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Effect of Low Shock Wave Versus Low Level Laser on Temporomandibular Joint Disorders

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ABSTRACT

Background: Temporomandibular disorders (TMDs) are musculoskeletal conditions, often presenting with joint clicking, limited mouth opening, and pain of muscular or articular origin. Various physical therapy modalities, including low-level laser therapy (LLLT) and extracorporeal shock wave therapy have demonstrated potential in reducing pain, improving jaw function, and modulating neuromuscular responses through non-invasive mechanisms but there are still contradicts
Aims: This study was designed to evaluate the effect of low shock wave versus low-level laser on jaw function in TMJ disorders.

Methods: Sixty-six patients of both genders with unilateral TMJ disorders who suffered from limitation in jaw function, their age ranged from 20-40 years. All patients were subjected to measurement Jaw function by Jaw function limitation scale (JFLS). The patients were randomly assigned simply into three homogeneous groups, group A (Control group) received conventional physiotherapy treatment (ultrasound, tens, heat and exercises (to the most painful masticatory areas. Group B (Experimental group 1) received conventional physiotherapy treatment as group A (Control group) plus low intensity extracorporeal shock wave therapy wave therapy. Group C (Experimental group 2) received conventional physiotherapy treatment as group A (Control group) plus low-level laser therapy.

Results: There was no significant difference among the three groups in the mean values of age, weight, height and BMI ($p>0.05$). Also, there was no significant difference in sex distribution, between the three groups ($p =0.574$). Regarding the JFLS among the three groups, there was significant difference between groups A (Control group) and B (Experimental group 1) in favor to group B ($P = 0.004$) (Experimental group 1). There was significant difference between Groups A (Control group) and C (Experimental group 2).in favor of group C($p=0.012$) (Experimental group 2), while there was no significant difference between Groups B (Experimental group 1) and C($p=0.990$) (Experimental group2).

Conclusion: Low shock wave therapy showed numerically greater improvement, both interventions demonstrated comparable efficacy on the Jaw Functional Limitation Scale.

Keywords: *Low-intensity extracorporeal shock wave therapy, Low-level laser therapy, Temporomandibular joint disorders, Jaw function limitation scale, Randomized controlled trial*

1. Introduction

Temporomandibular disorders (TMDs) are clinical conditions that affect the masticatory musculature of temporomandibular joint (TMJ) and associated structures (1). The prevalence of TMJD was approximately 31% for adults/elderly and 11% for children/adolescents (2). The common symptoms of TMD include clicking of the joint, limited mouth opening, and pain in jaw muscles, which is the most significant clinical symptom.

Physical therapy includes a large number of different modalities, from simpler therapies (use of hot/cold packs, massage, posture training, exercise, mobilization) to instrumental techniques transcutaneous electrical nerve stimulation, low level laser (3).

Low intensity extracorporeal shock wave therapy reduce pain and improve the function of the stomato-gnathic system (4). Previous studies have suggested that these mechanisms also play a role in reducing the muscle tone for spasticity (5) In addition, low shock wave may generate an analgesic effect during the treatment that blocks the activation and transmission of pain signals by non-invasive stimulation of cell membranes and nerve endings (6), which may be related to reduced imitation in Jaw function.

Low level laser therapy may act via numerous mechanisms of action, including facilitating the release of endogenous opioids, augmenting tissue repair and cellular respiration, increasing vasodilation and pain threshold and decreasing inflammation (7). LLLT exerts a photochemical effect, in contrast to the ablative or thermal effects related to medical laser procedures (8) The LLLT has recently been advocated to alleviate symptoms and improve function in patients with TMD. A number of clinical trials and analyses have shown that LLLT effectively reduces the pain level, clicking and improving range of mandibular motions (9) there is a debate withered low shockwave that has more effect than low level laser in treating TMJ Disorder, So we hypothesized that both LSWT and LLLT, when combined with conventional physiotherapy, would significantly improve jaw function compared to physiotherapy alone, and that LSWT would yield superior functional outcomes.

2. Material and methods

2.1 study Design and Setting

This pre and post randomized controlled trial was conducted at outpatient clinic in Faculty of Dentistry at Cairo University, Egypt. They were diagnosed by dentist as temporomandibular disorder.

Ethical considerations

This study started after approval from the Ethical Approval Committee at faculty of physical therapy, Cairo University. All participants were asked to sign an informed consent form Subjects

Sixty-six Patients were randomly distributed into three groups using random generator Group A (Control group) received conventional physiotherapy treatment ultrasound, tens, heat and exercises to the most painful masticatory areas and jaw range of motion exercises (three sessions per week for 4 weeks). Group B (Experimental group 1) received the same conventional physiotherapy treatment as group (A) in addition to low shock wave therapy (one session per week for 4 weeks). Group C (Experimental group 2) received the same conventional physiotherapy treatment as group (A) in addition to low level laser therapy (three sessions per week for 4 weeks). Subjects underwent physical examination to confirm eligibility and rule out exclusion criteria, they were recruited from the outpatient clinic in Faculty of Dentistry at Cairo University, Egypt. They were diagnosed by dentist as temporomandibular disorder.

2.2 inclusion and exclusion criteria

To be included in the study, subjects were evaluated using the following criteria: Age ranges between 20-40 years from both genders, Patient with unilateral joint impairment suffering from TMJ myogenic (10). Patients who suffered from limitation in TMJ range of motion (11).

This study excluded patients with cancer disease, epilepsy, history of infectious diseases, Pregnancy, patients had Pacemaker or other implant devices, patients suffered from hypermobility in their jaw, patients suffered from instability in their jaw, Arthritis, Adolescent Internal Condylar Resorption (AICR), Condylar hyperplasia (CH), End-stage TMJ pathology.

2.3 Sample size calculation and ethics

The study's sample size was calculated using G*Power program 3.1.9, resulting in 66 patients, with a required 22 subjects per group. The minimum proper sample size is 58 subjects, adding 8 (14%) subjects as drop out, so total sample size is 66 subjects, 22 subjects in each group. Sixty-six patients from both genders suffering from temporomandibular joint impairment participated in this study after signing the consent form. This study extended from December 2024 and ended to May2025. It was conducted at outpatient clinic in faculty of physical therapy at Cairo University, Cairo governorate, Egypt. The study was approved by the Ethical Committee for Human Research at the Faculty of Physical Therapy, Cairo University, Egypt (NO: P.T.REC/012/005033) .

2.3 Statistical analysis

Data were expressed as mean± SD for jaw function (score). ANOVA was used to compare between subjects Characteristics of the three groups and chi square test for sex distribution. Shapiro-Wlik test was used for testing normality of data distribution. MANOVA was performed to compare within and between groups' effects for measured variables, Bonferroni test for post hoc between groups. Statistical package for the social sciences computer program (version 20 for Windows; SPSS Inc., Chicago, Illinois, USA) was used for data analysis. P less than or equal to 0.05 was considered significant. Statistical analysis will be conducted using SPSS for Windows, version 20 (SPSS, Inc., Chicago, IL). Statistical significance will be set at the ($p< 0.05$).

2.4 Instrumentation
Instrumentations for measurements
Instrumentations for treatment.
All variables were measured before and after 4 weeks of treatment.

Instrument for measurements
Jaw function limitation scale it is a patient self-report questionnaire to measure a patient jaw functional level that is both joint-specific and separate from pain-related disability. It has a total of 20 items assessing mastication, jaw mobility, and verbal and emotional expression (12).

Instrumentations for treatment.
Hot pack
Hot packs are kept in a hydro collator, which is a container of water usually kept at a temperature between 70°C and 75°C (158°F–167°F) (13).

Transcutaneous Electrical Nerve Stimulation
Transcutaneous electrical nerve stimulation (TENS) was used at a low frequency (50 Hz) with intensity adjusted to elicit strong sensory perception without causing muscle contraction. Sessions lasted 15 minutes and were performed three times weekly for four weeks. This protocol aligns with previous randomized trials and meta-analytic findings showing that sensory-level TENS significantly reduces pain and improves masticatory function in patients with TMJ/myofascial TMD (14).
Ultrasound Therapy
Some preliminary studies show that US is effective in treating TMJ disorders and relieving pain
Particularly if it is used in combination with an ice bath (15) a better understanding of the therapeutic effects is still required for rational and effective use of this therapy for TMD

Shock wave
Low level laser therapy
Low level laser device of light (usually a low powered diode laser -10mW–500mW). Light with a wavelength in the red to near infrared region of the spectrum (660nm–905nm), is generally employed because these wavelengths have the ability to penetrate skin, and soft/hard tissues and are proven in clinical trials to have a good effect on pain, inflammation and tissue repair. The power density (irradiance) is usually between 5W/cm2. Low Level Laser Therapy (LLLT) is now being recognized as a valid medical tool (16).
Low intensity extracorporeal shock wave therapy
Zimmer device radial shock wave. The device allows variability in the setting with Frequency range 0.5 - 21 Hz and Pressure range 0.3 - 5 bar.

2.5 Procedures

Patients history was taken, conducted the necessary measurements, and administered the compact treatment as mention before for each group

Measurements procedures

Jaw Function measurement by jaw function limitation scale

It is an organ-specific instrument comprising 3 constructs for assessing functional status of the masticatory system. Subjects were administered with the final 20-item instrument either: 0 to 3, 0 to 5, and 0 to 10. Then responses were normalized and compared across the 3 instruments for consistency and subjects were interviewed regarding their preferred response format (17).

Treatment procedures

Conventional physical therapy program

This program was applied to three groups.

Hot pack

Patient sit in relaxed position on a chair hot pack was applied over TMJ for 5 minutes at the beginning of each session (3 days per week for 4weeks) (18).

Ultrasound Therapy

Patients was rested in a sitting position on a chair. The treatment was applied over TMJ area (10-15 cm^2) with circular motion. The parameters used: intensity of 1.0 W/cm2 at a 1MHz frequency for 5 minutes and pulsed (25%) with gel as the coupling, this therapy was applied for 5 min/session, (3 days per week for 4 weeks) (19).

Transcutaneous Electrical Nerve Stimulation treatment

Parameters used were low frequency of 50 Hz. Muscle contractions were avoided while trying to obtain hypoesthesia or paresthesia of the treated region, regulating the device according to patients' sensory tolerance threshold. Treatment time: 15 minutes per session (3 days per week for 4weeks).

Therapeutic Exercises

The patient sit in a comfortable position. The patient was asked actively to open and close the mouth as wide as possible without feeling any pain then return to closed mouth. An object (pen) that is about half an inch thick was placed between teeth. The patient was asked actively to move their jaw from side to side. The patient was asked actively to move lower teeth forward until they are in front of the upper teeth. The patient was asked to open the mouth as wide as possible and place the tip of tongue to the roof of the mouth, while gently applying pressure, then to move the tip of tongue towards the tonsils and hold 5 seconds. (20)

Low intensity extracorporeal shock wave therapy

Low intensity extracorporeal shock wave therapy was applied for the experimental group (Group B) once per week for 4 weeks for LI-ESWT (11). The intensity of low intensity extracorporeal shockwave adjusted according to highest energy flux density the patient can tolerate. To achieve the best improvement in pain relief, the energy level of low shock was adjusted to the maximum level that patients can tolerate the pain induced by LI-ESWT.

The patient was in a supine position, with the therapist standing beside the patient. After rubbing the gel, a conductive medium to guide the waves, the probe of the device was placed on the spot to transmit the transmit the waves to the site. Applying 2000 shots, at a 1.8 bars energy density flux and at 18 Hz frequency (21).

Low level laser therapy

The low-level laser was applied for the experimental group (Group C) three times a week for 4 weeks (22). The patient was in a supine position, with the therapist standing beside the patient. The laser was applied in contact mode with a peak power of approximately 80 W, 50 mW average power at a pulse repetition rate of 1500 Hz, pulse length of 1 ms, 6 J per point, 3.4 J/cm2, and spot size 1.76 cm2, for 2 minutes per point (22).

Results

General characteristics of the subjects

As shown in table (1) and figures, there was no significant difference between three groups in the mean values of age, weight, height and BMI ($p>0.05$). Also, there was no significant difference in sex distribution, between the three groups ($p =0.574$).

Data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. Shapiro-Wlik test for normality showed that measured variable (jaw functional level) was normally distributed. Mixed MANOVA was conducted to investigate the effect of treatment on the measured variable. There was statistically

significant interaction effect of (treatment *time) (p=0.001), there was statistically significant effect of time (p = 0.001). Also, there are statistically significant effects of treatment (p=0.001)

Table 1 General characteristics of subjects of three groups.

Subject characteristic	Group A (n=22)	Group B (n=22)	Group C (n=22)	f-value	p-vlaue
Age (years)	35.86 ± 7.96	30.27 ± 9.97	32.95 ± 12.1	1.67	0.197
Weight (kg)	58.76 ± 6.65	57.48 ± 6.59	55.93 ± 8.1	0.868	0.425
Height (cm)	162.59 ± 7.45	163.59 ± 7.42	160.82 ± 6.86	0.826	0.443
BMI (kg/m^2)	22.19 ± 1.5	21.45 ± 1.78	21.53 ± 1.94	1.16	0.319
Sex N (%) Male Females	 4 (18%) 18 (82%)	 7 (32%) 15 (68%)	 6 (27%) 16 (73%)	χ^2 =1.1	0.574

Data was expressed as mean ± standard deviation, N (%): number (percentage)

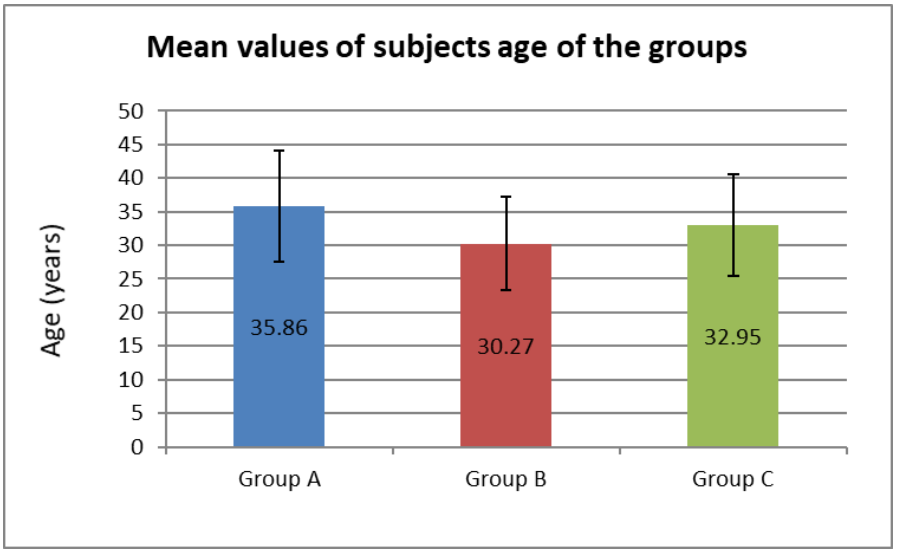

Fig. (1). Mean values of subjects age of three groups

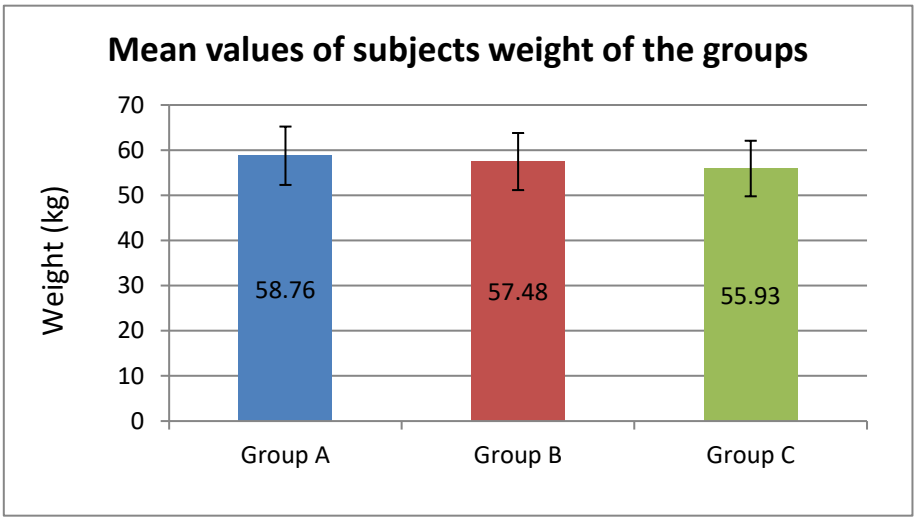

Fig. (2). Mean values of subject's weight of three groups

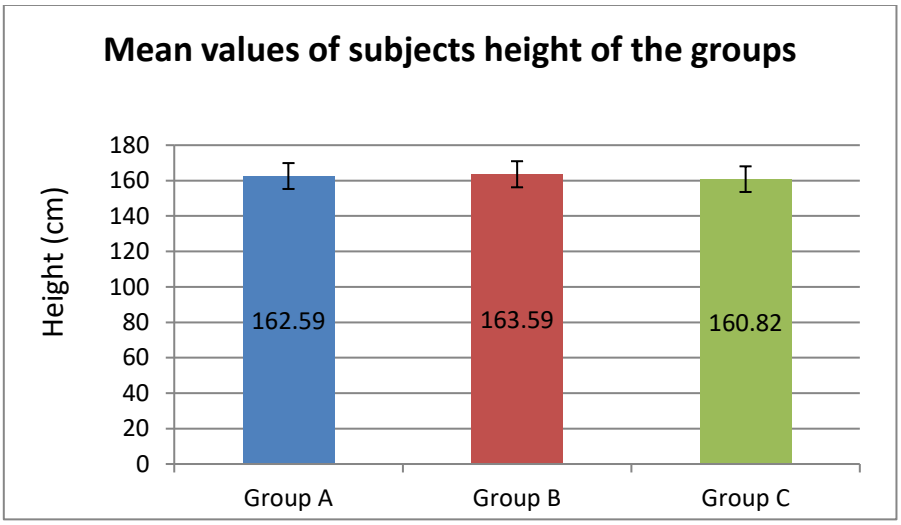

Fig. (3). Mean values of subject's height of three groups

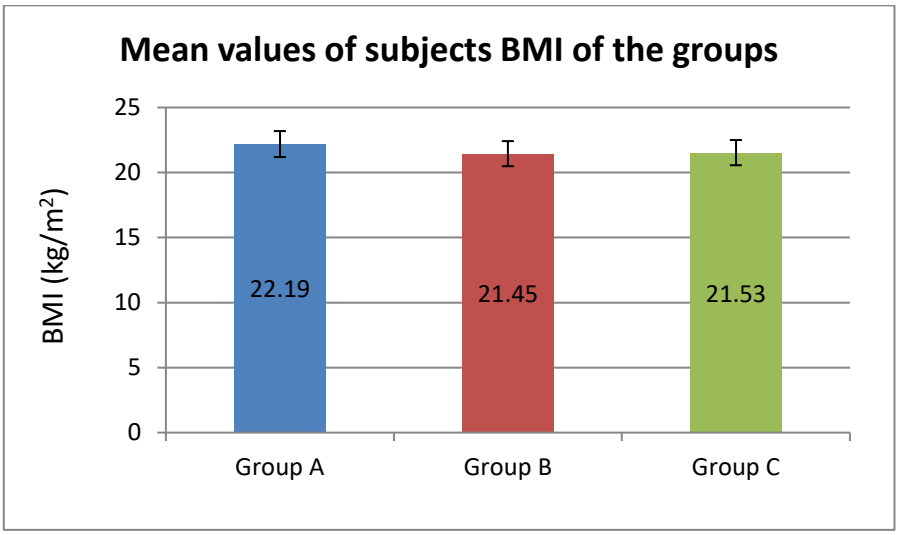

Fig. (4). Mean values of subjects BMI of three groups

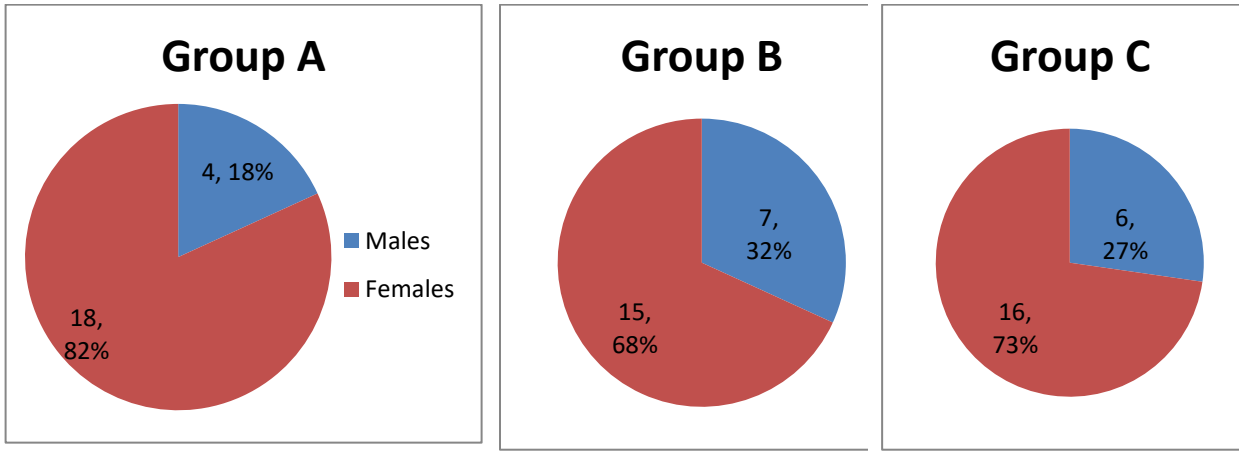

Fig. (5). Sex distribution of three groups Jaw functional level

Regarding between groups comparison**,** there was a statistically significant difference in post study between the three groups (p = 0.002). Bonferroni test revealed that, there was a statistically significant difference between groups A and B (P = 0.004) in favor to group B, also there was statistically significant difference between Groups A and C (p=0.012) in favor to group C. While there was no statistically significant difference between Groups B and C (p=0.990). Regarding within group comparison, there was a statistically significant decrease in mean value of JFLS in groups A, B and C post study compared to pre study (p = 0.001) . Also there was positive percentage decrease in limitation by 23%, 27% and 25% respectively table 2.

Table 2. Comparison between pre- and post-study mean values of measured variable between and within groups

JFLS					
Pre-study	110.54 ± 2.13	111.27 ± 5.92	109.27 ± 3.27	0.268	0.041
Post-study	85.45 ± 2.1	81.27 ± 5.92	81.77 ± 3.26	0.002*	0.179
MD (95% CI)	25.09 (24.9, 25.2)	30 (29.9,30.1)	27.5 (27.4,27.6)		
% of change	23%	27%	25%		
(P-value)	0.001*	0.001*	0.001*		

Bonferroni test for between group comparison post study for JFLS			
MD (95% CI) p-value	4.18 (1.15, 7.21) 0.004*	3.68 (0.65, 6.72) 0.012	-0.5 (-3.53, 2.53) 0.990

Data is represented as mean ±SD, *: significant, η2: partial eta square, MD: mean difference, CI: confidence interval

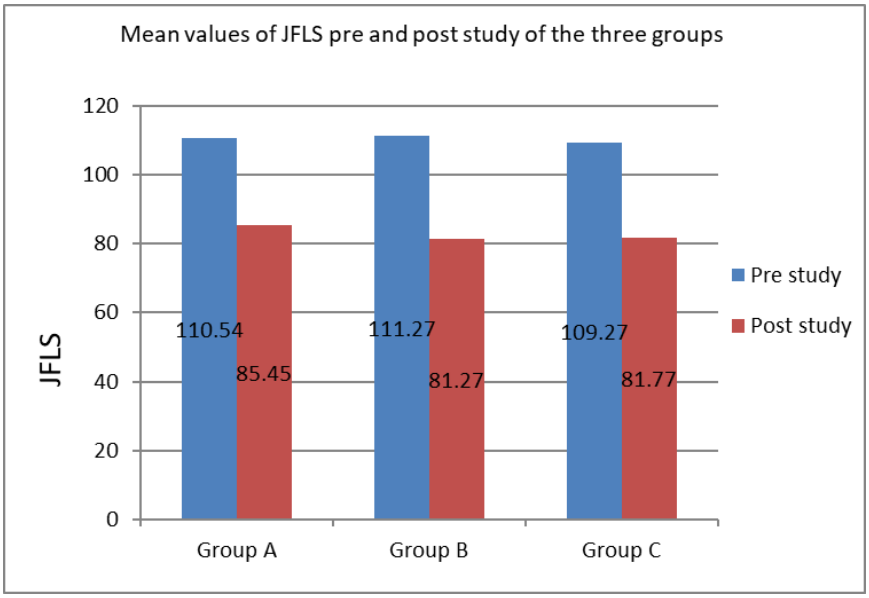

Fig. (6). Mean values of JFLS pre and post-study of the three groups

Discussion

This study was designed to evaluate the effect of low intensity shock wave with low level laser on jaw function in TMJ disorder patients.

Our main findings indicate in this randomized clinical trial indicated that both LSWT and LLLT produced significant improvements in jaw function compared with the control group. While LSWT showed slightly greater numerical improvements.

Low-intensity shock wave therapy (LSWT) promotes therapeutic effects through mechanical stimulation, which induces neovascularization, improves local blood circulation, reduces inflammation, and disrupts chronic pain cycles. In contrast, Low-level laser therapy (LLLT) exerts its effects primarily through photo biomodulation, leading to enhanced mitochondrial activity, increased ATP production, modulation of inflammatory mediators, and stimulation of tissue repair.

Low intensity shock wave alleviate pain by means of hyper stimulation analgesia. (23) Previous investigations have suggested that mechanotransduction seems to be the major mechanism whereby LSWT triggers antigenic and tissue regeneration responses at cellular and molecular levels, generating beneficial therapeutic effects in clinical scenarios.

In Zhang et al.,(2025) a randomized controlled trial involving 60 patients diagnosed with myogenic TMDs. Patients with myogenic TMDs (Class I) were randomly divided into ESWT group and Ultrashort Wave (UW) group. The UW group was given ultrashort wave combined with drug therapy, while the ESWT group was given an extracorporeal shock wave combined with drug therapy. The primary outcome was pain intensity measured by the Visual Analog Scale (VAS), and secondary outcomes included maximum mouth opening (MMO) and temporomandibular joint function indices. Post-treatment assessments revealed significant improvements in VAS scores and MMO in both groups ($p < 0.05$). Besides, compared with the UW group, the VAS score, the degree of MMO and Friction indexes of the TMDs patients in the ESWT group were remarkably improved after treatment ($p < 0.05$).

However, a systematic review and meta-analysis by Hassan et al., (2025) on 28 studies involving 1,460 patients to compare the effectiveness of Extracorporeal Shock Wave Therapy (ESWT) versus Laser therapy (LLLT and High-Intensity Laser Therapy (HILT) in treating musculoskeletal disorders (MSKDs). They showed that there was no statistically significant difference between ESWT and both types of laser therapies in improving pain. The discrepancy in findings may be attributed to differences in study design and population characteristics, as their

study included a broader range of musculoskeletal disorders, whereas our investigation focused specifically on TMJ disorders

Characteristic of the study
There was no significant difference among three groups in the mean values of age, weight, height and BMI. Also, there was no significant difference in sex distribution among three groups. Screening data for normality revealed that all date normal distributed. Jaw function limitation scale will normality distributed
Jaw functional level
There was equal improvement in jaw function level in group B and group C. Jaw function was improved in group B more than group A and it improved in Group C than Group A. Also, equal improved in Group B than Group C.
Our findings showed a 23–27% reduction in JFLS, which likely exceeds the minimal clinically important difference. This suggests that the improvements are not only statistically significant but also clinically translate TMD patients into better daily jaw function.

Low intensity shock wave improves jaw function by reduce muscle over activity, improve revascularization, and has anti-inflammatory effects, leading to faster and greater improvements in mandibular movements.
According to our study, there was a significant interaction effect of (treatment, time) and there was significant effect of time. Also, there statistically significant effects of treatment.

The results of our study indicate that both LLLT and ESWT produced greater functional improvement compared to conventional therapy alone, as reflected by significant reductions in JFLS scores. Importantly, LSWT showed a numerically greater, but not statistically significant, improvement over LLLT, suggesting that both modalities are comparably effective in enhancing jaw function among TMD patients.
Aligning with our study, Keskin Tunç et al., (2024) observed that ESWT application improved mandible functional movements such as painless maximum mouth opening and passive forced mouth opening (24).
Similarly, Song et al., (2024) found that the ESWT could significantly improve the function of the temporomandibular joint (25).
In further accordance with our results, Li and Wu, (2020) revealed that the ESWT significantly improves the functional indexes (11).
This was supported by Díaz et al., (2025) who demonstrated that the LLLT significantly improved mandibular function (26).

Conclusion

Both low shock wave therapy and low-level laser therapy when administered alongside conventional physiotherapy enhanced jaw function in patients with TMJ disorders, low shock wave therapy showed numerically greater improvement. These improvements may hold clinical relevance by enhancing patients' daily function and quality of life

Limitations
The sample size was relatively small.
A relatively short-term follow-up (one month).
No long-term follow-up to assess durability of effects.
Dependence on a single outcome measure (JFLS).

Recommendations
Further studies of large sample sizes are needed.
Further studies of gender dependent.
Further investigations should incorporate extended follow-up periods to evaluate the durability and long-term effects of low shock wave and low-level laser therapies on TMJ disorder outcomes.
More research is required to validate our findings.
Further studies should compare the cost-effectiveness of LSWT and LLLT to help guide treatment choices in clinical practice.

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Patient consent statement prior to the start of data collection, all patients provided their written, informed consent.

Disclosure

Conflicts of interest for this article, none of the authors have disclosed any potential conflicts.

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