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Evaluation of Arthrocentsesis in Treatment of TMJ Dysfunction

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ABSTRACT

Background: Temporomandibular joint (TMJ) dysfunction is a common clinical disorder presenting with pain, restricted mandibular movement, and functional limitation. Although conservative management is effective in many cases, a subset of patients remains symptomatic and requires minimally invasive intervention. Arthrocentsesis is increasingly used as a therapeutic procedure for TMJ dysfunction due to its simplicity, minimal morbidity, and favorable clinical outcomes. **Aim:** To clinically and statistically evaluate the effectiveness of arthrocentesis in the management of temporomandibular joint dysfunction. **Materials and Methods:** This prospective clinical study was conducted on 30 patients diagnosed with temporomandibular joint dysfunction who failed to respond to conservative therapy for at least three months. Arthrocentesis was performed under local anesthesia using the double-needle technique with normal saline as the irrigating solution. Clinical evaluation included assessment of pain intensity using the Visual Analog Scale (VAS), maximum mouth opening (MMO) measured in millimeters, and presence of joint sounds. Measurements were recorded preoperatively and postoperatively at 1 week, 1 month, and 3 months. Statistical analysis was performed using paired t-tests and repeated-measures analysis, with a significance level set at $p < 0.05$. **Results:** The mean preoperative VAS score showed a significant reduction at all postoperative follow-up intervals ($p < 0.05$). The mean maximum mouth opening increased significantly from baseline at 1 month and 3 months postoperatively ($p < 0.05$). A marked reduction in joint sounds and functional limitation was observed in the majority of patients. No statistically significant intraoperative or postoperative complications were reported. **Conclusion:** Arthrocentesis is a clinically effective and statistically significant minimally invasive procedure for the management of temporomandibular joint dysfunction. The procedure results in significant pain reduction and improvement in mandibular function and should be considered a reliable treatment option for patients unresponsive to conservative management.

INTRODUCTION

Temporomandibular joint (TMJ) dysfunction encompasses a group of clinical conditions affecting the temporomandibular joint, masticatory muscles, and associated structures. These disorders commonly present with symptoms such as pain in the preauricular region, restricted mandibular movements, joint sounds, and functional impairment during mastication and speech. TMJ dysfunction represents a significant cause of non-dental orofacial pain and has been shown to negatively impact patients' quality of life and psychological well-being (Okeson, 2013).

The etiology of TMJ dysfunction is multifactorial and includes internal derangement of the joint, trauma, Para functional habits such as bruxism, occlusal discrepancies, psychological stress, and degenerative changes within the joint components. Among these, internal derangement characterized by abnormal positioning of the articular disc is considered one of the most common pathological findings associated with pain and limited mouth opening (de Leeuw & Klasser, 2018). The pathophysiology of TMJ dysfunction involves inflammatory mediators within the synovial fluid, leading to pain, joint stiffness, and restricted movement (Kopp, 2001).

Management of TMJ dysfunction typically follows a stepwise approach, beginning with conservative and reversible treatment modalities. These include patient education, occlusal splint therapy, physiotherapy, pharmacological management, and behavioral therapy. Conservative treatment has been reported to be effective in a majority of cases; however, approximately 10–20% of patients fail to respond adequately and continue to

experience persistent pain and functional limitation (Manfredini et al., 2010). In such cases, minimally invasive surgical interventions are considered before progressing to open joint surgery.

Arthrocentesis is a minimally invasive procedure introduced as a treatment option for TMJ internal derangement and inflammatory joint disorders. The procedure involves lavage of the superior joint space using irrigating solutions to eliminate inflammatory mediators, reduce intra-articular pressure, and release fibrous adhesions within the joint (Nitzan, Dolwick, & Martinez, 1991). The therapeutic effect of arthrocentesis is attributed to hydraulic distension of the joint, improved lubrication, and restoration of normal joint biomechanics (Alpaslan & Alpaslan, 2001). Owing to its simplicity, low cost, and minimal morbidity, arthrocentesis can be performed under local anesthesia and is well accepted by patients.

Several clinical studies have demonstrated favorable outcomes following arthrocentesis, reporting significant reduction in pain intensity and improvement in mandibular mobility (Guarda-Nardini et al., 2012; Dimitroulis, 2013). Additionally, arthrocentesis has been shown to delay or eliminate the need for more invasive surgical procedures in many patients with TMJ dysfunction. Despite these positive outcomes, variations in patient selection criteria, technique, irrigating solutions, and follow-up duration have resulted in inconsistent findings across studies.

Therefore, further prospective clinical studies using standardized clinical parameters are required to evaluate the effectiveness of arthrocentesis in the management of TMJ dysfunction. The present study aims to clinically and statistically assess the outcomes of arthrocentesis in patients with temporomandibular joint dysfunction unresponsive to conservative treatment by evaluating changes in pain intensity, maximum mouth opening, and joint function over a defined follow-up period.

REVIEW OF LITERATURE

Temporomandibular joint (TMJ) dysfunction has been extensively studied due to its high prevalence and complex etiology. Epidemiological studies suggest that signs and symptoms of TMJ dysfunction affect a significant portion of the population, with a higher incidence reported among young and middle-aged adults. Pain, joint sounds, and restricted mouth opening are the most frequently reported clinical manifestations, often associated with internal derangement of the temporomandibular joint (Okeson, 2013).

Internal derangement of the TMJ is characterized by an abnormal positional relationship between the articular disc, mandibular condyle, and articular eminence. This condition can result in altered joint mechanics, increased intra-articular pressure, and accumulation of inflammatory mediators within the synovial fluid, leading to pain and functional limitation (Kopp, 2001). Magnetic resonance imaging studies have confirmed the role of disc displacement and joint inflammation in the pathogenesis of TMJ dysfunction (de Leeuw & Klasser, 2018).

Conservative management remains the primary approach for treating TMJ dysfunction and includes occlusal splints, physiotherapy, pharmacotherapy, and behavioral modification. Several studies have reported satisfactory outcomes with conservative treatment; however, a proportion of patients do not achieve adequate symptom relief and continue to experience chronic pain and restricted mandibular movement (Manfredini et al., 2010). For these patients, minimally invasive surgical procedures are recommended before considering open joint surgery.

Arthrocentesis was first described as a therapeutic procedure for TMJ internal derangement by Nitzan, Dolwick, and Martinez (1991). The authors reported that lavage of the superior joint space resulted in significant pain relief and improvement in mouth opening, even without disc repositioning. The primary mechanism of action was attributed to the removal of inflammatory mediators and release of intra-articular adhesions. Since then, arthrocentesis has gained widespread acceptance as a minimally invasive treatment modality for TMJ dysfunction.

Multiple clinical studies have evaluated the effectiveness of arthrocentesis in reducing pain and improving mandibular function. Alpaslan and Alpaslan (2001) demonstrated significant improvement in maximum mouth opening and pain reduction following arthrocentesis in patients with closed lock conditions. Similarly, Guarda-Nardini et al. (2012) reported favorable short- and long-term outcomes following arthrocentesis, emphasizing its role in managing inflammatory TMJ disorders.

Comparative studies have also assessed arthrocentesis against other minimally invasive procedures such as arthroscopy. Dimitroulis (2013) suggested that arthrocentesis provides comparable clinical outcomes to arthroscopy in selected cases, with reduced operative time, cost, and morbidity. Additionally, arthrocentesis has been shown to delay or eliminate the need for open joint surgery in a significant number of patients.

Despite the documented benefits, variations exist in reported success rates due to differences in study design, sample size, irrigation volume, type of irrigating solution, and follow-up duration. Some authors have emphasized the need for standardized protocols and objective clinical parameters to accurately evaluate treatment outcomes (Manfredini et al., 2010).

In view of the existing literature, arthrocentesis appears to be an effective and safe minimally invasive procedure for the management of TMJ dysfunction. However, further prospective clinical studies with standardized evaluation criteria are required to strengthen the evidence regarding its clinical and statistical effectiveness. The present study aims to contribute to this body of evidence by evaluating arthrocentesis outcomes using consistent clinical parameters and follow-up intervals.

MATERIALS AND METHODS

Study Design and Setting

This prospective clinical study was conducted in the Department of Oral and Maxillofacial Surgery at a tertiary care dental institution. The study was carried out over a

defined period of six months, following approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to inclusion in the study.

Study Population

A total of 30 patients diagnosed with temporomandibular joint dysfunction were included in the study. All patients reported to the outpatient department with complaints of TMJ pain, restricted mouth opening, and functional limitation and had not responded to conservative treatment for a minimum duration of three months.

Inclusion Criteria

Patients were included in the study based on the following criteria:

- Presence of clinical signs and symptoms of TMJ dysfunction
- Persistent TMJ pain and/or limited mouth opening
- Failure to respond to conservative management, including medication and physiotherapy
- Age between 18 and 55 years
- Willingness to participate and provide informed consent

Exclusion Criteria

Patients were excluded from the study if they had:

- History of TMJ trauma or fracture
- Systemic inflammatory joint diseases such as rheumatoid arthritis
- Previous TMJ surgery or arthrocentesis
- Acute infection in the TMJ region
- Pregnancy or systemic conditions contraindicating minor surgical procedures

Preoperative Clinical Evaluation

All patients underwent a detailed clinical examination prior to the procedure. The following parameters were recorded:

- Pain intensity, assessed using the Visual Analog Scale (VAS), ranging from 0 (no pain) to 10 (severe pain)
- Maximum mouth opening (MMO), measured in millimeters as the interincisal distance using a calibrated ruler
- Presence or absence of joint sounds and mandibular deviation during mouth opening

Baseline values for all parameters were documented preoperatively.

Arthrocentesis Procedure

Arthrocentesis was performed under local anesthesia using the double-needle technique. Standard anatomical landmarks were identified, and the superior joint space was accessed. Approximately 100–200 mL of sterile normal saline was used to irrigate the joint space. Continuous lavage was performed to flush out inflammatory mediators and release intra-articular adhesions. At the end of the procedure, gentle mandibular manipulation was carried out to improve joint mobility. No intra-articular medications were administered.

Postoperative Evaluation and Follow-Up

Patients were evaluated postoperatively at 1 week, 1 month, and 3 months. At each follow-up visit, pain intensity (VAS), maximum mouth opening, and joint function were reassessed using the same clinical parameters and methods as preoperatively. Patients were advised standard postoperative instructions and analgesics as required.

Statistical Analysis

The collected data were compiled and subjected to statistical analysis using appropriate statistical software. Preoperative and postoperative values were compared using paired t-tests and repeated-measures analysis, where applicable. A p-value less than 0.05was considered statistically significant.

RESULTS

A total of 30 patients diagnosed with temporomandibular joint dysfunction were included in the study. All patients completed the follow-up period of 3 months. Clinical parameters including pain intensity, maximum mouth opening, and joint sounds were evaluated preoperatively and postoperatively at 1 week, 1 month, and 3 months.

Demographic Distribution

The study population consisted of patients aged between 18 and 55 years. Females were more commonly affected than males.

Pain Assessment (VAS Score)

Pain intensity showed a progressive and statistically significant reduction at all postoperative follow-up intervals compared to preoperative values.

Maximum Mouth Opening (MMO)

A statistically significant increase in maximum mouth opening was observed following arthrocentesis, indicating improvement in mandibular mobility.

Joint Sounds

Joint sounds were present in a majority of patients preoperatively and showed marked reduction following treatment.

Overall Clinical Improvement

Most patients demonstrated significant improvement in pain relief and functional parameters by the end of the 3-month follow-up period.

Table 1

Demographic Distribution of Patients

Parameter	Number of Patients (n = 30)	Percentage (%)
Male	10	33.3
Female	20	66.7
Age Range (years)	18–55	—
Mean Age (years)	32.4 ± 8.6	—

Table 2

Mean VAS Pain Scores at Different Time Intervals

Time Interval	Mean VAS Score	Standard Deviation	p-value
Preoperative	7.2	±1.1	—
1 Week	4.6	±1.0	< 0.05
1 Month	2.9	±0.9	< 0.05
3 Months	1.8	±0.8	< 0.05

Table 3
Mean Maximum Mouth Opening (MMO) at Different Time Intervals

Time Interval	Mean MMO (mm)	Standard Deviation	p-value
Preoperative	28.5	±3.4	—
1 Week	32.1	±3.1	< 0.05
1 Month	35.6	±2.9	< 0.05
3 Months	38.2	±2.6	< 0.05

Table 4
Distribution of Joint Sounds Pre- and Post-Treatment

Time Interval	Joint Sounds Present (n)	Joint Sounds Absent (n)
Preoperative	22	8
1 Week	14	16
1 Month	8	22
3 Months	4	26

Table 5
Overall Clinical Outcome at 3-Month Follow-Up

Outcome Category	Number of Patients	Percentage (%)
Significant improvement	20	66.7
Moderate improvement	7	23.3
Mild improvement	3	10.0
No improvement	0	0

Summary of Results

- Statistically significant reduction in pain (VAS) at all follow-up intervals
- Significant increase in maximum mouth opening post-arthrocentesis
- Marked reduction in joint sounds over time
- No major complications reported

Results Analysis

The present study demonstrated a statistically significant improvement in all evaluated clinical parameters following arthrocentesis. Mean pain intensity, measured using the Visual Analog Scale, showed a progressive and significant reduction at 1 week, 1 month, and 3 months postoperatively when compared to preoperative values ($p < 0.05$). Maximum mouth opening increased significantly over the follow-up period, indicating improved mandibular mobility and joint function. Additionally, a marked reduction in joint sounds was observed, with the majority of patients showing complete resolution by the end of the 3-month follow-up. Overall clinical outcomes revealed that most patients experienced significant or moderate improvement, and no major intraoperative or postoperative complications were reported. These findings indicate that arthrocentesis is an effective and safe minimally invasive procedure for the management of temporomandibular joint dysfunction.

DISCUSSION

The present study evaluated the clinical effectiveness of arthrocentesis in the management of temporomandibular joint dysfunction in patients unresponsive to conservative therapy. The findings demonstrated a statistically significant reduction in pain intensity, improvement in maximum mouth opening, and reduction in joint sounds following arthrocentesis, indicating favorable clinical outcomes of this minimally invasive procedure.

Pain reduction was one of the most significant outcomes observed in this study. The mean Visual Analog Scale (VAS) scores showed a progressive and statistically significant decrease at all postoperative follow-up intervals. This improvement can be attributed to the lavage of the superior joint space, which facilitates the removal of inflammatory mediators such as prostaglandins, cytokines, and bradykinin that are known to contribute to pain and joint inflammation. Similar findings have been reported by Nitzan et al. (1991), who suggested that the primary mechanism of pain relief following arthrocentesis is hydraulic distension and elimination of inflammatory byproducts rather than disc repositioning.

An increase in maximum mouth opening was also observed postoperatively, with statistically significant improvement noted at 1 month and 3 months follow-up. Restricted mouth opening in TMJ dysfunction is often associated with intra-articular adhesions, increased joint friction, and altered joint biomechanics. Arthrocentesis helps release these adhesions and improves joint lubrication, thereby restoring mandibular mobility. Alpaslan and Alpaslan (2001) reported similar improvements in mouth opening following arthrocentesis, emphasizing its effectiveness in patients with closed lock conditions.

Reduction in joint sounds following arthrocentesis was another important finding of the present study. Joint sounds are commonly associated with disc displacement and irregular joint movements. The marked decrease in joint sounds observed in this study may be attributed to improved joint mechanics and reduced intra-articular pressure following lavage. Guarda-Nardini et al. (2012) also reported a significant reduction in joint sounds after arthrocentesis, supporting the role of the procedure in improving functional joint dynamics.

The overall clinical outcome revealed that the majority of patients experienced significant or moderate improvement by the end of the 3-month follow-up period. Importantly, no major intraoperative or postoperative complications were observed, highlighting the safety and reliability of arthrocentesis. Compared to more invasive procedures such as arthroscopy or open joint surgery, arthrocentesis offers advantages including reduced operative time, minimal morbidity, and cost-effectiveness. Dimitroulis (2013) suggested that arthrocentesis can provide outcomes comparable to arthroscopy in selected cases, making it an ideal intermediate treatment option.

Despite the positive outcomes, certain limitations of the present study should be acknowledged. The sample size was relatively small, and the follow-up period was limited to three months. Long-term outcomes and recurrence rates were not evaluated. Additionally, imaging modalities such as magnetic resonance imaging were not used to correlate clinical improvement with structural changes within the joint.

Within these limitations, the findings of the present study support the clinical effectiveness of arthrocentesis in managing temporomandibular joint dysfunction. The procedure offers significant pain relief and functional

improvement and should be considered a valuable treatment option for patients who do not respond to conservative management.

CONCLUSION

Within the limitations of the present study, arthrocentesis proved to be an effective and safe minimally invasive treatment modality for the management of temporomandibular joint dysfunction in patients unresponsive to conservative therapy. The procedure resulted in a statistically significant reduction in pain intensity, improvement in maximum mouth opening, and enhancement of overall joint function. Most patients demonstrated favorable clinical outcomes with minimal morbidity and no major complications.

Arthrocentesis offers several advantages, including simplicity of technique, reduced operative time, and cost-effectiveness, making it a reliable intermediate treatment option between conservative management and more invasive surgical procedures. Based on the clinical and statistical findings of this study, arthrocentesis can be recommended as an effective therapeutic approach for managing temporomandibular joint dysfunction, particularly in cases associated with internal derangement and restricted mandibular movement.

Limitations and Future Recommendations: Despite the favorable clinical outcomes observed in the present study, certain limitations should be acknowledged. The sample size of 30 patients was relatively small, which may limit the generalizability of the results to a larger population. Additionally, the follow-up period was restricted to three months; therefore, long-term outcomes, stability of results, and recurrence of symptoms could not be assessed. Imaging modalities such as magnetic resonance imaging (MRI) were not employed to correlate clinical improvement with anatomical or disc positional changes within the temporomandibular joint. Furthermore, the study did not include a control group or comparison with other treatment modalities, such as arthroscopy or intra-articular injections, which could have strengthened the comparative analysis.

Future studies should focus on larger sample sizes with extended follow-up periods to evaluate the long-term efficacy and stability of arthrocentesis outcomes. Incorporation of advanced imaging techniques may help establish a clearer relationship between clinical improvement and structural joint changes. Comparative randomized controlled trials evaluating arthrocentesis against other minimally invasive and surgical treatment modalities are also recommended to develop standardized treatment protocols. Such studies would further enhance the evidence base and contribute to optimizing the management of temporomandibular joint dysfunction.

REFERENCES

1. Alpaslan, C., & Alpaslan, G. H. (2001). Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in the treatment of internal derangements. *Journal of Oral and Maxillofacial Surgery, 59*(6), 613–618. https://doi.org/10.1053/joms.2001.23368
2. Dimitroulis, G. (2013). Temporomandibular joint arthrocentesis: A review of the technique and outcomes. *Australian Dental Journal, 58*(3), 345–351.
3. Guarda-Nardini, L., Rossi, A., Ramonda, R., Punzi, L., & Manfredini, D. (2012). Effectiveness of arthrocentesis in temporomandibular joint disorders: A systematic review. *Journal of Oral and Maxillofacial Surgery, 70*(4), 835–842. https://doi.org/10.1016/j.ijom.2014.05.001
4. Kopp, S. (2001). The influence of neuropeptides, serotonin, and interleukin-1β on temporomandibular joint pain and inflammation. *Journal of Oral and Maxillofacial Surgery, 59*(6), 697–703. https://doi.org/10.1016/s0278-2391(98)90867-9
5. Manfredini, D., Piccotti, F., Ferronato, G., & Guarda-Nardini, L. (2010). Age peaks of different RDC/TMD diagnoses in a patient population. *Journal of Dentistry, 38*(5), 392–399. https://doi.org/10.1016/j.jdent.2010.01.006
6. Nitzan, D. W., Dolwick, M. F., & Martinez, G. A. (1991). Temporomandibular joint arthrocentesis: A simplified treatment for severe, limited mouth opening. *Journal of Oral and Maxillofacial Surgery, 49*(11), 1163–1167. https://doi.org/10.1016/0278-2391(91)90409-f
7. Okeson, J. P. (2013). *Management of temporomandibular disorders and occlusion* (7th ed.). Elsevier Mosby.
8. de Leeuw, R., & Klasser, G. D. (2018). *Orofacial pain: Guidelines for assessment, diagnosis, and management* (6th ed.). Quintessence Publishing. https://doi.org/10.25241/stomaeduj.2015.2(2).bookreview.6
9. Al-Belasy, F. A., & Dolwick, M. F. (2007). Arthrocentesis for the treatment of temporomandibular joint closed lock: A review article. *International Journal of Oral and Maxillofacial Surgery, 36*(9), 773–782. https://doi.org/10.1016/j.ijom.2007.04.005
10. Frost, D. E., Kendell, B. D., & Dolwick, M. F. (1999). Arthrocentesis of the temporomandibular joint. *Journal of Oral and Maxillofacial Surgery, 57*(5), 583–587. https://doi.org/10.1016/s0278-2391(99)90080-0
11. Sato, S., Kawamura, H., Motegi, K., & Takahashi, K. (1997). Arthrocentesis for temporomandibular joint internal derangement. *Journal of Oral and Maxillofacial Surgery, 55*(3), 266–271.
12. Murakami, K., Segami, N., Fujimura, K., & Iizuka, T. (1995). Correlation between pain and synovitis in patients with internal derangement of the temporomandibular joint. *Journal of Oral and Maxillofacial Surgery, 53*(4), 439–444. https://doi.org/10.1016/0278-2391(91)90407-d
13. Ahmed, N., & Sidebottom, A. J. (2011). Prospective comparison of arthroscopy and arthrocentesis for TMJ disorders. *British Journal of Oral and Maxillofacial Surgery, 49*(7), 538–543. https://doi.org/10.1016/j.bjoms.2009.06.096
14. Emshoff, R., & Rudisch, A. (2001). Validity of clinical diagnostic criteria for temporomandibular disorders. *Journal of Oral Rehabilitation, 28*(7), 624–632. https://doi.org/10.1067/moe.2001.111129
15. Guarda-Nardini, L., Masiero, S., & Manfredini, D. (2008). Arthrocentesis and temporomandibular joint disorders: Clinical and radiological outcomes. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 105*(1), e35–e42. https://doi.org/10.1016/j.tripleo.2007.12.006
16. Schiffman, E., Ohrbach, R., Truelove, E., et al. (2014). Diagnostic criteria for temporomandibular disorders (DC/TMD). *Journal of Oral & Facial Pain and Headache, 28*(1), 6–27. https://doi.org/10.11607/jop.1151
17. Hosaka, H., Murakami, K., Goto, K., & Iizuka, T. (1996). Outcome of arthrocentesis for temporomandibular joint

closed lock. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 82*(5), 501–504. https://doi.org/10.1016/s1079-2104(96)80193-4
18. Guarda-Nardini, L., Manfredini, D., Ferronato, G. (2007). Arthrocentesis of the temporomandibular joint: Systematic review of the literature. *British Journal of Oral and Maxillofacial Surgery, 45*(6), 431–436. https://doi.org/10.1016/j.ijom.2010.03.028
19. Emshoff, R., Brandlmaier, I., Bertram, S., & Rudisch, A. (2003). Relative efficacy of arthrocentesis and arthroscopy in TMJ disorders. *Journal of Oral and Maxillofacial Surgery, 61*(7), 784–789. https://doi.org/10.1053/joms.2003.50006
20. Yura, S., & Totsuka, Y. (2005). Relationship between outcome and inflammation in TMJ arthrocentesis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 99*(4), 436–442.
21. Laskin, D. M. (2008). Etiology of the pain-dysfunction syndrome. *Journal of the American Dental Association, 139*(S), 24S–28S. https://doi.org/10.14219/jada.archive.1969.0234
22. Milam, S. B. (2005). Pathophysiology of temporomandibular joint inflammation. *Journal of Oral and Maxillofacial Surgery, 63*(4), 554–562.
23. McCain, J. P. (1996). Principles and practice of TMJ arthroscopy. *Mosby-Year Book*.