Al-Shamahy, A. N. A. Mabkhout, B. S. M. Khalid, and A. A. M. Al-Ankoshy (2024). "Assessment of the anatomical structure of canalis sinuosus in the anterior maxilla to avoid surgical complications".
19. Bakry S, S. Awad, and H. Kamel (2021). "Comparative Evaluation of Low-level Laser Therapy (lllt) Versus Sodium Hyaluronate with Arthrocentesis in Management Temporomandibular Joint Disorders (tmd): A Clinical Randomized Controlled Study," Egyptian Dental Journal, vol. 67, no. 2, pp. 1077-1087,
20. Daabiss M, "American Society of Anaesthesiologists physical status classification," (2011). Indian journal of anaesthesia, vol. 55, no. 2, pp. 111-115.
21. Van Bellinghen X et al., (2018). "Temporomandibular joint regenerative medicine," International journal of molecular sciences, vol. 19, no. 2, p. 446, 2018.
22. Abdel-Gawwad AE, A. A. B. Abdullah, M. Y. Farhat, and M. A. Helal (2021). "Effect of using Photobiomodulation, stabilization, and anterior repositioning splints on the pain level of subjects with temporomandibular joint disc displacement with reduction," Brazilian Dental Science, vol. 24, no. 4 Suppl.
23. Madani A, F. Ahrari, A. Fallahrastegar, and N. Daghestani (2020). "A randomized clinical trial comparing the efficacy of low-level laser therapy (LLLT) and laser acupuncture therapy (LAT) in patients with temporomandibular disorders," Lasers in medical science, vol. 35, pp. 181-192.
24. Maixner W et al., (2011). "Orofacial pain prospective evaluation and risk assessment study–the OPPERA study," The journal of Pain, vol. 12, no. 11, pp. T4-T11. e2.
25. Abdelhay LM, M. M. Hussein, and A. M. Hassaneen (2021). "Effectiveness of occlusal splints with low-level laser therapy on anterior disc displacement of the temporomandibular joint," Al-Azhar Assiut Dental Journal, vol. 4, no. 1, pp. 13-19.
26. Lomas J GT (2018). "Temporomandibular dysfunction," Aust J Gen Aust J GenPract., pp. 212-215.
27. Mazzetto MO, T. H. Hotta, and R. C. d. A. Pizzo (2010). "Measurements of jaw movements and TMJ pain intensity in patients treated with GaAlAs laser," Brazilian dental journal, vol. 21, pp. 356-360.
28. Chang SW, C. Y. Chuang, J. R. Li, C. Y. Lin, and C. T. Chiu (2010). "Treatment effects of maxillary flat occlusal splints for painful clicking of the temporomandibular joint," The Kaohsiung journal of medical sciences, vol. 26, no. 6, pp. 299-307.
29. Xu GZ, J. Jia, L. Jin, J.-H. Li, Z.-Y. Wang, and D.-Y. Cao (2018). "Low-level laser therapy for temporomandibular disorders: A systematic review with meta-analysis," Pain Research and Management, vol. 2018, no. 1, p. 4230583.
30. Hosgor H, B. Bas, and C. Celenk, (2017). "A comparison of the outcomes of four minimally invasive treatment methods for anterior disc displacement of the temporomandibular joint," International journal of oral and maxillofacial surgery, vol. 46, no. 11, pp. 1403-1410.
31. Máximo CFBG, J. F. Coêlho, S. D. Benevides, and G. Â. d. S. Alves (2021). "Effects of low-level laser photobiomodulation on the masticatory function and mandibular movements in adults with temporomandibular disorder: a systematic review with meta-analysis," in Codas, 2022, vol. 34: SciELO Brasil, p. e20210138
32. Farshidfar N et al., (2023). "The Effect of Photobiomodulation on Temporomandibular Pain and functions in patients with Temporomandibular disorders: an updated systematic review of the current randomized controlled trials," Journal of lasers in medical sciences, vol. 14, p. e24.

33. Carvalho CM et al., (2011). "Evaluation of laser phototherapy in the inflammatory process of the rat's TMJ induced by carrageenan," Photomedicine and Laser Surgery, vol. 29, no. 4, pp. 245-254, 2011.

34. Sakurai Y, M. Yamaguchi, and Y. Abiko (2000). "Inhibitory effect of low-level laser irradiation on LPS stimulated prostaglandin E2 production and cyclooxygenase 2 in human gingival fibroblasts," European Journal of Oral Sciences, vol. 108, no. 1, pp. 29-34.

DOI:10.31579/2690-1919/550