

Comparison of Double-Puncture and Single-Puncture Arthrocentesis in the Management of Unilateral Temporomandibular Joint Disc Displacement Without Reduction

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Abstract

Temporomandibular joint (TMJ) disorders represent a group of conditions affecting the masticatory muscles, temporomandibular joint, and associated structures. Disc displacement without reduction is a common intra-articular disorder characterized by pain and restricted mouth opening. Arthrocentesis has become a widely accepted minimally invasive treatment modality for patients who do not respond to conservative therapy. Traditionally, the procedure is performed using a double-puncture technique; however, single-puncture arthrocentesis has been introduced as a simplified alternative. This article compares the clinical effectiveness of double-puncture and single-puncture arthrocentesis in the management of unilateral temporomandibular joint disc displacement without reduction. Parameters such as pain reduction, improvement in mouth opening, joint function, and patient satisfaction are considered.

Aim : To Compare the clinical efficiency of the conventional double puncture versus single puncture type 2 arthrocentesis for management of temporomandibular joint disc displacement without reduction (DDWOR).

Materials and methods: Twenty-six patients with DDWOR were randomly and blindly assigned to two treatment groups (n = 13 each). Group 1, conventional double puncture arthrocentesis; Group 2, single puncture type 2 arthrocentesis. Data on gender, side of painful joint complaint, age (years), duration of joint pain (months), maximum interincisal distance (MID – mm), and pain intensity self-reported with a visual analogue scale (VAS; 0-10) were collected. VAS scores and MID were measured before (baseline) and 6 months after arthrocentesis (final).

Results: Both techniques resulted in significantly reduced VAS scores and increased MID ($p=0.001$) after 180 days. However, no statistically significant difference was observed between the techniques ($p > 0.05$).

Conclusion: Two arthrocentesis methods tested were effective in reducing VAS scores and increasing MID in patients with DDWOR.

Keywords: temporomandibular joint disorders; disc displacement without reduction; arthrocentesis.

Introduction

Temporomandibular disorders (TMDs) constitute a group of musculoskeletal conditions affecting the temporomandibular joint and associated structures. These disorders commonly present with symptoms such as pain in the joint region, limitation of mandibular movement, joint sounds, and functional disturbances during mastication or speech (1).

Among the different forms of TMD, internal derangement of the temporomandibular joint is frequently encountered. Disc displacement without reduction, commonly referred to as **closed lock**, occurs when the articular disc is displaced anteriorly and fails to return to its normal position during mouth opening (2). This results in restricted mouth opening, pain in the joint region, and impaired mandibular function.

Conservative treatment modalities such as pharmacotherapy, physiotherapy, occlusal splints, and behavioural therapy are usually recommended as the first line of management (3). However, when these approaches fail to provide adequate relief, minimally invasive procedures such as arthrocentesis are considered.

Arthrocentesis is a lavage technique that involves irrigation of the superior joint space with physiological solutions to remove inflammatory mediators and release intra-articular adhesions (4). Traditionally, the procedure is performed using a **double-puncture technique**, in which two needles are inserted into the joint space. Recently, a **single-puncture technique** has been introduced as a simplified alternative with potentially reduced surgical trauma (5).

This article aims to compare the effectiveness of these two techniques in the management of unilateral temporomandibular joint disc displacement without reduction.

Disc displacement without reduction may develop due to several factors including trauma, parafunctional habits such as bruxism, occlusal abnormalities, and degenerative joint changes (6).

In this condition, the articular disc is displaced anteriorly relative to the mandibular condyle. During mouth opening, the condyle is unable to translate normally due to mechanical obstruction caused by the displaced disc. As a result, patients experience restricted mandibular movement and pain.

Inflammatory mediators accumulate within the joint space, leading to synovitis and increased intra-articular pressure. In addition, fibrous adhesions may develop between the articular

surfaces, further restricting joint mobility (7). Arthrocentesis helps to eliminate these inflammatory mediators and release adhesions, thereby improving joint movement.

Materials and methods:

This randomized controlled trial was conducted in accordance with established ethical standards and received approval from the Ethics and Research Committee of the Faculty of Dental Sciences, Rama University, Kanpur, Uttar Pradesh. All patients freely signed an informed consent form before participating in the study.

Sample:

Sample calculation was conducted with 80% power and 5% significance level. After adding 10% to compensate for possible losses and refusals, the final sample size was 26, which was equally divided into 2 groups (n=13): Group 1, conventional double puncture arthrocentesis; Group 2, single puncture type 2 arthrocentesis. Patients were blinded to the procedures and allocated to the groups by a computer-generated randomization draw performed immediately before the procedure. All arthrocentesis was conducted by a single experienced professional. Patients were followed for 7, 14, 30, 60, 90 and 180 days. After arthrocentesis, 1 mL of hyaluronate (SH) 10 mg was infiltrated in the upper TMJ compartment in all patients. Besides SH injections, no other treatment was applied after arthrocentesis during the follow-up period. The study sample included individuals of both genders aged over 18 years who presented with clinical signs and symptoms of intra-articular temporomandibular disorders consistent with DDWOR, accompanied by joint pain (acute or chronic, unilateral or bilateral), and who had not responded to conservative management—such as inter-occlusal appliances, anti-inflammatory medications, warm compresses, a soft diet, and physiotherapy—for a minimum of three months.

The diagnosis of DDWOR was established through a combination of clinical examination based on the Research Diagnostic Criteria for Temporomandibular Disorders. Patients with rheumatoid arthritis, condylar agenesis, hypoplasia or malignancy, bony ankylosis, a history of prior TMJ surgery, muscular disorders, or previous arthrocentesis (with or without adjunctive substances), as well as those with extreme anxiety, were excluded from the study.

Data were collected by a second blinded evaluator who was unaware of group allocation. The recorded variables included gender, side of joint pain, age (in years), duration of pain (in months), maximum interincisal distance (MID) measured in millimeters using a digital caliper, and pain intensity assessed using a self-reported visual analogue scale (VAS; 0–10).

Data for the variables MID and VAS were collected before (baseline) and 180 days after arthrocentesis (final).(18)

Arthrocentesis of the Temporomandibular Joint

Arthrocentesis is considered a minimally invasive surgical procedure used in the management of internal derangement of the TMJ. The technique involves lavage of the upper joint compartment using saline or lactated Ringer's solution.

The main objectives of arthrocentesis include:

- Removal of inflammatory mediators from the joint space
- Reduction of intra-articular pressure
- Release of fibrous adhesions
- Improvement of synovial fluid circulation
- Restoration of mandibular function

Due to its simplicity and effectiveness, arthrocentesis is widely accepted as an intermediate treatment option between conservative therapy and more invasive surgical procedures (8).

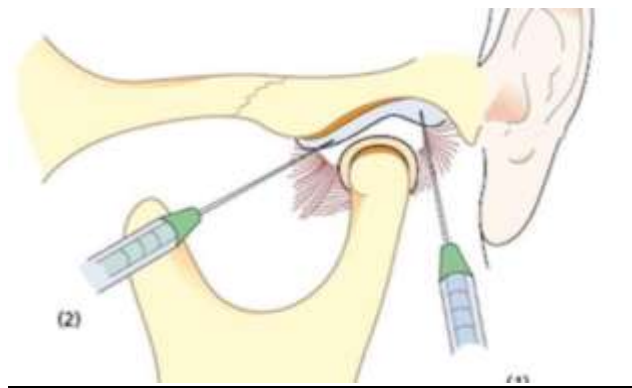


Fig 1 . Arthrocentesis of temporomandibular joint

Double-Puncture Arthrocentesis Technique

The double-puncture technique is the conventional method used for TMJ arthrocentesis. In this procedure, two needles are inserted into the superior joint space at predetermined anatomical landmarks.

The posterior needle acts as the inlet for irrigation fluid, while the anterior needle serves as the outlet. Saline solution is circulated through the joint cavity to flush out inflammatory mediators and debris (9).

This method provides effective lavage and ensures continuous fluid circulation. However, accurate placement of two needles can be technically demanding and may cause additional tissue trauma.

- **Reference Line:** A straight line is drawn from the mid-portion of the auricular tragus to the lateral corner of the eye (canthus).

- **Posterior Point (P1 - Inflow):** 10 mm forward from the tragus and 2 mm below the line.
- **Anterior Point (P2 - Outflow):** 20 mm forward from the tragus and 10 mm below the line.
- **Needle Depth:** The needles are generally inserted to a depth of about 20–25 mm¹¹

These markings are designed to target the superior joint space of the temporomandibular joint (TMJ) for irrigation



Fig 2. Double puncture arthrocentesis technique

Single-Puncture Arthrocentesis Technique

Single-puncture arthrocentesis was developed as a modification of the conventional technique. In this method, a specially designed cannula or dual-lumen needle is inserted into the joint space through a single entry point.

Both the inflow and outflow of irrigation fluid occur through the same device, thereby eliminating the need for a second puncture site (10).

The advantages of this technique include reduced operative time, minimal tissue trauma, and easier performance compared to the traditional method.

Single puncture arthrocentesis for the temporomandibular joint (TMJ) utilizes a primary needle entry point located 10 mm anterior and 2 mm inferior to the middle of the tragus, along the canthotragal line.

This point is identified with the patient's mouth closed to target the upper joint space or with the mouth open to maximize space, aiming for the posterior aspect of the glenoid fossa.(18)

- **Reference Line** :A line is drawn connecting the center of the tragus to the lateral canthus of the eye.
- **Primary Puncture Point**: 10 mm forward from the tragus and 2 mm below the tragal-canthal line.
- **Secondary Reference (for optional 2nd needle/outflow)**: 20 mm anterior to the tragus and 10 mm below the tragal-canthal line, indicating the articular eminence.
- **Procedure**: A single, specialized needle (or two soldered needles) is inserted into the posterior-superior joint space.
- **Movement**: The mandible is moved through opening, closing, and lateral excursions to facilitate adhesion lysis'.⁽¹¹⁾

This technique, often termed "Type 1" (one cannula) or "Type 2" (two soldered needles), aims to simplify the traditional double-puncture method.

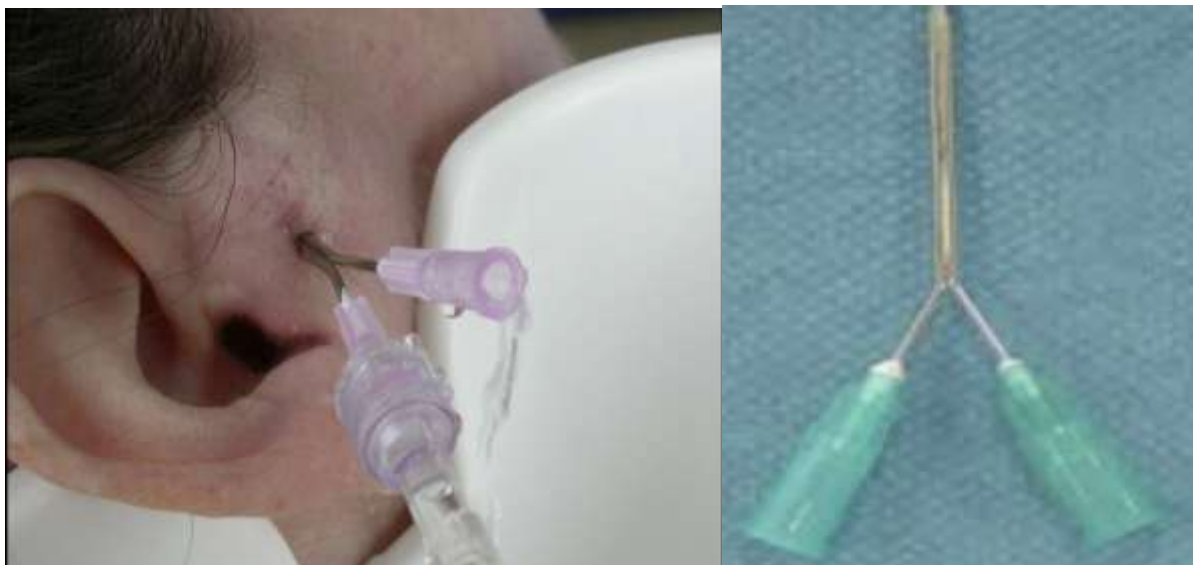


Fig 2. Single puncture arthrocentesis technique

Table 1: Demographic and Clinical Characteristics of Patients

Variable	Double-Puncture Group (n=13)	Single-Puncture Group (n=13)	p-value
Age (years, mean $\pm$ SD)	30.8 $\pm$ 7.6	37.4 $\pm$ 10.2	0.073
Female, n (%)	12 (92.3%)	11 (84.6%)	0.999
Male, n (%)	1 (7.7%)	2 (15.4%)	
Right side involvement	5 (38.5%)	9 (69.2%)	0.238
Left side involvement	8 (61.5%)	4 (30.8%)	
Duration of pain (months, median)	9 (6–16)	8 (6–8.5)	0.244

Table 2: Comparison of Maximum Interincisal Distance (MID) Statistical analysis:

Group	Baseline MID (mm)	6-Month MID (mm)	p-value
Double-Puncture	31.1 $\pm$ 2.3	42.0 $\pm$ 3.2	0.001*
Single-Puncture	31.3 $\pm$ 2.5	42.3 $\pm$ 3.5	0.001*

Table 3: Comparison of Pain Scores (VAS)

Group	Baseline VAS	6-Month VAS	p-value
Double-Puncture	7.0 $\pm$ 1.1	0.2 $\pm$ 0.4	0.001*
Single-Puncture	8.0 $\pm$ 1.3	0.4 $\pm$ 0.6	0.001*

Table 4: Overall Clinical Outcome

Outcome	Double-Puncture	Single-Puncture
Pain reduction	Significant	Significant
Mouth opening improvement	Significant	Significant
Complications	None	None
Overall success rate	High	High

Table: Mean VAS Score Before and After Arthrocentesis

Group	Baseline VAS Score (Mean $\pm$ SD)	6-Month VAS Score (Mean $\pm$ SD)	Mean Reduction	p-value
Double-Puncture Arthrocentesis	7.0 $\pm$ 1.1	0.2 $\pm$ 0.4	6.8	0.001*

Group	Baseline VAS Score (Mean $\pm$ SD)	6-Month VAS Score (Mean $\pm$ SD)	Mean Reduction	p-value
Single-Puncture Arthrocentesis	8.0 $\pm$ 1.3	0.4 $\pm$ 0.6	7.6	0.001*

Statistical analysis:

Statistical analysis was conducted using SPSS version XX. The Student's t-test and Mann–Whitney test were applied, and a p-value of < 0.05 was considered statistically significant.

Result:

A total of 26 patients with unilateral temporomandibular joint disc displacement without reduction were included in the study. They were randomly allocated into two groups: Group I (double-puncture arthrocentesis) and Group II (single-puncture arthrocentesis), with 13 patients in each group.

Demographic Characteristics

The mean age of patients in the double-puncture group was 30.8 ± 7.6 years, while in the single-puncture group it was 37.4 ± 10.2 years. Females constituted the majority of the study population, accounting for 92.3% in Group I and 84.6% in Group II. There was no statistically significant difference between the groups with respect to demographic characteristics ($p > 0.05$).

Maximum Interincisal Distance (MID)

The mean maximum interincisal distance showed significant improvement in both groups following arthrocentesis.

In the double-puncture group, the mean MID increased from 31.1 ± 2.3 mm at baseline to 42.0 ± 3.2 mm at 6 months.

Similarly, in the single-puncture group, the mean MID increased from 31.3 ± 2.5 mm at baseline to 42.3 ± 3.5 mm at 6 months.

The improvement in mouth opening within both groups was statistically significant ($p = 0.001$). However, when the two groups were compared, no statistically significant difference was observed between them ($p > 0.05$).

Pain Assessment (VAS Score)

Pain intensity was evaluated using the Visual Analog Scale (VAS). Both groups demonstrated a marked reduction in pain following arthrocentesis.

In the double-puncture group, the mean VAS score decreased from 7.0 ± 1.1 at baseline to 0.2 ± 0.4 after 6 months.

In the single-puncture group, the mean VAS score decreased from 8.0 ± 1.3 at baseline to 0.4 ± 0.6 after 6 months.

A statistically significant reduction in pain was observed within both groups ($p = 0.001$); however, no significant difference was found between the two groups in terms of pain reduction.

Complications

No major intraoperative or postoperative complications were reported in either group. All patients tolerated the procedure well, and no cases of infection, facial nerve injury, or persistent swelling were observed.

Overall Outcome

All 26 patients complete the study. No interurrences or complications were observed during or after the procedures. Both treatment groups demonstrated statistically significant improvement in pain reduction and mouth opening when compared with baseline values ($p < 0.05$)¹¹. No significant difference was observed between the single-puncture and double-puncture groups in terms of VAS scores or MID improvement^{10, 11}.

No major intraoperative or postoperative complications were reported, confirming the safety of both techniques⁸.

Comparison of Both Techniques

Both single-puncture and double-puncture arthrocentesis aim to improve joint function by eliminating inflammatory mediators and releasing adhesions within the joint space.

The double-puncture technique allows continuous irrigation through separate inlet and outlet needles, which may enhance lavage efficiency. However, the requirement of two needle insertions can make the procedure more technically challenging.

In contrast, the single-puncture technique simplifies the procedure and reduces the risk of tissue trauma. Clinical studies have shown that both techniques produce comparable improvements in pain reduction and mandibular mobility (10).

The selection of technique often depends on surgeon preference, patient factors, and the clinical situation.

Discussion

Temporomandibular joint disc displacement without reduction (DDWOR) is a common intra-articular disorder characterized by persistent anterior displacement of the articular disc relative to the mandibular condyle. Clinically, the condition often presents with pain, restricted mouth opening, and deviation of the mandible during opening movements². The primary aim of treatment is to reduce pain, restore mandibular mobility, and improve overall joint function.

While conservative therapies remain the first line of management, arthrocentesis has emerged as a reliable minimally invasive intervention for patients who do not respond adequately to non-surgical approaches^{3,4}.

Arthrocentesis involves lavage of the superior joint compartment of the TMJ using sterile irrigating solution. The therapeutic effects of this procedure are largely attributed to the mechanical removal of inflammatory mediators, breakdown of adhesions, and reduction of intra-articular negative pressure³. In addition, hydraulic distension of the joint space may help restore normal disc-condyle movement and improve lubrication within the joint⁴.

The present study evaluated and compared the clinical outcomes of the conventional double-puncture technique and the single-puncture arthrocentesis technique in the management of unilateral DDWOR. Both techniques demonstrated significant improvement in pain reduction and maximum interincisal distance following treatment. These findings suggest that arthrocentesis, regardless of the puncture technique used, can effectively improve joint function and patient comfort.

The reduction in pain observed in this study may be explained by the removal of inflammatory mediators such as prostaglandins, cytokines, and bradykinin from the joint space. These substances are known to contribute to synovial inflammation and pain perception in temporomandibular joint disorders^{3,4}. By flushing the joint with saline solution, arthrocentesis helps dilute and remove these mediators, thereby decreasing nociceptive stimulation and reducing patient discomfort.

Improvement in mandibular mobility following arthrocentesis is another important outcome. Restricted mouth opening in DDWOR is often caused by mechanical obstruction due to disc displacement, as well as the formation of intra-articular adhesions. The hydraulic pressure generated during lavage can disrupt these adhesions and increase joint space mobility, allowing improved condylar translation⁸. As a result, patients often experience a measurable increase in mouth opening following the procedure.

The findings of the present study are in agreement with earlier research reporting comparable improvements in pain relief and mandibular mobility following arthrocentesis. Multiple clinical studies comparing single-puncture and double-puncture techniques have demonstrated that both methods yield similar outcomes with respect to pain reduction and functional improvement^{10,11}. These observations suggest that the therapeutic efficacy of arthrocentesis is largely attributable to joint lavage and hydraulic distension rather than the number of needle entry points.

Despite the comparable clinical outcomes, the single-puncture technique offers several practical advantages. Because only one entry point is required, the procedure may be associated with reduced surgical trauma and improved patient comfort⁹. In addition, the single-puncture technique may decrease operative time and simplify the surgical procedure, particularly in patients with limited joint space or difficult anatomical access. These factors may make the technique particularly attractive for clinicians seeking a minimally invasive treatment approach.

However, the single-puncture technique also has certain limitations. The use of specialized double-lumen cannulas or dedicated devices may increase procedural cost and may not be readily available in all clinical settings¹². Furthermore, precise placement of the cannula within the superior joint compartment can sometimes be technically challenging, especially in patients with severe joint degeneration or reduced joint space.

In contrast, the conventional double-puncture technique remains widely practiced and well documented in the literature. The use of two separate needles allows a clear inflow and outflow pathway for irrigation fluid, which may provide more controlled lavage of the joint cavity³. For many surgeons, this technique remains the standard approach because of its simplicity and reliability.

Another important factor influencing treatment outcome is the duration of symptoms prior to intervention. Several studies have suggested that earlier treatment of DDWOR may lead to better clinical outcomes, as prolonged disc displacement can result in degenerative changes within the joint structures¹⁵. Early intervention may therefore prevent progression of the disorder and improve the likelihood of successful treatment.

The results of this study should be interpreted in light of certain limitations. The sample size was relatively small, and the follow-up period was limited. Larger multicenter studies with longer follow-up durations would be valuable to further evaluate the long-term effectiveness of these techniques. Additionally, postoperative imaging such as magnetic resonance imaging could provide further insight into structural changes within the joint following arthrocentesis.

Despite these limitations, the present study supports the growing body of evidence indicating that arthrocentesis is an effective minimally invasive treatment for temporomandibular joint disc displacement without reduction. Both single-puncture and double-puncture techniques appear to offer similar clinical benefits, allowing clinicians flexibility in selecting the most appropriate method based on surgical preference, available equipment, and individual patient characteristics.

Clinical Outcomes

The success of arthrocentesis procedures is generally evaluated using several clinical parameters, including:

- Pain intensity using visual analog scale (VAS)
- Maximum mouth opening
- Muscle tenderness
- Joint function
- Patient satisfaction

Numerous studies have reported significant improvement in these parameters following arthrocentesis for TMJ disc displacement without reduction (4,9).

Conclusion

Temporomandibular joint disc displacement without reduction is a condition that can significantly impair mandibular function and quality of life. Arthrocentesis has proven to be an effective minimally invasive treatment modality for patients who fail to respond to conservative therapy.

Both double-puncture and single-puncture arthrocentesis techniques are effective in reducing pain and improving mandibular mobility. While the double-puncture technique allows more efficient lavage of the joint space, the single-puncture method offers a simpler and less invasive approach.

Further clinical studies with larger sample sizes and longer follow-up periods are required to determine the long-term outcomes and relative superiority of these techniques.

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