



## **Assessment of Concentric Needle Technique for the Management of Temporomandibular Joint Internal Derangement. A Randomized Controlled Trial.**

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### **Abstract:**

**Objectives:** Assessment of concentric needle technique for the management of temporomandibular joint internal derangement in comparison with the double needle technique.

**Materials and methods:** This study was conducted on twenty patients with clinical and radiological diagnosis of TMJ internal derangement (anterior disc displacement with reduction). The patients in the study were divided into two equal groups. Magnetic resonance imaging (MRI) was performed in both groups preoperatively. The control group included ten patients that were subjected to conventional double needle arthrocentesis. The study group included ten patients that were subjected to arthrocentesis by concentric needle cannula technique. Patient's follow up will be preoperatively and postoperatively following the procedure.

**Results:** There was no significant difference between both groups regarding gender. For intergroup comparison, pre-operatively, there was no significant difference between both groups. However, at the next day, the double needle group had significantly higher pain score than the concentric needle group. For intragroup comparison, in both groups, there was a significant pain reduction the next day. Regarding edema, the difference between both groups was not statistically significant. There was no arterial or neural injury for both groups.

**Conclusions:** Double needle technique can be quite challenging. Concentric needle technique can overcome the disadvantages of double needle technique.

**Keywords:** Temporomandibular joint internal derangement-Anterior disc displacement with reduction-Concentric needle technique

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## **Introduction:**

In 1934, an otolaryngologist called Costen offered the first comprehensive explanation of TMJ symptoms. Based on a sample of eleven participants, he observed a variety of symptoms such as hearing loss, vertigo, tinnitus, headaches, popping in the TMJ, stuffiness, earaches, dry mouth, and burning in the tongue and throat. The name "Costen's syndrome" was coined to describe these symptoms. Several writers have proposed new symptoms associated with the condition throughout the years, while others have left out parts of Costen's symptoms. The name Costen's condition subsequently became obsolete and was replaced with TMJ dysfunction syndrome.<sup>1</sup>

One of the most typical manifestations of TMJ dysfunction is internal derangement where there is a disruption in the disc's internal structure that prevents it from functioning as it should with the condyle and the temporal bone.<sup>2</sup>

When the mouth is closed and the teeth are at their maximum occlusion, disc derangement with reduction is often described as a condition in which the articular disc of the TMJ is displaced, mostly anteriorly. When the joint opens, the condyle presses against the disc posterior band until it can slide or snap under it, allowing the disc to be on its normal position on the top of the condyle. The clicking noise is said to be caused by the disc's thick posterior band being overcome by the condyle. When the condyle cannot move or snap back underneath the disc, the situation is known as disc derangement without reduction. Thus, during the opening movement, the displaced disc, which is mainly anteriorly displaced, does not reduce to its position on top of the condyle. The disc prevents the condyle from translating farther, impairing the opening and contralateral movements.<sup>3</sup>

According to **Tvrđy et al**<sup>4</sup>, The first detailed description of the indications, technique and therapeutic benefit of arthrocentesis was done in 1592 in knee joint. To eliminate inflammatory mediators, free the articular disc, and dissolve adhesions between the disc's surface and the joint fossa using hydraulic pressure from the lavage solution. The temporomandibular joint arthrocentesis used nowadays originally started in 1991.

An easy, secure, and minimally invasive method of treating TMJ diseases is arthrocentesis. Following arthrocentesis, there have been reports of significant improvements in the elimination of TMJ pain when opening the mouth and decrease in clicking or popping sounds in the TMJ. The removal of bradykinin, interleukin-6, and protein from the TMJ can be accomplished using arthrocentesis.<sup>5</sup>

Arthrocentesis is a straightforward procedure that involves blocking the auriculotemporal nerve with local anaesthetic before injecting fluid into the joint.<sup>6</sup> For the operation to be effective, these two needles must triangulate and be precisely positioned in the upper joint region, which can be challenging at sometimes and is viewed as a disadvantage for this treatment.<sup>7</sup> Additional concerns include extradural hematoma, strong bradycardia, temporary

facial paresis brought on by local anaesthesia, preauricular infection swelling and swelling of the surrounding tissues.<sup>8</sup>

2008 saw the introduction of the single-puncture arthrocentesis by Guarda-Nardini et al. They performed arthrocentesis using a single needle that served as both a fluid input and output.<sup>7</sup>

A 27-gauge, 50-mm-long needle inserted into a 21-gauge, 38-mm-long needle is the idea of concentric needle technique. The larger needle hub from which the perfusate emerges is not blocked by the longer 27-gauge needle, and both needle tips are located in the same point. Lavage is done once it is inside the joint space. The use of a single puncture for both irrigation and outflow allows for effective arthrocentesis without the need for a second needle, reduces the chance of losing the proper location during lavage, and results in less pain for the patient, a lower risk of infection, and less bleeding. Additionally, a single puncture lessens postoperative pain for the patient, which lowers the need for additional treatment. Because the facial nerve is located anteriorly and medially to the glenoid fossa, right where the second needle is put, using a single needle approach lowers the chance of facial nerve injuries.<sup>9</sup>

The aim of this study was to assess the concentric needle technique for the management of temporomandibular joint internal derangement in comparison with the double needle technique.

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## **Materials and methods:**

Patients were chosen from the oral and maxillofacial surgery department's outpatient clinic at Faculty of dentistry-Cairo univeristy.

The study included 20 patients suffering from anterior disc displacement with reduction (painful click) based on the clinical and radiographic evidence.

### **Inclusion criteria:**

- 1- Patients with age ranges from 18-50.
- 2- Patients with painful clicking.
- 3- Patients free of systemic conditions that might affect the TMJ or interfere with carrying out the surgical procedure (osteoarthritis, rheumatoid arthritis, uncontrolled diabetes).

### **Exclusion Criteria:**

- 1- Patients with painless TMJ clicking.

- 2- Patients with osteo-arthritic changes of the TMJ.
- 3- Patients with systemic conditions that might affect the TMJ or interfere with carrying out the surgical procedure (osteoarthritis, rheumatoid arthritis, uncontrolled diabetes).
- 4- Patients with previous TMJ surgeries.

### **Group Allocation:**

After using a website to generate random teams, the patients were split evenly between two groups.

**(Control group):** TMJ was lavaged using double needle technique.

**(Study group):** TMJ was lavaged using concentric needle cannula technique.

Prior to surgery, every patient was given detailed information on the procedure, its risks, and the materials that will be used. They gave their consent to participate.

### **Study programme:**

All patients in both groups were subjected to the following parameters.

#### **1. Preoperative evaluation:**

##### **a) Medical history:**

Patient's medical history was reviewed to rule out the presence of any underlying diseases that might have an effect on the TMJ or make surgery more complicated (osteoarthritis, rheumatoid arthritis, uncontrolled diabetes).

##### **b) Dental history:**

Data concerning the chief complaint, its onset and duration, precipitating and reliving factors, parafunctional behaviours like bruxism, and how it relates to other activities like eating, talking, and yawning.

#### **2. Clinical examination:**

##### **a) Extra oral examination:**

It includes general examination of the TMJ and assessing pain score using visual analogue scale (VAS).(Figure 1)

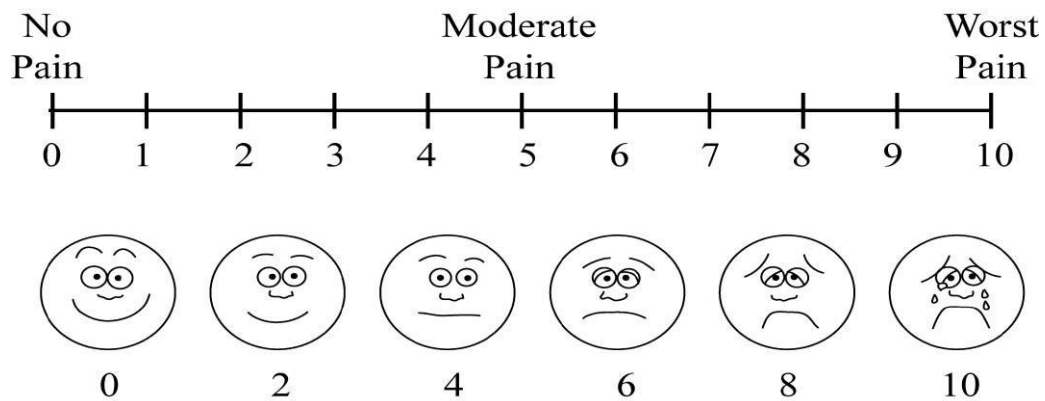


Figure (1): Visual analogue scale

**b) Intra oral examination:**

It includes evaluation of the present dentition, occlusion, restorations, premature contacts and dental causes of pain.

**3. MRI:**

MRI was taken for all patients for accurate evaluation of the disc position to the condyle.

(Figure 2,3)

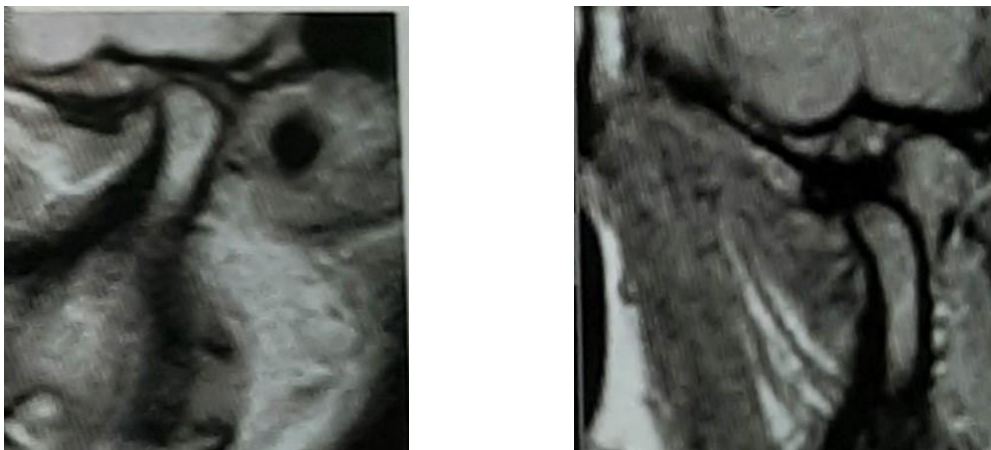


Figure2: Closed TMJ showing anteriorly displaced disc. Figure3: Open TMJ showing disc displaced. recapture.

**Treatment procedure:**

- 1- For both groups the surgical field is draped and painted with povidone iodine 7.5% (Betadine).
- 2- Auriculotemporal nerve block is done using an aspirating syringe of (alexadricaine with adrenaline 1:100,000)\*

\*ALEXANDRIA Co. PHARMACEUTICALS AND CHEMICAL INDUSTRIES\*

**a) Double needle technique (control group):**

1. A reference line is drawn from the middle of the tragus of the ear to the outer canthus of the eye.
2. The two points for needle insertion is marked. The first point which is the point of the inlet needle, is placed at a point 10 mm from the centre of the tragus and 2 mm below the canthal-tragal line. It corresponds to the glenoid fossa's.
3. The second point which is the point for the outlet needle, is placed at a point 20 mm from the centre of the tragus and 10 mm below the canthal-tragal line. This point represents the articular eminence's.
4. Those landmarks help in inserting the two needles in the upper joint space.
5. TMJ lavage is done by 100 ml of lactated ringer solution. (Figure 4)

**b) Concentric needle cannula technique (Study group):**

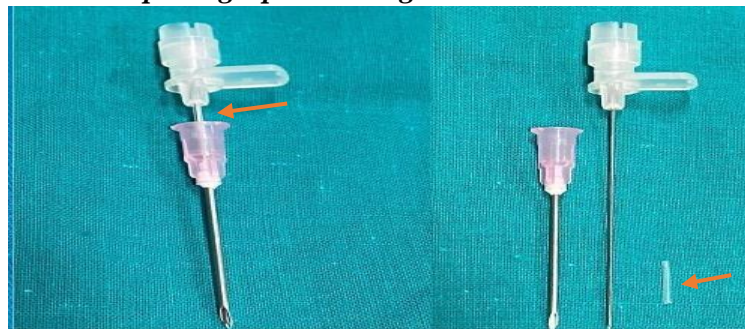
1. The single-needle method uses a single puncture for both irrigation and outflow. The idea in this technique is inserting the needle of cannula gauge 20 into needle of plastic syringe 20 ml. After that, approximately 3–4 mm of the cannula is retracted to allow the tip of the it to be flushed with the end needle of the plastic syringe. This is done by cutting a small piece of the plastic cover of the cannula and using it as a stopper. (Figure 5)
2. A reference line is drawn from the middle of the tragus of the ear to the outer canthus of the eye.
3. According to **Öreroğlu et al**, A puncture mark is made 10 mm from the tragus and 0.5 mm below this line <sup>9</sup>.
4. The patient is instructed to open the mouth halfway so that the needle-cannula unit can be put into the upper joint space.
5. 100 cc of the lactated ringer solution is used to do lavage once being inside the joint space. (Figure 6)

**c) For both groups:**

The cases with edema were postponed to the next week. Complications during and after the arthrocentesis procedure were documented.



*Figure 4: Clinical photograph showing double needle arthrocentesis case*



*Figure 5: Concentric needle cannula, the arrow showing the stopper*



*Figure 6: Clinical photograph showing concentric needle cannula arthrocentesis case*

### **Follow up:**

Immediate post operatively all the patients in both groups:

- 1- Will be instructed to put hot fomentation, avoid any sticky food and prescribed a soft diet and Paracetamol\* 500 mg tablet every 8 hours for 7 days.
- 2- The patients were then followed up clinically at 1day postoperatively to measure the pain score (VAS).

\*Paracetamol, El Nasr Pharmaceutical Chemicals Co. “ADWIC” – ARE.

### **Statistical analysis:**

Categorical data were presented as frequency and percentage values and were analyzed using Fisher’s exact test. Numerical data were presented as mean and standard deviation values. They were explored for normality by checking the data distribution using ShapiroWilk test. VAS data were non-parametric and were analyzed using Mann-Whitney U test for intergroup comparisons and signed rank test for intragroup comparisons. Age data were parametric and were analyzed using independent t-test. The significance level was set at  $p \leq 0.05$  within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows<sup>1</sup>.

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<sup>1</sup> R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.



## **RESULTS:**

Twenty patients (6 males and 14 females) with an average age of 34 years (range from 18 to 50 years) were chosen for this study from the outpatient clinic at the department of oral and maxillofacial surgery-Faculty of dentistry, Cairo University-Egypt.

- All patients were suffering from anterior disc displacement with reduction.
- Eligible patients were divided into two equal proportions between concentric needle cannula technique (Study group) and double needle technique (control group).

All patients were included for statistical analysis.

### **1- Demographic data:**

Intergroup comparisons and summary statistics for demographic data were presented in table (1)

The study was conducted on 20 cases that were equally and randomly allocated to each of the tested groups (i.e. 10 cases each). There was 2(20.0%) males in the concentric needle group and 8 (80.0%) females. While in the double needle group there was 4(40.0%) males and 6(60.0%) females. The mean age of the cases in the concentric needle group was (23.90±13.17) years while in the double needle group it was (28.70±11.50) years. There was no significant difference between both groups regarding gender (p=0.628) and age (p=0.397).

**Table (1): Intergroup comparisons and summary statistics for demographic data**

Parameter			Concentric needle	Double needle	p-value
Gender	Male	n	2	4	0.628ns
		%	20.0%	40.0%	
	Female	n	8	6	
		%	80.0%	60.0%	
Age (years)	Mean±SD	23.90±13.17	28.70±11.50	0.397ns	

\*, significant ( $p \leq 0.05$ ) ns; non-significant ( $p > 0.05$ )

## 2- Pain score (VAS):

Inter, intragroup comparison, mean and standard deviation (SD) values of pain score (VAS) were presented in table (2)

### A- Intergroup comparison:

Pre-operatively, there was no significant difference between both groups ( $p=0.819$ ). However, at the next day, double needle group had significantly higher pain score than concentric needle group ( $p=0.025$ ).

### B- Intragroup comparison:

In both groups, there was a significant pain reduction the next day ( $p<0.05$ ).

*Table (2): Inter, intragroup comparison, mean and standard deviation (SD) values of pain score (VAS)*

Interval	Pain score (VAS) (mean±SD)		p-value
	Concentric needle	Double needle	
Pre-operative	4.60±1.78	5.10±2.88	<b>0.819ns</b>
Next day	1.60±1.35	3.60±2.07	<b>0.025*</b>
p-value	<b>0.006*</b>	<b>0.008*</b>	

\*; significant ( $p \leq 0.05$ ) ns; non-significant ( $p>0.05$ )

## 3- Edema:

Intergroup comparison, frequency and percentage values of edema incidence for different groups were presented in table (3)

In concentric needle group, 2 (20%) cases had edema, while in double needle group 4(40.0%) cases were edematous and the difference between both groups was not statistically significant ( $p=0.628$ ).

**Table (3): Mean  $\pm$  standard deviation (SD) of edema incidence for different groups**

Edema		Concentric needle	Double needle	p-value
No	n	8	6	0.628ns
	%	80.0%	60.0%	
Yes	n	2	4	
	%	20.0%	40.0%	

\*; significant ( $p \leq 0.05$ ) ns; non-significant ( $p > 0.05$ )

## **Discussion:**

The treatment of temporomandibular joint (TMJ) abnormalities advanced during the 1990s from a series of procedures performed by maxillofacial surgeons who were not specialists to an increasing number of sub-specialist-lead practices.<sup>10</sup>

Roughly 10% of the population suffers from temporomandibular joint (TMJ) problems. The oral and maxillofacial clinic faces difficulty in treating TMJ dysfunction. Although there are numerous aetiologic variables that can lead to TMJ pain and dysfunction, inflammation has been recognized as a primary contributor to both of these problems. Patients with TMD who experience pain and discomfort for a prolonged period of time will have radiographic and biochemical evidence of inflammation.<sup>11</sup> Joint discomfort and limited mandibular motion are the most noticeable signs. There is also, joint sounds like clicking and crepitation. Increased amounts of pro-inflammatory interleukins, matrix-degrading enzymes, and reactive cytokines are frequently found in the synovial fluid of inflamed TMJs.<sup>12</sup>

Internal derangement comes in females more than males especially at the age of 40s.<sup>13</sup> The unequal prevalence of women and men in is attributable to hormonal, anatomical, behavioural, and hereditary factors, and this was in accordance with the results of our thesis where 14 out of the 20 cases were females.

The first detailed description of the indications, technique and therapeutic benefit of arthrocentesis was in 1592 by **Fray Augustin Farfan** in knee joint. To eliminate inflammatory mediators, free the articular disc, and dissolve adhesions between the disc's surface and the joint fossa using hydraulic pressure from the lavage solution, **Nitzan et al**<sup>14</sup> originally reported temporomandibular joint arthrocentesis in 1991.<sup>14</sup> Following arthrocentesis, there have been reports of significant improvements in the elimination of TMJ pain when opening the mouth and decrease in clicking or popping sounds in the TMJ. The removal of bradykinin, interleukin-6, and protein from the TMJ can be accomplished using arthrocentesis.<sup>5</sup>

Arthrocentesis can be done by several techniques like double puncture technique, in which two needles are inserted through two separate puncture sites<sup>5</sup> or concentric needle technique through single puncture site.<sup>9</sup>

In the present study where comparing double needle technique to concentric needle technique, MRI was taken to all 20 patients to confirm the clinical diagnosis. MRI imaging has several obvious benefits, including the fact that it is less invasive, less reliant on operator experience, and more accurate for disc displacements to the medial and lateral sides.<sup>15</sup>

In our study, 100 ml of Ringer solution was used for irrigation and lavage of TMJ and this was in agreement with **Zardenteta et al**<sup>16</sup> who stated that 100 ml of total irrigation is enough for irrigation and lavage of TMJ.

**Nardini et al**<sup>17</sup> suggested a new technique to improve the tolerability of TMJ arthrocentesis by using a single needle for both input and output of the injected solution instead of using two needles. While placing a second needle can compromise the stability of the first one, placing a single needle should enable stable access to the joint region. By using just one, less trauma is caused by the intervention, which lessens postoperative discomfort and disability for the patients.

This factor becomes even more significance when taking into account the dangers of postoperative facial nerve paresthesia, which is a potential side effect of the conventional 2needle arthrocentesis. In this study, we emphasize the idea of single puncture TMJ arthrocentesis to overcome the disadvantages of the two needle technique.

**Oreroglu et al**<sup>9</sup> described the concentric needle technique which is inserting a 27-gauge, 50-mm long needle into a 21-gauge, 38-mm-long needle. The larger needle hub from which the perfusate emerges is not blocked by the longer 27-gauge needle, and both needle tips are located in the same point similar to the technique used in this study.

**Skarmeta et al**<sup>18</sup> made a variation of the TMJ arthrocentesis technique reported by **Oreroglu et al**, by using a 20-gauge 30-mm or 32-mm intravenous catheter replacing the two concentric needles. This technique was easy, cheap and less traumatic for the patient. This agrees with the results of our study.

**Nagori et al**<sup>7</sup> suggested using 2 peripheral intravenous catheters of different gauges. A 16-gauge catheter of length 45 mm and a 22-gauge catheter of length 25 mm. First, the 22-gauge needle which acts as the input port and the solution flows out through the 16-gauge catheter tube which acts as an output. This technique is simple, cheap and tolerated by the patients. This results of this study agrees with the results of our study.

**Khaleeq et al**<sup>19</sup> found that the insertion of two cannulas can be difficult at sometimes, so they suggested using a single **Shepard cannula** which has two ports and two lumens, and this allows both irrigation and washout through the same device. This improves the probability of success and makes the procedure less difficult. They have used this cannula for more than 10 years for over 100 procedures with no complications. The problem with **Shepard cannula** is that it isn't easily available in all countries. The **Shepard cannula** implies the concept of a single puncture instead of double puncture like the concentric needle technique used in this study.

**Talaat et al**<sup>20</sup> compared between two groups of patients who underwent TMJ arthrocentesis where in the first group, they used **Shepard cannula** and in the second group, they used the standard technique. The follow up was post-operative, 1 day, 1 month, 3

months and 6 months. In both treatment groups, significant improvement in pain scores with respect to the baseline levels was achieved for all patients during the 6 months follow-up period. The differences between groups were not significant, except in terms of the immediate postoperative value.

In this study, The concentric needle group showed less pain scores than the double needle group and this agrees with **Oreroglu et al**<sup>9</sup> who stated that concentric needle technique in TMJ arthrocentesis yields less patient discomfort as a single puncture is made and no need for second puncture eliminating the pain and discomfort resulting from multiple insertion of the second needle to put in the correct position.

**Günay Yapici Yavuz et al**<sup>21</sup> stated that complications can occur in TMJ arthrocentesis due to the proximity to the cranial region, vascular, and nerve tissues. These complications include temporary swelling of periauricular region, hemorrhage due to injury of superficial temporal artery and nerves injury like facial, inferior alveolar and lingual nerves. In the current study, no arterial and/or nerve injuries occurred while there were two cases with temporary swelling of preauricular region due to fluid extravasation in the concentric needle group and four cases in the double needle group that was resolved less than one day, the difference between both groups was not statistically significant and the work was postponed 1 week for these cases not to affect the results of the VAS and to assure the patients due to pain from the extravasated fluids.

## **Conclusion:**

- 1- Arthrocentesis is an effective and simple technique for treatment of TMJ disc displacement with minimal complications.
- 2- Double needle technique can be quite challenging.
- 3- Concentric needle technique can overcome the disadvantages of double needle technique

## **Recommendations:**

- 1- To confirm the findings of this study and to obtain more accurate results, additional research with a larger sample size is required.

## **References:**

1. MOSS RA, GARRETT JC. Temporomandibular joint dysfunction syndrome and myofascial pain dysfunction syndrome: a critical review. *J Oral Rehabil.* 1984;11(1):3-28.
2. Gouda AM, Abd Elrahman H, Askar NA. Single Needle versus Double Needle Arthrocentesis for Management of patients with closed lock of tempromandibular joint. *Dent J.* 1804;56(1797):2010.
3. Reny de Leeuw DDS. Internal Derangements of the Temporomandibular Joint.
4. Tvrdy P, Heinz P, Pink R. Arthrocentesis of the temporomandibular joint: a review. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub.* 2015;159(1):31-34.
5. AL-Said SN, Shawky N, Ragab HR. Comparative study of arthrocentesis with or without using piroxicam in the management of temporomandibular joint disorders. *Alexandria Dent J.* 2015;40(2):160-165.
6. Kuruvilla VE, Prasad K. Arthrocentesis in TMJ internal derangement: a prospective study. *J Maxillofac Oral Surg.* 2012;11(1):53-56.
7. Nagori SA, Chattopadhyay PK, Pathy KK, Dua G. The double intravenous catheter technique for single-puncture arthrocentesis. *J Craniofac Surg.* 2017;28(7):e603-e605.
8. Vaira LA, Raho MT, Soma D, et al. Complications and post-operative sequelae of temporomandibular joint arthrocentesis. *CRANIO®.* 2018;36(4):264-267.
9. Öreroğlu AR, Özkaya Ö, Öztürk MB, Bingöl D, Akan M. Concentric-needle cannula method for single-puncture arthrocentesis in temporomandibular joint disease: an inexpensive and feasible technique. *J oral Maxillofac Surg.* 2011;69(9):2334-2338.
10. Sidebottom AJ. Current thinking in temporomandibular joint management. *Br J Oral Maxillofac Surg.* 2009;47(2):91-94.
11. ChanDraSheKhar VK, KenChappa U, Chinnannavar SN, Singh S. Arthrocentesis a minimally invasive method for TMJ disc disorders-A prospective study. *J Clin Diagnostic Res JCDR.* 2015;9(10):ZC59.

12. Vos LM, Slater JJRH, Stegenga B. Arthrocentesis as initial treatment for temporomandibular joint arthropathy: a randomized controlled trial. *J CranioMaxillofacial Surg.* 2014;42(5):e134-e139.
13. Önder ME, Tüz HH, Koçyiğit D, Kişnişci RŞ. Long-term results of arthrocentesis in degenerative temporomandibular disorders. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology.* 2009;107(1):e1-e5.
14. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular Joint Arthrocentesis: A Simplified Treatment for Severe, Limited Mouth Opening. *J Oral maxillofac surf* 1991;49:1163-7.
15. Westesson P-L. Reliability and validity of imaging diagnosis of temporomandibular joint disorder. *Adv Dent Res.* 1993;7(2):137-151.
16. Zardeneta G, Milam SB, Schmitz JP. Elution of proteins by continuous temporomandibular joint arthrocentesis. *J oral Maxillofac Surg.* 1997;55(7):709-716.
17. Guarda-Nardini L, Manfredini D, Ferronato G. Arthrocentesis of the temporomandibular joint: a proposal for a single-needle technique. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology.* 2008;106(4):483-486.
18. Skármeta NP, Pesce MC, Espinoza-Mellado PA. A single-puncture arthrocentesis technique, using a peripheral intravenous catheter. *Int J Oral Maxillofac Surg.* 2016;45(9):1123-1125.
19. Rehman K-U, Hall T. Single needle arthrocentesis. *Br J Oral Maxillofac Surg.* 2009;47(5):403.
20. Talaat W, Ghoneim MM, Elsholkamy M. Single-needle arthrocentesis (Shepard cannula) vs. double-needle arthrocentesis for treating disc displacement without reduction. *CRANIO®.* 2016;34(5):296-302.
21. Yavuz GY, Keskinruzgar A. Evaluation of complications of arthrocentesis in the management of the temporomandibular joint disorders. *Galore Int J Heal Sci Res.* 2018;3:50-53.