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Effect Of Shockwave Therapy On Temporomandibular Joint Pain And Trismus After Maxillofacial Surgeries

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Abstract

Objectives: *To examine the efficacy of Shockwave Therapy on Temporomandibular Joint Pain and Trismus After Maxillofacial Surgeries.* ***Methods:*** *The present study was conducted on sixty-four patients (30 males and 34 females) with age ranging from (19 to 45) and suffered from temporomandibular joint pain and trismus after maxillofacial surgeries assigned into two equivalent groups each consisting of thirty two patients. Group (A) was given one shockwave session per week over a period of one month consisting of 1500 to 2000 shocks at 8 Hz frequency and at a pressure of 1.5 to 2 bar on painful points of masseter and temporalis muscles as well as conventional physiotherapy program Group (B) received conventional physiotherapy 3 times per week over a period of one month consisting of (10 minutes of massage on temporalis and masseter muscles, 10 minutes of joint mobilization and exercises).* ***Outcome measures:*** *pressure algometry was used to assess pressure pain threshold (PPT) at masseter, anterior temporalis muscles along with temporomandibular joint, Vernier caliper was used for measurement of maximum mouth opening. Evaluation was performed before, 2 and 4 weeks after beginning of treatment.* ***Results:*** *shock wave group (group A) revealed significant enhancement more than control group (group B) in PPT and maximum mouth opening.* ***Conclusion:*** *shockwave therapy is effective in improving temporomandibular joint pain and maximum mouth opening after maxillofacial surgeries.*

Key words*: shockwave, temporomandibular joint, trismus, maxillofacial surgeries*

INTRODUCTION:

A subspecialty of oral and maxillofacial surgery, oral and maxillofacial surgeons diagnose and treat disorders, injuries, and disorders affecting the structural and functional components of the jaws, mouth, face, and neck, as well as their cosmetic and functional features (1).

The term "oral and maxillofacial surgery" describes a wide range of procedures aimed at improving the health or appearance of the mouth and surrounding facial and jaw areas. In some countries, including Canada and Australia, this is considered a dental specialty, even though it's really a subspecialty of medicine (2).

Pain, edema, and trismus are postoperative complications. Patients may have disruptions due to these adverse effects, which impair their ability to speak and mastic (3).

Trismus is outlined as incapability to properly open the mouth or restricted mobility of the temporomandibular joint, the expected normal mouth opening range, measured from the interincisal distance is around 40-55 millimeters in adults (4).

Temporomandibular disorders (TMD) are a collection of musculoskeletal illnesses indicated by pain and/or dysfunction in the masticatory muscles. Symptoms may vary from moderate discomfort to crippling agony, and they can also include restrictions of jaw function (5).

Noninvasive, conservative treatments provide improvement or relief of symptoms and are recommended, especially, in the initial management of TMD. Frequently, the physical therapists collaborates with dental professionals for the management of TMD. Physical therapists can use a broad range of techniques for helping patients recover from injury or disease. These include manual therapies like soft tissue and joint mobilization, therapeutic exercises, physical agents like thermotherapy, cryotherapy, electroacupuncture, as well as electrical stimulation like TENS and MENS, relaxation exercises, alongside postural correction (6). Shock wave therapy has been shown effective in treating musculoskeletal diseases in prior studies, with success rates ranging from 65% to 91% with minimal complications (7).

The first documented utilization of shockwave (SW) outside of the treatment of kidney or gallbladder occurs in the field of delayed fracture healing, where it was shown to stimulate osteogenesis. Additionally, it has been highlighted in several publications as a potential therapy for masticatory muscle problems and TMJ.(8)

SW is a strong mechanical (acoustic) wave that emits low-frequency, radially-focused radiation at a low pressure. The exact way SW promotes anti-inflammatory mechanisms, which in turn enhance tissue repair and regeneration, remains unclear. Shock waves enhance blood flow as well as cell permeability toward the area, which in turn releases membrane-bound proteins such as bone morphogenetic proteins in addition to transforming growth factor-beta1 (9).

SUBJECT, MATERIALS AND METHODS:

Subjects:

This study was carried-out in the department of physical therapy at El-Sahel teaching hospital from august 2023 to July 2024, Patients who fulfilled inclusion criteria were chosen from out-clinics of oral and maxillofacial surgeries at Nasser institute.

The Cairo University Ethical Committee for the Physical Therapy Faculty (No: P.T.REC/012/003934) gave their approval for this study.

Sixty-four patients (30 males and 34 females) with age ranging from (19 to 45) who underwent maxillofacial surgeries and complained of TMJ pain and trismus for six weeks after surgery were included in this study patients were randomized into two groups; study group (n=32) and control group (n=32). Group (A) study group: received 4 sessions of shockwave (one per week) over a period of one month as well as conventional physiotherapy program (10 minutes of massage on temporalis and masseter muscles, 10 minutes of joint mobilization and exercises), (as well as conventional physiotherapy was applied 3 times per week). Group (B): control group received as well as conventional physiotherapy 3 sessions per week over a period of month

Sample- size framework.

Considering pain pressure threshold of the joint was primary outcome, eight patients in every group served as a pilot test to detect the sample size (managed by G Power analysis program. According to the attached figure, the effect size was 1.05 tested at a 95% power. The number of patients estimated to complete the study was 50 patients (25 participants in each group). The dropout (estimated by 27% or nearly 14 patients) of those participants urged the authors to increase the total participants to nearly 64 patients (32 participants in every group).

- **Inclusion criteria:** A standard medical evaluation was used to select the patients, all patients were approximately at the age (24 - 40), all patients were conscious and were under own prescribed medications described by their physicians, all patients undergone surgery (impacted third molar, TMJ arthrocentesis or arthroscopy) Every patient has varying degrees of pain and has a limited range of motion while opening their mouth, they had unilateral side affected, they have not been undertaken another physical therapy electro- modality except the traditional physical therapy

Exclusion criteria: patients with infection present in the head and neck region, patients with coagulopathy, or using anticoagulants, patients who suffered from skin diseases, myocardial infarction, patients those were pregnant or presented with active malignancy were excluded from the study, patients who were suffering from Hemorrhage, patients with pacemakers, acute cases of TB or viruses, as well as mental disorders were also excluded from the study.

Instrumentation:

In this study the measuring equipment and tools were Vernier caliper and Pressure algometry, Vernier caliper for measuring maximum mouth opening, the dial and digital calipers provide an accurate and direct measurement of the distance. Though they provide the same information in various ways, they are otherwise functionally equivalent. Two parts make up these calipers: one is a calibrated scale having a fixed jaw, and the other is a moving jaw with a pointer. Next, the measurement of the gap between the jaws is taken (10). One semi-objective approach to determining the pressure-pain threshold (PPT) of different tissues is pressure algometry (11). The threshold at which a pressure stimulation that is not uncomfortable becomes painful is called the PPT (12).

The therapeutic equipment and tools was the shockwave therapy unit, (Chattanooga intellect RPW) and traditional physical therapy program

PROCEDURES:

Measurement procedures:

Vernier Caliper: The maximum mouth opening was measured using a Vernier Caliper. The mandibular opening (MMO) was determined by calculating the vertical distance from the incisal ends of the upper to the lower front teeth. Patients were directed to open their mouths as wide as possible, while the examiner measured the maximum vertical distance among the incisal margins of the maxillary in addition to mandibular central incisors at the midline (13).

Pressure algometry: The measurement of Pressure Pain Threshold was conducted using a digital algometer equipped with a rod featuring a flat circular tip measuring 1 cm^2 at one end. The flat portion of this tip was utilized to exert pressure on the masseter, the anterior temporalis muscle, along with the temporomandibular joint on the affected side while the patient maintained a relaxed posture (14).

Treatment procedures:

Both groups received traditional physical therapy which was applied 3 sessions per week over a period of month consisting of 10 minutes of massage on temporalis and masseter muscles, 10 minutes of joint mobilization and exercises

Study group:

Patients in this group were treated in a lying or sitting position with their mouth slightly open to relax the jaw muscles. Patients in the shockwave group had been given one session per week over a period of month consisting of 5 minutes of 1500 to 2000 shocks at 8 Hz frequency and at a pressure of 1.5 to 2 bar (15), a radial shock wave device (Chattanooga intellect RPW) on painful points of masseter and temporalis muscles, the apparatus was linked to an applicator with a 15-mm diameter.

Control group:

Patients in this group received traditional physical therapy

STATISTICAL ANALYSIS

A- Data collection

Before, 2 weeks after starting therapy (post 1), and 4 weeks after the therapy (post 2), the following assessments were done: MMO, PPT at masseter, (PPT masseter), PPT at anterior temporalis (PPT anterior temporalis), and PPT at tempromandibular Joint (PPT-TMJ) for two groups.

B- Data analysis

The following statistical steps were done:

A Shapiro-Wilk test was used to ensure that the data was normal distributed. the homogeneity of variances was tested using levene's test, and the results showed that they were. An independent t test was run to compare participant characteristics among groups, and chi-squared tests were run to compare gender distribution as well as side of affection. A mixed MANOVA was run to compare the effects of time (pre versus post) and treatment (between groups), in addition to the interaction between the two variables. The results showed that the data were normally distributed and that the results were homogeneous. A significance criterion of $p < 0.05$ was established for all statistical tests. Data analysis was carried out using SPSS version 23 for Windows, which is a statistical tool for social sciences (16).

Informed consent:

All participants in this research gave their informed permission.

RESULTS:

Sixty-four patients (males and females) who underwent maxillofacial surgeries and complained of TMJ pain and trismus were included in this study, patients were randomized into two groups; study group (n=32) along with control group (n=32)

Age, pain duration, genders, and affected side distribution were not significantly different between the two groups when comparing the overall characteristics of the patients (Table 1)

Table (1) Baseline characteristic of patients (N=64)

	Study group Mean ± SD	Control group Mean ± SD	p-value	Sign
Age (years)	31.68±7.15	33.34±6.83	0.347	**NS**
Pain duration (days)	47.68±10.65	45.62±10.93	0.448	**NS**
Gender (Male/Female)	13/19	17/15	0.316	**NS**
Affected side (right/left)	9/23	15/17	0.121	**NS**

*: Data were expressed as mean ±SD:Standard deviation. N: number. P: probability Sign: significance
NS: non significant

Effect of treatment on MMO:

As shown at (table 2) there was no significant difference in MMO between study and control groups pre-treatment ($p = 0.089$), at 2 weeks follow up there was a significant difference in MMO between groups post-treatment.The improvement was greater in the study group than the control group ($p<0.05$). Additionally, during the 4-week follow-up, there was a significant difference in MMO among groups post treatment. The study group showed a more significant improvement compared to the control group ($p<0.05$) **(Table 2)**

Table. (2). Effect of treatment on MMO (N=64) *

MMO(mm)	Study group Mean ± SD	Control group Mean ± SD	MD	p- value	Sig
Pre-treatment	38.93±6.69	36.15±6.17	2.78	=0.089	NS
2-week follow up	41.09±6.34	37.37±6.35	3.71	0.022	S
4-week Follow-up	43.34±6.48	38.71±6.52	4.62	0.006	S

N: number.MD: Mean difference.. P: Probability value. * Data are mean± SD(Standard deviation). P-Value ≤0.05 indicate statistical significance difference. MMO:Maximal mouth opening. S: significant

Effect of treatment on Pressure pain threshold (PPT) for masseter, anterior temporalis muscles and TMJ:

Prior to treatment, the study group as well as the control group did not vary significantly on PPT for the masseter muscle, the anterior temporalis muscle, or TMJ (p = 0.074, 0.07, and 0.055 respectively). Groups differed significantly at the 2-week follow-up on PPT regarding the masseter, anterior temporalis muscles, in addition to TMJ. The study group showed a more significant improvement compared to the control group (p<0.05). Additionally, during the 4-week follow-up, a significant difference was noted among the groups on post-treatment PPT for the masseter, anterior temporalis muscles, along with TMJ. The enhancement in the study group was statistically significant higher than in the control group (p<0.05) **(Table 3)**

Table. (3). Effect of treatment on Pressure pain threshold (PPT) masseter, anterior temporalis muscles and TMJ (kg/cm^2) (N=64)

		Study group	Control group	MD	p- value	Sig
		Mean ± SD	Mean ± SD			
PPT Masseter (kg/cm^2)	Pre-treatment	1.37±0.29	1.25±0.23	0.12	=0.074	NS
	2-week follow up	1.78±0.31	1.32±0.23	0.46	<0.001	S
	4-week Follow-up	2.16±0.34	1.42±0.26	0.74	<0.001	S
PPTanterior temporalis (kg/cm2)	Pre-treatment	1.72±0.33	1.58±0.25	0.13	=0.07	NS
	2-week follow up	1.99±0.34	1.66±0.26	0.33	<0.001	S
	4-week Follow-up	2.43±0.37	1.79±0.30	0.64	<0.001	S
PPT-TMJ (kg/cm2)	Pre-treatment	1.31±0.27	1.19±0.22	0.12	=0.055	NS
	2-week follow up	1.61±0.29	1.29±0.23	0.32	<0.001	S
	4-week Follow-up	2±0.30	1.39±0.24	0.60	<0.001	S

DISCUSSION:

Sixty-four patients who underwent maxillofacial surgeries and complained of TMJ pain and trismus were involved in this study, patients were randomized into two groups; each group included thirty two patients study group received 4 sessions of shockwave therapy (one session per week) over a period of one month as well as conventional manual therapy and massage and control group received 12 sessions of conventional manual therapy, massage and exercises, (3 times per week) for one month.

The study revealed significant difference in Maximum Mouth opening of the study group more than the control group at 2 and 4 weeks follow up ($p<0.05$). In terms of PPT, anterior temporalis muscles, and TMJ after 2 and 4 weeks follow up, the study group demonstrated a statistically significant improvement compared to the control group ($p<0.05$).

The study's results are in line with those of Li and Wu, who compared the effectiveness of SW and ultra-short wave (UW) therapy for the management of temporomandibular joint disorders (TMD). They discovered that following therapy, both groups' Visual Analogue Scale (VAS) scores decreased, but the SW group's decline was more pronounced. In addition, compared to the UW group, SW showed a higher improvement in the pain-free MMO following therapy, proving that SW is superior to UW for treating TMD (15).

Marotta et al. (17) conducted a randomized controlled trial (RCT) to assess the efficacy of a multi-faceted rehabilitation program including radial Shock Wave Therapy (rSWT) in supplementing physical therapy for patients with muscle-related TMD. The program was designed to reduce pain and enhance muscle function, The primary endpoint was the pain intensity measured by a VAS and the secondary endpoints were muscle activity and function assessed through the surface electromyography evaluation of the anterior temporalis and the masseter muscles, The rSWT group showed a statistically significant pain reduction whereas patients in the sham group did not reach statistical significance Concurrently, muscle activity and performance significantly improved in the active rSWT group, with an improvement in the percentage of the overlapping coefficient (POC) compared to the control group.

Researchers Keskin Tunç et al. (18) compared the effectiveness of SW with that of stabilization splints for the treatment of TMDs. The study's participants were individuals whose disc displacements had been reduced based on the diagnostic criteria for TMDs. Those patients who received SW had significantly lower VAS scores than those in the control group. The painless active as well as passive-forced mouth-opening measures were also significantly greater in the SW group in comparison with the control group.

In a study conducted by Kim et al (19), the impact of SWT on chondrocytes as well as TMJ osteoarthritis within rat models were examined. The results showed an improvement in chondrocyte cell viability, a reduction in pro-inflammatory cytokines (TNF-a, IL-1B, as well as IL-6), and a significant reduction in cartilage degradation markers, which are known to cause TMJ osteoarthritis. According to the results of the micro-CT, patients who had SWT had better bone quality along with tissue structure than those who didnt. They highlighted the fact that in instances of TMJ osteoarthritis, SWT protects the joint cartilage as well as subchondral bone structure by lowering inflammation, cartilage deterioration, and chondrocyte death.

We also found different findings from Li et al. (20), who evaluated the feasibility and effectiveness of extracorporeal shockwave therapy (SWT) for myogenous TMD treatment. The research involved M-TMD using a randomization process, the following 41 adult patients with M-TMD were included in the study: Those in Group 2 got a placebo, whereas those in Group 1 got SWT. There were no statistically significant differences among the groups when it came to the variables that were studied, which included pain as evaluated by a numerical rating scale (NRS) as well as mouth opening.

CONCLUSION:

The study revealed that shockwave therapy is effective in improving pain and trismus after maxillofacial surgeries

DECLARATION OF CONFLICTING INTERESTS:

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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