Effect of a Specific Exercise Program Post Temporomandibular Joint Arthrocentesis on Symptoms Severity, Pain, and Mouth Opening

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Abstract:

Background: Post arthrocentesis exercise program has a positive effect on symptoms, pain and the range of joint motion. **Aim:** to evaluate the effect of a specific exercise program post temporomandibular joint arthrocentesis on symptoms severity, pain, and mouth opening. **Research design:** A quasi-experimental research design (study/ control groups) was utilized. **Subjects:** A sample of 40 patients. **Setting:** The study was conducted in the Oral and Maxillofacial Surgery Unit and outpatient clinic at Assiut University Hospital. **Tools:** Four tools were utilized: **Tool I:** Patient's assessment sheet included demographic data; **Tool II:** TMD questionnaire; **Tool III:** Wong-Baker pain rating visual analogue scale; and **Tool IV:** Range of maximal mouth opening measured in mm. **Results:** There was a statistically significant difference between the study and control groups regarding temporomandibular disorder mean score at 1 month (5.65±3.48&9.75±4.99) and 3 months (2.05±4.3&7.05±4.24) postoperatively with p.value (0.005**& 0.001**) respectively. A significant decrease in the mean pain score for both groups at 1 month and 3 months compared with the preoperative period and 1 week postoperatively with p.value (0.004**& 0.0001***). Also, there was a high statistically significant difference between the study and control groups regarding the mean score of the range of maximal mouth opening measured in mm (37.7±3.66& 33±4.58) at 3 months postoperatively with p.value (0.001**). **Conclusion:** The exercise program post arthrocentesis is more effective in decreasing symptoms severity, and pain and improving mouth opening. **Recommendations:** Applying the specific exercise program for patients with TMJ arthrocentesis to decrease symptoms severity, and pain and increase mouth opening.

Keywords: Arthrocentesis, Exercise Program, Mouth Opening, Pain, Symptoms Severity and Temporomandibular Joint.

Introduction:

The most typical non-dental cause of orofacial discomfort is temporomandibular disorder (TMD). This phrase refers to conditions that cause discomfort in the muscles or temporomandibular joints (TMJs), limited mobility, muscular soreness, and intermittent joint noises. These conditions can also affect the masticatory muscles and the temporomandibular joints. Temporomandibular disorder has been a common reason to seek medical attention in recent years. TMJ problems are characterized by clicking, grinding, discomfort, and abnormalities in mandibular mobility, such as decreased mouth opening (hypomobility) or, on the other hand, hypermobility and luxation. **(Polat & Yanik; 2020).**

The most prevalent arthropathy of the temporomandibular joint is articular disc displacement **(Hosgor et al., 2017).** Disc displacement without reduction (DDwoR) is a frequently observed intracapsular biomechanical disorder involving the condyle-disc complex. It is characterized by limited mouth opening, pain

at the TMJ region, and a shift in the patient's opening pattern **(De Leeuw et al., 2018).**

Temporomandibular disorders can be treated using a variety of non-surgical and surgical techniques. For first care, a nonsurgical strategy is advised; if this does not work, surgical intervention should be taken into consideration. Initially, reversible and conservative treatment involving medication, interocclusal devices, and physiotherapy should be used for DDwoR. **(Grossmann et al., 2019)**.

Using sterile needles and sterile irrigants, arthrocentesis is the term used to describe the lavage of the TMJ without visualizing the joint space. The goal is to either reduce pain by eliminating inflammatory mediators from the joint or increase mandibular mobility by removing intra-articular adhesions using hydraulic pressure from irrigation of the upper chamber of the TMJ. Arthrocentesis is typically recommended for individuals who do not respond to conventional therapy. **(Soni, 2019)**.

Nonetheless, arthrocentesis is a useful therapy option for TMJ problems, particularly for those with discomfort and restricted mouth opening. Physical activity is typically advised by surgeons following arthrocentesis and arthroscopy treatments. For TMDs, physiotherapy is recommended as a therapeutic approach to move the joint, avoid adhesions, restore biting force, and regulate muscle function and blood circulation. **(Miernik et al., 2015).**

In their first study on TMJ arthrocentesis, **Hosgor et al. (2017)** recommended a physiotherapy program immediately following arthrocentesis because physical activity, which involves extending the muscle and joint, lowers discomfort and reduces functional impairment.

Significance of the study:

After arthrocentesis, surgeons typically advise patients to engage in physical exercise. However, there is a lack of research regarding the effects of exercise on clinical outcomes and joint disability, pain, and maximum mouth opening (MMO). For these reasons, this study will be carried out to inform patients about how to maintain their health and to assess the effects of these exercises on symptoms severity, pain, and limited mouth opening.

Aim of the study:

– To evaluate the effect of a specific exercise program post TMJ arthrocentesis on symptoms severity, pain and limited mouth opening in patients with temporomandibular joint disc displacement without reduction.

Hypotheses: To fulfil the aim of the study the following research hypothesis will be formulated:

H1: Symptoms severity will be significantly improved among patients with temporomandibular joint disorders post-implementation of the exercise program after arthrocentesis.

H2: Pain levels will be significantly decreased among patients with temporomandibular joint disorders post-implementation of the exercise program after arthrocentesis.

H3: Limited mouth opening will be significantly improved among patients with temporomandibular joint disorders post-implementation of the exercise program after arthrocentesis.

Subjects and Method:

Research design: -

In this study, a quasi-experimental design was used. Establishing a cause and effect relationship between an independent and dependent variable is the goal of this design. In addition, it is an empirical interventional study that uses randomized assignment to estimate the intervention's causal impact on the target population.

Setting: -

The study was conducted in the Oral and Maxillofacial Surgery Unit and Outpatients' Clinic at Assiut University Hospital. The unit is located on the second floor of the main building. It has eight rooms for patients and two rooms for nursing and medical staff. While the outpatient clinic is located on the ground floor of the clinic

building, it operates on Sunday and Tuesday of every week, and patients are followed up there.

Sample size:

A purposive sample of 40 patients of both sexes is divided into a study group and a control group treated with TMJ arthrocentesis. Based on the findings of the earlier study, a G-power analysis was done to determine the sample size. With a 95% confidence interval (CI), we assume a power of 0.80%, a type I error of 0.05%, and a type II error of 0.20. A minimum of 25 people must be included in the sample. Following the evaluation of whether or not they satisfied all inclusion requirements, the qualified patients (n = 40) were asked to take part.

Selection Criteria:

Patients with temporomandibular joint disc displacement without reduction of any ethnic group and gender who are aged ≥ 20 years, in good general health, and physically and psychologically able to undergo TMJ arthrocentesis are included in the study.

Inclusion criteria;

- Patients complain of pain and/ or limited mouth opening (painful locking).
- Mandibular distraction or forced opening maneuvers.
- Mandibular hypomobility.
- Joint noises or clicking.
- Failure of conservative treatments.

Exclusion criteria;

- Patients with degenerative joint diseases, such as osteoarthritis, rheumatoid arthritis, and gout.
- History of condylar fractures or trauma.
- Previous joint surgery
- Poor compliance.

Tools:

Four tools for data collection were used to achieve the purpose of the current study.

Tool I: Patient's assessment sheet.

It was developed by the researcher based on current national and international literature. It included:

Demographic data for the patient as (age, gender, occupation, marital status, and level of education).

Tool II: TMD Questionnaire (Conti, et al., 2003): This questionnaire was originally used with a 5% level of significance and is a modification of Helkimo's anamnestic index. Anamnestic Questionnaire responses were requested from patients to categorize them based on the most often reported symptoms of TMD. A score of '0' denotes the lack of symptoms, whereas a score of '1' is awarded in case of an infrequent occurrence reported. A score of two denotes the existence of symptoms, whereas a score of three denotes bilateral symptoms or extreme discomfort.

The sum of the scores classified into four categories:

(1) From 0 to 3, TMD free.

(2) From 4 to 8, mild TMD.

(3) From 9 to 14, moderate TMD.

(4) From 15 to 23, severe TMD.

Tool III: Wong-Baker pain rating visual analog scale (McCaferry& Pasero, 1999):

The pain was evaluated using the visual analog Wong-Baker pain rating scale. This questionnaire was used to measure pain intensity. A pain score ranges from 0 to 10, with 10 being the most severe pain a person has ever experienced.

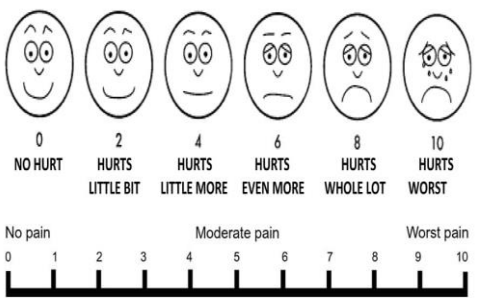

Fig. 1: Wong-Baker pain rating visual analog scale

Tool IV: Range of maximal mouth opening (MMO) measured in mm (Laplanche et al., 2012):

Using a millimeter ruler, the maximum unsupported mouth opening is measured innately (between the incisal margins of the top and lower incisors at the midline). Opening of less than 35 mm is considered abnormal in an adult.

Fig. 2: Interincisal measuring mouth opening using a millimeter ruler

Scoring System:

- Normal mouth opening 35 to 45mm.
- Limitation of normal mouth opening < 35mm.
- Exaggerated mouth opening > 55mm.

The Specific Exercise Program:

The researchers created a particular exercise program with two components based on the patient requirements assessment, the literature review, and the resources available.

Part (I): General instructions as:

1.A bandage may be placed over the surgical site. It must remain in place according to the surgeon's instructions. A small amount of blood may be observed on the bandage, which is normal.

2.Apply antibiotic ointment to the affected area twice daily.

3.It is okay to shower and shampoo starting the day after surgery. You may reapply a bandage to the surgical site as necessary.

4.If there are some bruises and swelling at the site of surgery. Apply cold compresses to the affected side (for 20-minute intervals) for the first 48 hours after surgery. After 48 hours, stop using the compresses.

5.All medications must be taken according to the doctor's instructions, such as muscle relaxants, pain relievers, and antidepressants.

6.Keep the head elevated, especially while sleeping or resting, for at least 24 hours.

7.Avoid bending, lifting heavy objects, or any activities that increase pressure in the head area.

8.Commitment to the follow-up scheduled appointment.

9.For one week after surgery, food should consist of easy-to-chew ingredients, because chewing may affect the joint. The diet should not be limited to liquids but should be of easy-to-chew textures such as cheese, pasta, mashed potatoes, and other soft foods that do not require vigorous chewing.

10. Place your tongue at the roof of your mouth with the teeth slightly apart; which helps relax the tense jaw.

11. We can benefit from moist heat, such as: using a warm, wet cloth on the jaw, to relieve temporomandibular joint pain.

12. Set an alarm to go off every hour and remind you to relax and relax your jaw.

13. Use proper posture to reduce neck and face pain, especially when sleeping

14. **Avoid:**

– Opening the mouth completely and limiting severe jaw movement (for example while yawning or singing).
– Resting the chin on the hand.
– Hold the phone between your neck and ear.
– Chewing gum or biting your nails to reduce the pain and discomfort associated with TMJ disorder.
– Clenching or pressing your teeth for a long time.

– Bite your nails to reduce the pain and discomfort associated with temporomandibular joint disorder.

Part (II): specific exercises as:

1.To warm the muscles, gently move your mouth up, down, and side to side without contacting your teeth.

2.Make sure the teeth are not in contact, relax the tongue, and let the lower jaw create the M sound.

3.Move the jaw up and down as well as side to side after opening the mouth as wide as you can without experiencing any discomfort. Before letting your jaw muscles rest, perform this complete exercise at least ten times.

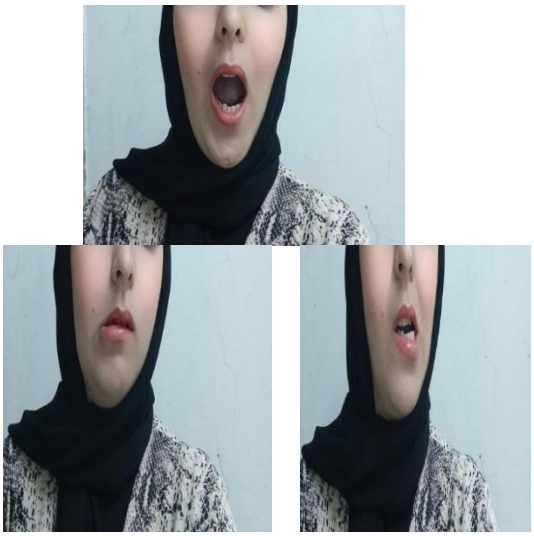

Fig.3: Jaw movement up and down and from side to side

4.Perform the same movements as in exercise 3, but against resistance with the hand.

a.Open your lips and place your hand beneath your chin.

b.When moving forward, press the finger on the tip of the chin; when moving laterally, press the finger against the left and right sides of the chin. For a few seconds, hold the lower jaw at the farthest point of each motion.

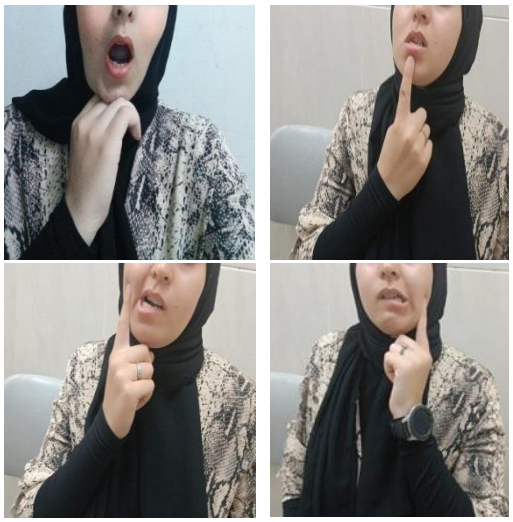

Fig.4: (a&b) Jaw movement against resistance

c. Spread your lips as wide as you can, then try to shut them while fighting the urge to do so by using your fingers to press on your lower front teeth. Hold your jaw like this for a few seconds.

d.Let your mouth open as widely as you can. Next, apply pressure with your fingertips on the front teeth, both upper and lower.

Fig.5: c

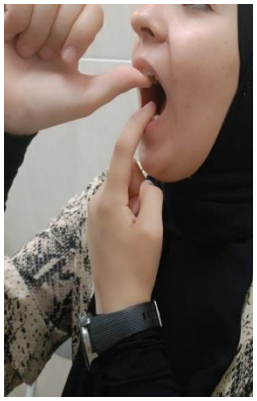

Fig.6: d

5.Attempt to move the lower jaw straight up and down while gazing in the mirror. Steer clear of deviations and motions that cause the jaw to lock or click.

6. Rest on your back for five to ten minutes to wrap off the workout.

Procedure: -

This study was carried out in three phases:

The preparatory phase:

A review of current and past, local and international related literature ***(Ferreira, et al., 2017; Bas et al., 2018; Li, et al., 2020)*** in the various aspects using books, articles, periodicals, and magazines were done.

Administrative approval:

Official approval and administration permission was obtained from the Oral and Maxillofacial Surgery Unit at Assiut University Hospital to gather the needed data after the study aims explanation.

Content validity and reliability:

Five experts (two from the medical staff of the department of maxillofacial surgery and three from the field of medical-surgical nursing) checked the validity of the content of the study tools. They evaluated the tool for readability, comprehensiveness, understanding, and applicability. A correction was made to the few minor changes that were needed. The Pearson's correlation coefficient for test–retest reliability was 0.83. The Cronbach's α for internal consistency was 0.73.

Ethical Considerations:

The research was approved by the faculty of the nursing – ethics committee (December 2022). The study followed ethical principles in clinical research. Anonymity and confidentiality were guaranteed. At any point, participants were free to leave the research without giving a reason or to decline to take part. To prevent their names from being identified, participants' codes were used throughout the data entry. Following an explanation of the study's objectives, patients gave their formal consent to take part in it.

Pilot study:

Based on the opinions of experts, a pilot study was carried out on 10% of the sample in the chosen environment to assess the applicability, practicality, and clarity of the generated tools. Changes were made as needed.

Implementation phase:

- Data collection for this study was carried out from January 2023 to April 2024, during the morning shift. The researchers attended the Oral and Maxillofacial Surgery Unit at Assiut University Hospital. Every patient gave their consent to participate in this study due to ethical concerns. The majority of patients were followed up at the outpatient clinic; some of them were followed up by telephone.
- The exercise program had been implemented for the study group in terms of sessions. The exercise program sessions aimed to evaluate the effect of the exercise program on pain, symptoms severity, and mouth opening for patients undergoing TMJ arthrocentesis.
- The researchers created the workout regimen after reviewing pertinent literature and accessible resources. Each patient had a total of two sessions, lasting anywhere from twenty to thirty minutes each.

- **The 1st session:** At the beginning of the interview, the researchers introduced themselves to the patient and explained the purpose of the study. Each patient was interviewed individually after admission. Formal consent was obtained for participation. During the initial visit, the researchers started to fill patient's assessment sheet to assess the patient's demographic characteristics using **Tool I**, assess TMD using **Tool II,** pain assessment using Wong-Baker pain rating visual analog scale using **Tool III**, and clinical examination included a range of maximal mouth opening (MMO), measured in mm by the distance between the incisal edges of the upper and lower incisors using **Tool IV.** This interview was done before TMJ arthrocentesis.

In the 2nd session: the researchers explained and demonstrated the exercise program to the study group besides general teaching about eating a soft diet and avoiding parafunctional habits while the control group received the routine care. Patients started the program 24 hours after the arthrocentesis procedure.

It includes massage, resistance to the masticatory muscle, and passive and active stretching exercises. It is recommended that each patient follow the workout regimen three times a

day and refrain from painful motions. The workouts are done for six weeks. Patients receive a written pamphlet with activities to be done at home. The significance of the research was underscored to guarantee complete collaboration.

Evaluation phase:

Patients were followed up at 1 week, 1 month, and 3 months at the Oral and Maxillofacial clinic at Assiut University Hospital. Clinical parameters (Tool II, Tool III & Tool IV) were assessed at each follow-up visit.

Statistical analysis:

Before doing any statistical analysis, the data underwent homogeneity variance testing and the Anderson-Darling test for normalcy. Number and percent were used to characterize categorical variables, whereas mean and standard deviation (Mean, SD) were used to characterize continuous variables. Comparing categorical variables is done using the chi-square test and the Fisher exact test; for continuous variables, the t-test is utilized. The association between scores appears through person correlation. Statistical significance was defined as a two-tailed $p < 0.05$. The IBM SPSS 20.0 program was used for all analyses.

Results:

Table (1) clarifies that more than half of patients in both study and control groups their age ranges between 18 to less than 30 years with a mean of 28.95±9.89 years. More than three-quarters of patients in the study group (80%) and more than half (65%) of them in the control group were females. More than half of patients in both study and control groups their educational levels ranging between secondary school and university education. Regarding their occupation, half of the patients (50%) in the study group were students and nearly half of the control group patients were housewives. Where there were no significant differences between the study and control groups regarding demographic data.

Table (2) demonstrates that there was a statistically significant difference between the study and control groups regarding temporomandibular disorder mean score at 1 month and 3 months postoperative.

Figure(7) illustrates that regarding temporomandibular disorder symptoms severity, the majority of both study and control groups had severe temporomandibular disorder symptoms pre-application of the exercise program, while post one week from performing the exercise program about half of the study group and more than half of the control group had moderate TMD symptoms (50% & 70% respectively). Post one month after performing the exercise program the study group had free and mild TMD while the control group had mild and moderate TMD symptoms. Post 3 months the majority of the study group (85%) had free TMD symptoms, while (70%) of the control group had mild TMD symptoms.

Table (3) shows that there were statistically significant differences between the study and control groups regarding mean pain score at 1 month and 3 months postoperative. Also, the table shows a significant decrease in the mean pain score in both groups at one month and three months compared with the preoperative period and one week postoperative.

Table(4) clarifies that there was a significant increase in the mean score of the range of maximal mouth opening measured in mm. at three months postoperative compared with a preoperative period, one week, and one month postoperative. Also, there was a high statistically significant difference between the study and control groups regarding the mean score of the range of maximal mouth opening measured in mm. at three months postoperative.

Table (5) clarifies that in the study group of patients; there were positive correlations between the mean pain score and temporomandibular disorder symptoms score at one week, one month, and 3 months postoperative which means as the pain decreased the temporomandibular disorder symptoms decreased. Also, there were negative correlations between mean pain score and Maximal mouth opening measure in mm. at one week, one month, and 3 months postoperative which means as the pain decreased the range of maximal mouth opening increased. In the control group of

patients; only there were positive correlations between mean pain score and temporomandibular disorder score at one week, one month, and 3 months post-operative which means as the pain increased the TMD symptoms.

Table (1):- Number and percentage distribution of demographic data related to studied groups (N=40).

	Study (N=20)		Control (N=20)		X2	P. Value
	No	%	No	%		
Age group						
18 - > 30 years	14	70.0	11	55.0	2.50	0.286 ***NS***
30 - >40 years	2	10.0	6	30.0		
40 ≥ 65 years	4	20.0	3	15.0		
Mean ± SD(range)	28.95±9.89					
Gender						
Male	4	20.0	7	35.0	1.12	0.480 ***NS***
Female	16	80.0	13	65.0		
Marital						
Single	13	65.0	8	40.0	2.50	0.205 ***NS***
Married	7	35.0	12	60.0		
Education						
Illiterate	2	10.0	3	15.0	2.01	0.848 ***NS***
Read and write	1	5.0	0	0.0		
Primary school	2	10.0	1	5.0		
Preparatory school	1	5.0	2	10.0		
Secondary school	6	30.0	7	35.0		
University	8	40.0	7	35.0		
Occupation						
Skilled Worker	4	20.0	3	15.0	5.30	0.151 ***NS***
Student	10	50.0	4	20.0		
Housewife	4	20.0	9	45.0		
Employee	2	10.0	4	20.0		

Chi-square test for qualitative data between the two groups.
Fisher exact test is used to compare between categorical variables ($2^{\times}2$).
Independent T-test quantitative data between the two groups.
****Significant level at P value < 0.05, **significant level at P value < 0.01, N.S:- Not Significant***

Table(2):- Comparison Between Study and Control group related to assessing TMD score during Preoperative, 1 week, 1 month, and 3 months postoperative (N=40).

	Study (N=20)		Control (N=20)		T	P. Value
	Mean ± SD	%	Mean ± SD	%		
Preoperative	20.05±3.5	66.8	19.65±3.8	65.5	0.35	0.731
1 week	12.15±3.88	40.5	14.05±4.27	46.8	-1.47	0.149
1 month	5.65±3.48	18.8	9.75±4.99	32.5	-3.01	0.005**
3 month	2.05±4.3	6.8	7.05±4.24	23.5	-3.71	0.001**

Independent T-test quantitative data between the two groups
*****Significant level at P value < 0.01***

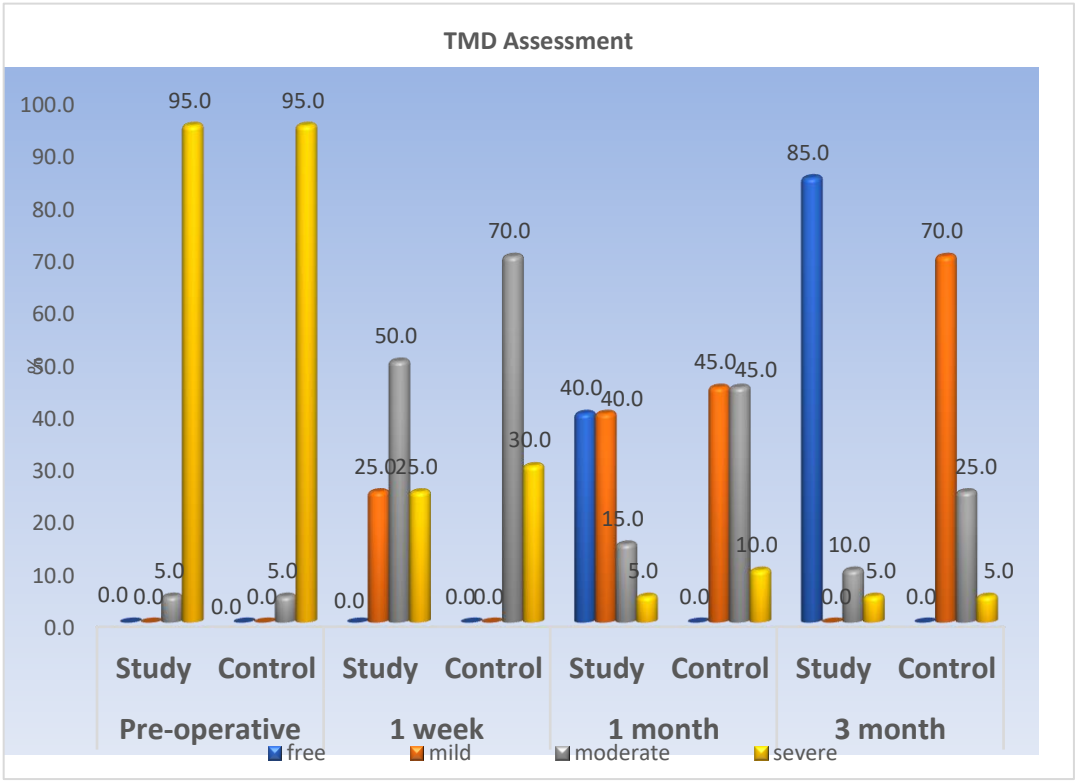

Figure (7): Distribution of the study and control groups according to TMD assessment during Preoperative, 1 week, 1 month, and 3 months postoperative (N=40).

Table(3):- Comparison between the Study and Control group related to Pain assessment during Preoperative, 1 week, 1 month, and 3 months postoperative (N=40)

	Study	Control	T	P. Value
	Mean ± SD	Mean ± SD		
Preoperative	6.85±1.09	6.3±0.66	1.93	0.061
1 week	3.6±0.68	3.95±0.89	-1.40	0.170
1 month	1.5±0.95	2.25±0.55	-3.07	0.004**
3 month	0.2±0.52	1.1±0.45	-5.85	0.0001***

Independent T-test quantitative data between the two groups
****Significant level at P value < 0.05, **Significant level at P value < 0.01***

Table(4):- Comparison Between the Study and Control group related to the Range of Maximal Mouth Opening (MMO) measured in mm during Preoperative, 1 week, 1 month, and 3 postoperative months (N=40).

	Study (N=20)	Control (N=20)	T	P. Value
	Mean ± SD	Mean ± SD		
Pre-operative	24.75±4.45	24.63±6.65	0.07	0.945
1 week	27.05±4.54	26.6±5.61	0.28	0.782
1 month	32.2±4.11	29.5±4.81	1.91	0.064
3 month	37.7±3.66	33±4.58	3.59	0.001**

Independent T-test quantitative data between the two groups
*****Significant level at P value <***

0.01

Table(5):- Correlation coefficient between Pain scale, TMD Score, and Range of Maximal Mouth Opening (MMO) measured in mm during Pre-operative, 1 week, 1 month, and 3 months after exercise program (N=40).

Correlations		Study		Control	
		Pain scale	TMD Score	Pain scale	TMD Score
Pre-operative					
TMD Score	R	0.181	1	.255	1
	P	0.444		.278	
Range of Maximal Mouth Opening (MMO) measured in mm	R	0.046	-0.378	-.256	-0.419
	P	0.847	0.101	.276	0.066
1 week					
TMD Score	R	.522*	1	.709	1
	P	0.018*		.0001**	
Range of Maximal Mouth Opening (MMO) measured in mm	R	-.505-*	-.490-*	.175	0.345
	P	0.023*	0.028	.459	0.136
1 month					
TMD Score	R	.579**	1	.503*	1
	P	0.007**		.024*	
Range of Maximal Mouth Opening (MMO) measured in mm	R	-.501-*	-.557-*	.129	.010
	P	0.025*	0.011	.587	.967
3 month					
TMD Score	R	.744**	1	.553*	1
	P	0.0001**		0.011*	
Range of Maximal Mouth Opening (MMO) measured in mm	R	-.600-**	-.588-**	-0.283	-0.114
	P	0.005**	0.006*	0.227	0.632

Statistically Significant Correlation at P. value <0.05

****Statistically Significant Correlation at P. value <0.01***

Discussion:

Although temporomandibular dysfunction is still primarily thought to be a musculoskeletal condition, its complex and biopsychosocial etiology is becoming recognized **(Gil-Martínez, et al., 2018).** Pain in the jaw, mouth, face, and peri-auricular regions that limit jaw motions, such as active or passive mouth opening **(Fernández-de-las-Peñas, & Svensson, 2016)** and sounds **(List, & Jensen, 2017),** is the most common symptom of temporomandibular disorders.

To prevent hypomobility and ankylosis following arthrocentesis and arthroscopy treatments, surgeons typically recommend physical workouts. It increases mandibular range of motion and inhibits the growth of aberrant fibrous tissue. According to **Klasser (2014),** therapeutic exercise that involves stretching the muscles and joints may help reduce discomfort and functional impairment in the chronic phase of temporomandibular dysfunction. Thus, the study's objectives are to lessen discomfort, promote mouth opening, and ameliorate symptoms of temporomandibular dysfunction in patients.

Regarding demographic data, the current investigation demonstrated that over 50% of patients in the study and control groups were between the ages of 18 and under 30 years, with a mean age of 28.95±9.89 years. This finding is consistent with **Cruz et al.'s (2022)** clarification that temporomandibular disorders are more common in the childbearing years (20–40 years old) and decrease with age. According to **(Bueno et al., 2018 & Sánchez-Torreloet et al., 2020)**, temporomandibular disorders are more common in the female population, most likely due to hormonal and sociocultural differences between males and females. The current study also showed that the largest percentage of both groups were females. According to experts, factors such as greater pain sensitivity, stress, hormone fluctuations, and treatment seeking may contribute to the fact that temporomandibular disorders are more frequent in women than in men.

Regarding education level; the educational backgrounds of almost half of the patients in the study and control groups varied from secondary school to university education. About half of the patients in the control group were housewives, whereas half of the patients in the research group were students. **Diab et al. (2023)** reported in their study "Prevalence and Severity of Temporomandibular Disorders Among Egyptian Postgraduate Students: A Cross-Sectional Study" that temporomandibular disorders (TMD) are more common in females and that TMD is even more serious among university students due to the numerous stressors they face. Additionally, TMD and oral parafunctions are much more common among emotionally burdened individuals. From the researcher's view, students complained of TMD because they faced more stress during this period also it was observed that the main cause of temporomandibular disorder was parafunctional habits practiced by them. Also, the cause of housewives being the highest percentage in the control group was the stress and responsibility of family behind hormonal changes.

The present study demonstrated that there was a statistically significant difference between the study and control groups regarding temporomandibular disorder mean score at 1 month and 3 months postoperative.

Regarding temporomandibular disorder assessment; the current study showed that before starting the exercise program, the majority of the study group and the control group had severe TMD symptoms. However, one week after starting the program, around half of the study group and more than half of the control group had mild TMD symptoms. After a month of exercising, the research group experienced mild to nonexistent TMD symptoms, whereas the control group experienced mild to moderate TMD symptoms. After three months, most research participants had no symptoms of TMD, although over half of the control group had moderate symptoms. From the researcher's view, symptoms of TMD illustrated improvement in the study group than the control group and this reflects the effect of the exercise program post arthrocentesis than arthrocentesis alone.

Regarding pain assessment; according to the current investigation, there were statistically significant variations in the mean pain score at one month and three months postoperatively between the study and control groups. Additionally, compared to the preoperative period and the first postoperative week, the mean pain score for both groups after one month and three months significantly decreased, according to the data. In line with **Bas et al. (2018),** who reported that during the one- and three-month follow-up, the physiotherapy group had a statistically significant reduction in pain. In line with **Nossier et al. (2022), who** clarified that there was a significant ($p<0.001$) difference between the two groups.

Regarding maximal mouth opening (MMO); the current study made clear that, in comparison to the preoperative period, one week, and one month postoperatively, there was a statistically significant rise in the mean score of the range of maximal mouth opening assessed in millimeters at three months postoperatively. Additionally, three months after surgery, there was a significant statistical difference in the mean score of the maximal mouth opening range, evaluated in millimeters, between the study and control groups. In line with the findings of **Nossier et al. (2022),** who discovered significant variations in MMO between the control and physiotherapy groups. Contrary to **Bas et al. (2018),** who found no discernible variation in MMO between the control and study groups.

Regarding correlations between mean pain score and TMD; the current investigation showed that, among the patients in the study group, the mean pain score and the TMD score showed positive associations after one week, one month, and three months postoperatively. This suggests that, as pain declined, so did TMD. Additionally, after one week, one month, and three months after surgery, there were negative correlations found between the mean pain score and the maximal mouth opening measure in millimeters. This indicates that as pain dropped, so did the range of maximal mouth opening. Only the mean pain score and the TMD score at one week, one month, and three months postoperatively showed positive associations with the control group of patients, indicating that the TMD increased with increasing pain. From

the researcher's view, these results reflect the positive effect of the exercise program post arthrocentesis on relieving pain and improving mouth opening.

Conclusion:

Exercise program post arthrocentesis was found to be more effective in decreasing symptoms severity, and pain and improving mouth opening for patients with TMD.

Recommendations:

- Applying the specific exercise program on the patients with TMJ arthrocentesis to decrease symptoms severity, and pain and increase mouth opening.
- To determine the optimal impact of an exercise regimen following arthrocentesis treatment, more studies with bigger patient samples and longer follow-up times are recommended.

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