

# Effect of Exercise Therapy on Pain Alleviation and Improvement of Range of Movement after Temporo mandibular Joint Arthrocentesis

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## Abstract

**Background:** Arthrocentesis is an effective treatment modality for temporomandibular disorders, especially in patients who have pain and limited mouth opening. Surgeons generally suggest therapeutic exercises after arthrocentesis and arthroscopy procedures.

**Aim of Study:** This study investigated whether immediate physical exercises after arthrocentesis would result in early improvements in clinical symptoms in patients with temporomandibular joint disc displacement without reduction (TMJ DDw/oR).

**Patients and Methods:** The study group was composed of 30 patients with TMJ DDw/oR. Patients who needed arthrocentesis after failed conservative nonsurgical treatment were enrolled in the study. The study was done in the Department of Oral and Maxillofacial Surgery, Hospital of Oral & Dental Medicine, Cairo University from March 2018 – March 2019. Informed written consent was obtained from all participants. The patients were randomly classified into 2 groups of equal number.

- Group 1 was composed of 15 patients who were started on an immediate physiotherapy program after the arthrocentesis procedure.
- Group 2 was composed of 15 patients who were not started on a physiotherapy program after the arthrocentesis procedure.

Physiotherapy included a 4-week exercise program. Patients were followed for 3 months. Range of maximal mouth opening (MMO) and joint pain as measured by the visual analog scale (VAS) were examined to determine clinical efficacy before and after treatment.

**Results:** There was a statistical increase in group A (study group) in comparison to group B (control group) with MMO (pretreatment, after 4 weeks and after 3 months).

There was a statistically significant decrease in group A (study group) in comparison to group B (control group) with

VAS (pretreatment, after 4 weeks and after 3 months arthrocentesis has a significant effect on the range of mouth opening and pain decrease.

**Conclusion:** Immediate Physical exercise after arthrocentesis has a significant effect on the range of mouth opening and does decrease pain.

**Key Words:** Arthrocentesis – Pain – Range of maximal mouth opening (MMO) – Physical exercise.

## Introduction

**TEMPOROMANDIBULAR** joint (TMJ) disc displacement without reduction (DDw/oR) is a commonly seen disorder characterized by restricted mouth opening and pain in the TMJ region. Pharmacologic therapy, splint therapy, physical therapy, and reassurance of the patient are first-line conservative treatment methods for temporomandibular disorders (TMDs) [3]. Arthrocentesis is efficient and minimally invasive. Since the technique was introduced in 1991, several studies have reported the short and long-term effects of arthrocentesis in patients with TMD with pain and limited mouth opening. The technique has been modified several times and different anatomic landmarks and methods are used to make the procedure more effective and easier [4]. Physical therapy and splint treatment are generally advised after arthrocentesis treatment [2].

### Abbreviations:

Max : Maximum.  
Min : Minimum.  
MMO : Maximum mouth opening.  
PT : Physical therapy.  
SD : Standard deviation.  
VAS : Visual analog scale.  
TMD : Temporomandibular joint disorders.  
TMJ DDw/oR : Disc displacement without reduction \*  $p < .05$ .

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This study evaluated the effect of therapeutic exercise on the range of movement and pain after arthrocentesis therapy in patients with TMJ DDw/oR

### Patients and Methods

The study involved 30 patients. To be included in the study sample, patients had to meet the following inclusion criteria:

- 1- Diagnosed with TMJ DDw/oR (classified according to the Research Diagnostic Criteria for Temporomandibular Disorders).
- 2- Failed conservative nonsurgical treatment for a minimum of 2 months.
- 3- Magnetic resonance imaging study for the assessment of TMJ internal derangement.

*The exclusion criteria were:*

- 1- The presence of known connective tissue or autoimmune diseases.
- 2- Previous TMJ surgery.
- 3- Degenerative joint disease.
- 4- History of major jaw trauma.
- 5- Concurrent use of steroids, muscle relaxants, or narcotics.

Clinical examination included the range of maximal mouth opening (MMO), measured by the distance between the incisal edges of the upper and lower incisors, and joint pain using a visual analog scale (VAS; 0 to 10). According to clinical and radiologic examinations, patients who needed arthrocentesis therapy were enrolled in the study.

Arthrocentesis was performed on the upper joint space as recommended by Nitzan et al., under sedation. After sedation was performed by an anesthesiologist, local anesthetic 2mL was injected subcutaneously around the joint capsule [5]. All arthrocentesis procedures were performed by the same surgeon [6]. The joints were lavaged with lactated Ringer solution of 60 to 100mL. No intraarticular medication (corticoid, hyaluronic acid, etc) was used after arthrocentesis. Tenoxicam taken once daily for 2 days was prescribed to all patients [7].

In group 1 (study physical therapy group n=15), were started on a self-administered physiotherapy program immediately after the arthrocentesis procedure.

In group 2 (control group n=15), patients were not started on a physiotherapy program after the arthrocentesis procedure.

*The procedure of treatment is divided into main 3 parts (Applied Phases):*

Part 1: Exercises performed by physiotherapist: The patient underwent hands-on guided exercises performed by a physiotherapist. The 8- to 10-sessions course started immediately after surgery at a rate of once or twice a week, and included several techniques:

1- *Intraoral manipulation to guide jaw, soft tissue manipulation technique:* Manipulations consisted of medial glide, lateral glide, and anterior glide. Each glide was given for 10-15 repetitions 5-6 times in a session. The total duration of mobilization has lasted 20 minutes as shown in Fig. (1).

a- *Anterior Glide of the mandible:* As shown in Fig. (1A):

- Patient position: Supine or sitting with his mouth slightly opened.
- Therapist position: Thumb on patient's lower teeth, the other fingers are outside on mandible.
- The direction of movement: Pull the mandible downward and forward with the thumb, while the other fingers outside are pushed against the chain. Each joint was mobilized individually.

b- *Medial Glide of the mandible:* As shown in Fig. (1B):

- Patient position: Side-lying or sitting with his mouth slightly opened.
- Therapist position: Thumb on patient's medial side of the mandible and teeth.
- The direction of movement: Push thumb laterally. Each joint was mobilized individually.

c- *Lateral Glide of the mandible:* As shown in Fig. (1C):

- Patient position: Side lying or sitting with his mouth slightly opened.
- Therapist position: Two thumbs overlapped on the patient's lateral aspect of the mandible outside the mouth.
- The direction of movement: Apply medial pressure to the condyle. Each joint was mobilized individually.

2- *Stretching exercises for cervical muscles:* As shown in Fig. (2) physiotherapist performed stretching exercises for the upper trapezius, scalene, semi spinal muscle of the head, splenius capitis, and sternocleidomastoid muscles [8]. These muscles are directly involved with head positioning and their shortening produces misalignment in head and neck segments. Each stretch was applied for 25-30 seconds, at high intensity [1].

a- *Semispinalis Capitis and Splenius Capitis Muscle Stretch:*

- Patient Position: Stand or sit upright, patient Keeps head up facing straight ahead.
- Therapist position: The therapist stands behind the patient with his hand over the patient's head giving a forward push.
- Command: Ask the patient to push his head forward by sticking out his chin. Keep your head up during this stretch. Do not let the patient's chin fall towards the ground, gently push the head forward. Hold for 25 to 30 seconds as shown in Fig. (2A).

b- *Sternocleidomastoid and Scalene Muscle Stretch:*

- Patient position: Sit on the chair, Hold the chair with the right hand.
- Therapist position: The therapist stands behind the patient with his hand over the patient's head giving a forward push.
- Command: Ask the patient to flex his neck forward, side bend to left, and turn his head to the right. Lean body to left and slightly forward. Hold for 25 to 30 seconds; repeat on the opposite side as shown in Fig. (2B).

c- *Upper Trapezius Muscle Stretch:*

- Patient position: Sit up straight, with the patient's feet flat and shoulders back, and grab onto the bottom of the chair with the patient's right hand.
- Therapist position: The therapist stands behind the patient, with his hand over the patient's right side of the head giving a push.
- Command: Ask the patient to slowly tilt his head sideways, bringing his left ear toward his left shoulder until he feels a gentle stretch along the right side of the neck and shoulder. Hold for 25 to 30 seconds; repeat on the opposite side as shown in Fig, (2C).

Part 2: Home program:

1- *Technique for the full range of motion stretch (FROMS) self-exercise:*

The FROMS self-exercise involves stretching the mandible in all directions: Vertical (opening), Horizontal (protrusion), and Transverse (lateral) [10]. One cycle of the FROMS consisted of an opening stretch held for 15 seconds, a protrusive stretch held for 5 seconds, and right and left lateral stretches each held for 5 seconds. Three cycles were defined as a single set of not more than 2 minutes. The exercise routine was performed every hour during the first postoperative week and then in a descending fashion for the remaining weeks:

every 2 hours in the second postoperative week, every 3 hours in the third postoperative week, and so on until the sixth postoperative week. Patients were advised to continue once daily FROMS self-exercise for maintenance until week 10-12 postoperative. The self-exercise was performed at each follow-up examination and was re-taught as needed. The patient can continue to perform these exercises not only for four weeks but until the end of the three-month follow-up.

2- *The Six Rocabado Exercises program 6x6:*

The program contains six fundamental components: The rest position of the tongue, TMJ rotation control, rhythmic stabilization technique, the liberation of the cervical joint, axial extension of the cervical spine, and shoulder girdle retraction [11]. The six different exercises are designed to relieve the discomfort of TMJ. Perform the exercises one after the other. It will take about one minute. The patient should exercise in front of a mirror [13].

*Exercise #1:* Tongue (Clucking) place tongue on the roof of the mouth (Rest position of the tongue). Rest the tip just behind the teeth and take six deep breaths. Repeat 6 times, 6 times a day. As shown in Fig. (6. #1).

*Aim:* It rests the tongue and jaw and promotes diaphragmatic breathing to decrease the activity of the accessory muscles.

*Exercise #2:* Controlled TMJ rotation on opening keep tongue on the roof of the mouth and open and close the mouth six times. Repeat 6 times, 6 times a day as shown in Fig. (6. #2).

*Aims:* Reduction of initiating jaw movements with translatory components (protrusive movement in the opening, talking, or chewing), therefore reducing masticatory muscle activity and joint overload.

*Exercise #3:* Mandibular rhythmic stabilization tongue remains on the roof of the mouth and two fingers are placed on the chin to open the mouth against gentle resistance. Repeat 6 times, 6 times a day as shown in Fig. (6. #3).

*Aims:* Induction of muscle relaxation through the principle of reciprocal inhibition. When a muscle is actively contracted, its antagonists are consequently relaxed. Rhythmic stabilization also promotes the proper jaw rest position through proprioception.

*Exercise #4:* Upper cervical distraction (Stabilized head flexion) place hands behind the neck

and bend chin down as if nodding head. Repeat 6 times, 6 times a day as shown in Fig. (6. #4).

*Aims:* Distraction of the upper cervical spine and alleviation of mechanical compressions; this allows the posterior cervical muscles to elongate.

*Exercise #5:* Axial extension of the cervical spine Move chin down and back as if making a double chin Repeat 6 times, 6 times a day as shown in Fig. (6. #5).

*Aims:* Distraction of the cervical vertebrae, allowing tension reduction in the supra- and infrahyoid muscles and enhancing the ability of the masticatory muscles to relax. With this exercise, the sternocleidomastoid muscle takes a more normal posterior angulation, which reduces further unnecessary muscle activity to maintain that position.

*Exercise #6:* Shoulder girdle retraction correct posture by lifting your ribs and chest upward while squeezing shoulder blades together. Repeat 6 times, 6 times a day as shown in Fig. (6. #6).

*Aims:* Correction of abnormal scapular protraction through shoulder girdle retraction.

### Part 3: Self-care tips:

It's effective in helping patients manage their TMD, and Relaxation of the muscles and joints of the jaw to allow healing. As shown in Table (3).

The self-care tips consist of the following tips:

*These self-care programs consisted of the following steps and instructions:*

- Soft food enables muscles and joints to heal.

- Not chewing gum lessens muscle fatigue and joint pain.
- Relax facial muscles: "Lips relaxed, teeth apart No clenching it irritates joints and muscles.
- Yawning against pressure prevents locking open and jaw pain.
- Moist heat for 20 minutes promotes healing and relaxation.
- Ice is for severe pain and new injuries (less than 72 hours).
- Heat and ice - 5 seconds of heat, 5 seconds of ice - for pain relief.
- Good posture; avoid head-forward position.
- Sleeping position: Side-lying, with good pillow support.
- Acupressure massage between thumb and forefinger.
- Over-the-counter medications: Ibuprofen or aspirin. Yoga and meditation for stress reduction.
- Massage promotes healing and relaxation.
- An athletic mouthguard can give temporary relief.
- Avoid long dental appointments.

### Statistical analysis:

Data were collected, coded, revised, and entered into the Statistical Package for Social Science (IBM SPSS) version 20. The data were presented as numbers and percentages for the qualitative data, mean, standard deviations, and ranges for the quantitative data with parametric distribution, and median with interquartile range (IQR) for the quantitative data with the non-parametric distribution.

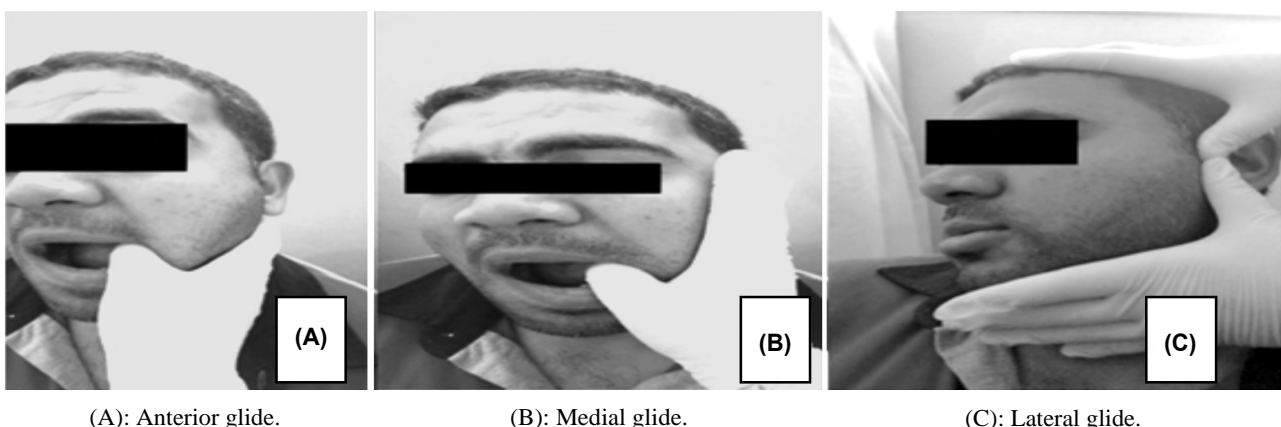
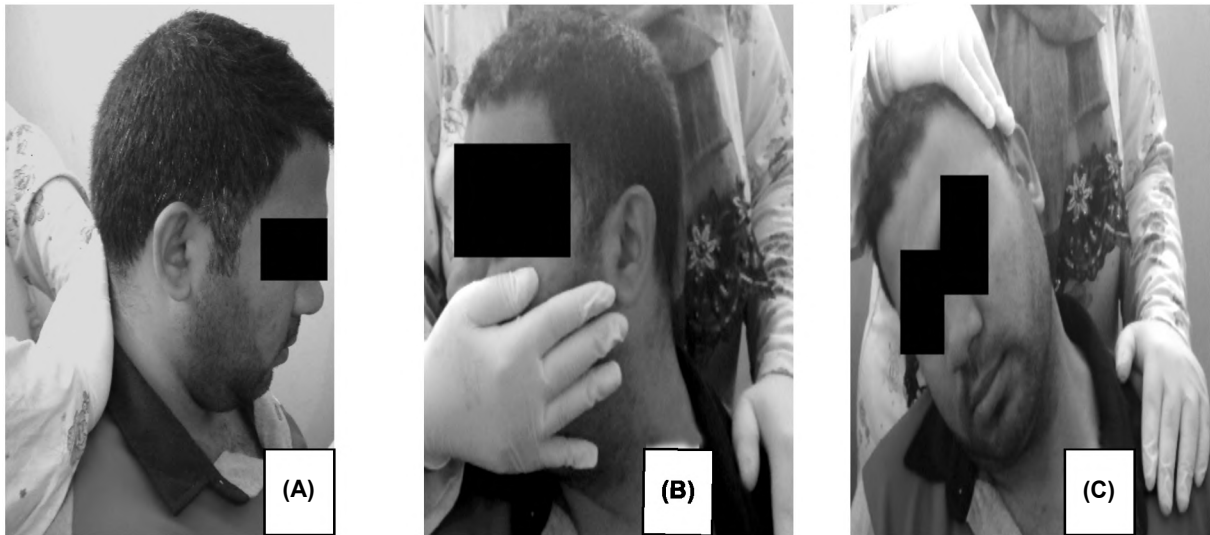


Fig. (1A,B,C): Intraoral manipulation to guide jaw.



(A): Semispinalis Capitis & Splenius Capitis. (B): Sternocleidomastoid & Scalenes. (C): Upper Trapezius.

Fig. (2): Stretching exercises to cervical muscles (A,B,C).

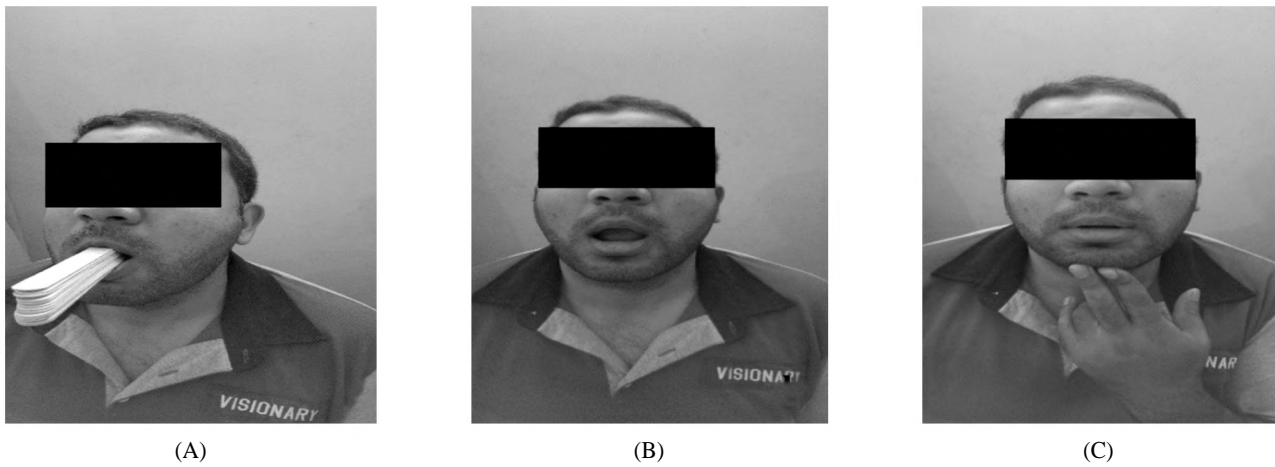


Fig. (3): Vertical stretch (A,B,C).

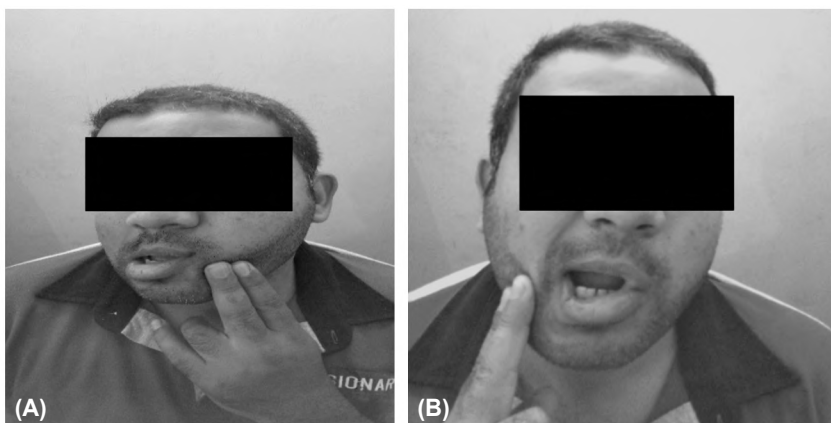


Fig. (4): Transverse stretch (A,B).



Fig. (5): Horizontal stretch.



Fig. (6): The Six Rocabado Exercises 6x6.

Table (1): Technique for the full range of motion stretch (FROMS) self-exercise.

<p>- Vertical stretch (Opening) Fig. (9)</p>	<ul style="list-style-type: none"> <li>• The patient slowly opens the mouth as wide as possible and inserts stacked wooden spatulas approximately 40mm thick between the upper and lower incisors. The mouth is held open for approximately 15 seconds. It works as active assisted exercise (Fig. 3A).</li> <li>• Gradually the patient is instructed to actively open the mouth rather than resting on the wooden spatulas. The mouth is held open. It works as active free exercise (Fig. 3B).</li> <li>• If the patient fails to actively open the mouth to the desired extent independently. He is instructed to start the exercise isometrically by slightly opening the mouth several times and resisting the movement with upward pressure on the lower border of the chin (by the hand), and then immediately opening without the hand's resistance. It works as an Isometric exercise (Fig. 3C).</li> </ul>
<p>- Transverse stretch (Lateral excursion) Fig. (10)</p>	<ul style="list-style-type: none"> <li>• The patient actively moves the mandible laterally as much as possible. Initially, the exercise may be assisted by the patient's fingers. The lateral position is held for approximately 5 seconds on each side. (Fig. 4A).</li> <li>• If the patient fails to demonstrate improvement in magnitude of active lateral excursion towards the unaffected side or continues to deviate to the affected side upon opening, the patient is instructed to perform the exercise isometrically by placing two fingers on the chin on the side of the movement and gently counteracting the lateral movement of the mandible against the pressing fingers. This is followed by assisted lateral excursion. (Fig. 4B).</li> </ul>
<p>- Horizontal stretch Fig. (11)</p>	<ul style="list-style-type: none"> <li>• The patient slowly moves the mandible forward. In patients with normal occlusion, the lower incisors should bypass the upper incisors. In patients with increased overjet, the goal should be to reach approximately an edge-to-edge relationship. The protrusive position is held for approximately 5 seconds. (Fig. 5).</li> </ul>

Table (2): Application of the full range of motion stretch (FROMS) self-exercise.

Post-operative WEEK 1	FROMS exercise every 1 hour
Post-operative WEEK 2	FROMS exercise every 2 hours
Post-operative WEEK 3	FROMS exercise every 3 hours
Post-operative WEEK 4	FROMS exercise every 4 hours
Post-operative WEEK 5	FROMS exercise every 5 hours
Post-operative WEEK 6	FROMS exercise every 6 hours
Post-operative WEEK 7-12	FROMS exercise once daily

Table (3): Instruction to the patients for the posture correction in daily life.

(A) Sitting:	<ul style="list-style-type: none"> <li>- Don't slouch when sitting on a chair.</li> <li>- Don't sit with your legs crossed.</li> <li>- Don't rest your chin in your hand. If you sit on the floor, sit upright by sitting on your folded legs.</li> </ul>
(B) Standing:	<ul style="list-style-type: none"> <li>- Rbst your weight on both feet evenly, and don't lean against a wall.</li> </ul>
(C) Sleeping:	<ul style="list-style-type: none"> <li>- Using a hard mattress or futon, lie on your back, keeping your neck straight with a low pillow or flattened towel.</li> </ul>
(D) Eating:	<ul style="list-style-type: none"> <li>- Bring the food to your mouth without tilting Masticate looking straight ahead and not downward.</li> </ul>
(E) Walking:	<ul style="list-style-type: none"> <li>- Walk with long strides while swinging your arms.</li> </ul>
(F) Others:	<ul style="list-style-type: none"> <li>- Don't carry a heavy package with one hand.</li> <li>- Don't thrust your head forward.</li> </ul>

**Results**

The study consisted of 30 patients. 17 female, and 13 male mean age was 40.73 years.

The baseline of MMO Average was 27.23cm. baseline of VAS Average was 6.29.

15 patients were included in the study group and 15 patients in the control group.

There were significant differences between the two groups regarding both previously mentioned variables (MMO, VAS).

The pretest, 4 weeks, and 3 months follow-up scores are present in the table respectively. Comparison between studied group & control group as regards MMO (pretest, after 4 weeks and after 3 months).

	(A) Patient group (No.=15)		(B) Control group (No.=15)		Independent <i>t</i> -test	
	Mean	SD	Mean	SD	<i>t</i>	<i>p</i> -value
Pre test	27.23	2.30	33.51	1.64	-8.617	<0.001
After 4 weeks	36.72	2.05	35.31	1.70	2.056	0.049
After 3 months	39.57	1.35	35.42	1.74	7.287	<0.001

This table shows that there was a statistically significant decrease in patients in comparison to the control group with MMO pretest but an increase in the patient in comparison to the control group with MMO (after 4 weeks and after 3 months).

Comparison between studied group & control group as regards VAS (pretest, after 4 weeks and after 3 months).

	(A) Patient group (No.=15)		(B) Control group (No.=15)		Independent <i>t</i> -test	
	Mean	SD	Mean	SD	<i>t</i>	<i>p</i> -value
Pre test	6.29	0.45	6.42	0.30	-0.964	0.344
After 4 weeks	1.93	0.26	5.50	0.33	-32.953	<0.001
After 3 months	1.43	0.26	4.91	0.45	-26.166	<0.001

This table shows that there was a statistically significant decrease in patients in comparison to the control group with VAS (after 4 weeks and after 3 months).

The mean MMO in the study group has increased by 30.1 %.

The mean MMO in the control group has increased by 10.4%.

The difference was statically significant (*p*<0.001).

Patient rated their pain level on 10-point VAS each evaluation.

The mean (VAS) value in the study group was at baseline 6.29, at 1 month 1.39 and at 3 months follow-up was 1.43.

The mean (vas) in the control group was at baseline 6.42, at 1 month 5.50, at 3 months 4.91 the difference between 2 groups was significant (*p*<0.001).

**Discussion**

TMDs are frequently seen and include problems related to the masticator muscles, TMJ, and relevant structures. The most prevalent symptoms are a pain in front of the ear that can spread toward the face, neck, and head; sensitivity in the masticatory muscles; clicking; and limited jaw motions. The aim of therapy for TMD is to increase the mouth opening and decrease pain. Because the pathogenic pathways cannot be clearly defined, noninvasive conservative recent publications, it has been suggested as a first-line treatment method, especially for patients with acute closed lock.

Physiotherapy is an advised treatment modality for TMDs to mobilize the joint, and prevent adhesions, methods are usually preferred as the first-line treatment modality [12]. If conservative treatment fails, then surgical treatment is considered. Arthrocentesis is a minimally invasive intervention for TMDs that do not respond to conservative management. It has been hypothesized that the lavage of the superior joint space, using irrigating

fluid at hydraulic pressure, removes the adhesions and allows the disc to free itself, leading to increased mandibular motion. Studies have reported 70 to 97% success with arthrocentesis, which is indicated especially for patients with acute closed locks [5,13,14]. Consistent with previous reports, the authors found a marked decrease in pain and an increase in mouth opening capacity in the 2 groups at all intervals. In the patient group, arthrocentesis was performed after failed conservative treatment (behavioral education, occlusal therapy, and pharmacologic therapy) for a minimum of 2 months. However, in normalize muscle function and blood circulation, and thereby restore bite force [10,16]. Several physiotherapy techniques have been suggested for patients with TMDs. These include active and passive stretching exercises, computer-aided devices, low-level laser therapy, superficial heat, and therapeutic ultrasound and nerve stimulation [13,14]. Found that exercise therapy decreased pain in 80% of cases and improved the range of motion in 75% of patients with closed locks. Exercise therapy also is strongly recommended after TMJ open surgeries for preventing hypomobility and ankylosis. It prevents the formation of abnormal fibrous tissue and improves the range of mandibular motion. It has been suggested that therapeutic exercise, involving stretching of the muscle and joints, relieves pain and decreases functional impairment during the chronic phase of TMD [16]. Surgeons generally suggest physical exercises after arthrocentesis and arthroscopy procedures.

The author found relevant differences in MMO between the physiotherapy and control groups. However, a meaningful decrease in pain was observed at 1 and 3 month follow-ups of patients in the physiotherapy group.

Several exercise programs have appeared in the literature at different times [15]. However, there has been no study on the comparison of outcomes of different programs. In the present study, a self-administered exercise program was used, which is a modification of exercises that have evolved through use in many clinics.

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## تأثير التمرينات العلاجية على تقليل الألم وتحسين المدى الحركي بعد عملية بزل مفصل الفك السفلي

الغرض من الدراسة: أجريت الدراسة الحالية لتقييم تأثير التمارين العلاجية على تخفيف الألم وتحسين نطاق الحركة بعد عملية بزل مفصل الفك. أشترك في الدراسة مريضاً يحتاجون إلى بزل مفصل الفك بعد فشل العلاج الغير جراحى التحفظى. المرضى يعانون من تشريد القرص المفصلى الصدغى دون تخفيض. تم تأكيد تشخيص الحالة بواسطة الرنين المغناطيسى. تم اختيارهم من وحدة قرية.

تصفا الصحية المتكاملة، وحدة قرية أسنيت الصحية المتكاملة، مستشفى الكويتى التخصصى فى مدينة بنها. تم تشكيل مجموعة الدراسة من ٣٠ مريض.

– المجموعة الأولى : كانت تتألف من ١٥ مريضاً بدأوا فى برنامج العلاج الطبيعى الفورى بعد إجراء عملية بزل مفصل الفك.

– المجموعة الثانية :كانت مؤلفة من ١٥ مريض لم يتم البدء معها فى برنامج العلاج الطبيعى بعد إجراء عملية بزل مفصل الفك . يشمل العلاج الطبيعى برنامج تمارين علاجية لمدة ٤ أسابيع. تمت متابعة المرضى لمدة ٣ أشهر. تم قياس المد الحركى الرأسى لفتحة الفم بالمسطرة ، شدة الألم بواسطة مقياس التناظرية البصرية. وقد أظهرت النتائج فروق ذات دلالة إحصائية بين المجموعتين وكانت الأفضلية لصالح المجموعة التى استخدمت تمارين علاجية بعد عملية بزل مفصل الفك. تم إجراء الدراسة من مايو ٢٠١٨ إلى مارس ٢٠١٩.