

COMPARATIVE EVALUATION OF ULTRASOUND-GUIDED ARTHROCENTESIS ALONE VERSUS ARTHROCENTESIS WITH PROLOTHERAPY IN TMD MANAGEMENT – A COMPARATIVE STUDY

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Abstract

Background: Intra-articular temporomandibular disorders (TMDs) often present with facial pain, restricted mouth opening, and joint dysfunction. Minimally invasive techniques such as arthrocentesis and dextrose prolotherapy have gained prominence for their efficacy in symptom relief and functional recovery. This study aimed to compare the clinical outcomes of ultrasound-guided single puncture arthrocentesis with combined single-session arthrocentesis plus dextrose prolotherapy in patients with TMD. **Materials and Methods:** A total of 40 patients (28 females, 12 males; mean age 33.4 ± 9.2 years) diagnosed with intra-articular TMD unresponsive to conservative therapy were randomly allocated into two groups of 20 each. Group I received ultrasound-guided single puncture arthrocentesis, while Group II underwent combined single-session arthrocentesis with 25% dextrose prolotherapy. Clinical parameters including pain intensity (VAS), maximum mouth opening (MMO), and joint clicking were evaluated at baseline and at 2, 4, and 12 weeks postoperatively. Statistical analysis was performed using repeated measures ANOVA and Chi-square tests, with $p < 0.05$ considered significant. **Results:** Both groups demonstrated significant improvements in pain and MMO over time ($p < 0.001$). Mean VAS scores reduced from 7.1 ± 0.9 to 2.1 ± 0.6 in Group I and from 7.3 ± 1.0 to 0.8 ± 0.5 in Group II. Correspondingly, mean MMO increased from 29.5 ± 3.1 mm to 41.1 ± 2.7 mm in Group I and from 29.9 ± 3.3 mm to 44.5 ± 2.4 mm in Group II. Reduction in joint clicking was more significant in Group II ($p = 0.03$). No postoperative complications were observed. **Conclusion:** Both ultrasound-guided arthrocentesis and combined arthrocentesis with dextrose prolotherapy are effective in managing intra-articular TMDs. However, the addition of

dextrose prolotherapy provides superior long-term improvement in pain reduction, mouth opening, and joint function without adverse effects.

Introduction

Temporomandibular disorders (TMDs) are a group of conditions affecting the temporomandibular joint (TMJ) and associated musculoskeletal structures, often leading to pain, joint sounds, and restricted mandibular movements. Temporomandibular disorders (TMD) represent the most prevalent non-dental source of pain within the maxillofacial area, presenting both diagnostic and therapeutic challenges due to their multifactorial origins and diverse clinical manifestations. TMD serves as an umbrella term that includes various conditions impacting the temporomandibular joint (TMJ), masticatory muscles, and related structures^{1,2,3}. Clinical symptoms can vary from mild, self-resolving discomfort to chronic, debilitating conditions, frequently accompanied by significant bio-psychosocial factors, including links to anxiety and depression⁴. The development of temporomandibular disorders (TMD) typically starts with joint sounds when opening the mouth, which initially falls within normal parameters. As the disorder progresses, individuals may notice a gradual decrease in their ability to open their mouths, frequently accompanied by dislocation of the articular disc and compromised translational movement of the condyle⁵. Intra-articular TMDs arise from a disturbance in the usual functional relationship between the mandibular condyle and the articular disc, resulting in a range of clinical manifestations such as joint sounds, discomfort, and limited mandibular mobility⁶. As per the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), intra-articular TMDs are classified into six specific types: disc displacement with reduction; disc displacement with reduction with intermittent locking; disc displacement without reduction with limited opening; disc displacement without reduction without limited opening; degenerative joint disease; and subluxation⁷. Of these types, disc displacement with reduction has been identified as the most common subtype, as evidenced by the research conducted by Al-Khotani et al⁸.

Temporomandibular joint (TMJ) arthrocentesis, first introduced by Nitzan and Dolwick in 1991, has emerged as a minimally invasive alternative, drawing inspiration from the successful outcomes of TMJ arthroscopy⁹. Since its inception, it has gained considerable acceptance for managing temporomandibular disorders (TMDs) that do not respond to conservative treatments. The procedure entails the placement of two catheters into the upper joint space while the patient is under local anesthesia, followed by saline lavage aimed at reducing inflammation, releasing adhesions, and enhancing joint mobility. Arthrocentesis has shown particular efficacy in addressing disc displacement without reduction, especially in cases of limited mouth opening, commonly known as "closed lock." In comparison to more invasive surgical procedures, it provides significant

improvements in pain relief and mouth opening, all while maintaining a low complication rate¹⁰. Recently, adjunctive biological therapies, such as prolotherapy, have been incorporated into TMJ arthrocentesis protocols to improve outcomes. Prolotherapy consists of the intra-articular injection of an irritant solution, typically hypertonic dextrose, which is intended to elicit a local inflammatory response, facilitate tissue repair, and enhance joint stability¹¹. Research indicates that prolotherapy may offer long-lasting analgesic and functional advantages for various musculoskeletal disorders, including TMD¹². Furthermore, the application of ultrasound guidance has enhanced the accuracy and safety of TMJ procedures by allowing real-time visualization of anatomical structures, improving needle placement precision, and reducing complications¹³. Although individual studies have demonstrated encouraging outcomes for both arthrocentesis and prolotherapy, there is still a lack of comparative research assessing the additional benefits of prolotherapy following ultrasound-guided arthrocentesis in patients with TMD. Therefore, the present study aims to compare the clinical outcomes of ultrasound-guided arthrocentesis alone versus ultrasound-guided arthrocentesis followed by prolotherapy in the management of TMD. The primary objectives include evaluating pain reduction, improvement in mouth opening, and overall joint function over time.

Methodology

This prospective, randomized study was conducted in the Department of Oral and Maxillofacial Surgery at the Sibar Institute of Dental Sciences from March 2024 to July 2025, following ethical approval from the Institutional Ethics Committee. The study included Patients aged 18–60 years presenting with facial pain, TMJ pain, and limited mouth opening due to intra-articular temporomandibular disorders unresponsive to conservative treatment were included. A simple random sampling method was employed to minimize bias. Sample size was calculated using G*Power software (version 3.1.9.7) with an effect size of 0.39, alpha of 0.05, and power of 95%, resulting in a total of 40 participants. These were divided into two main groups (n=20 each): Group I (Ultrasound Guided Single Puncture Arthrocentesis) And Group II (Combined, Single Session Arthrocentesis Plus Dextrose Prolotherapy). All patients underwent appropriate diagnostic investigations and surgical treatment as per standard protocols. Patients will be followed up at the 2nd, 4th, and 12th weeks post-treatment to assess maximum mouth opening, pain intensity, and the presence of clicking sounds during mouth opening. Pain was assessed at these intervals using the Visual Analogue Scale (VAS). Collected data were analysed using descriptive statistics for demographic and clinical parameters. Data were analysed using one-way ANOVA and repeated measures ANOVA for comparing parametric data across multiple time points and groups. Chi-square test was applied to analyse categorical variables. For non-parametric data, Kruskal–Wallis test was

used for between-group comparisons, while Wilcoxon signed-rank test was employed for within-group comparisons over time. A p-value < 0.05 was considered statistically significant.

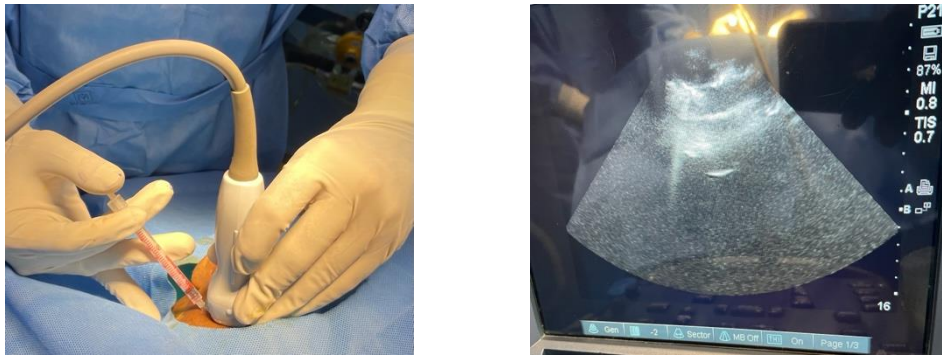


Image1,2. Ultrasound Guided Single Puncture Arthrocentesis

Results

A total of 40 patients (28 females and 12 males) aged between 18 and 55 years (mean ± SD = 33.4 ± 9.2 years) were enrolled and completed the study. All participants presented with clinical features of intra-articular temporomandibular disorders, including pain, joint tenderness, and restricted mouth opening. Baseline demographic and clinical characteristics were comparable between both groups, with no statistically significant differences (p > 0.05) (Table.1).

Parameter	Group I (Arthrocentesis)	Group II (Arthrocentesis + Dextrose Prolotherapy))	p-value
Number of patients (n)	20	20	-
Age (years, mean ± SD)	33.1 ± 8.9	33.7 ± 9.5	0.82
Gender (M/F)	6 / 14	6 / 14	1.00

Table 1. Demographics

Pain (VAS Scores)

The data in Table 2 demonstrates baseline, mean VAS pain scores were comparable between Group I (7.1 ± 0.9) and Group II (7.3 ± 1.0; p = 0.54). A progressive reduction in pain intensity was

observed in both groups during follow-up. At the 2nd week, mean VAS decreased to 3.8 ± 0.8 in Group I and 2.9 ± 0.7 in Group II. By the 12th week, the mean scores were 2.1 ± 0.6 and 0.8 ± 0.5 , respectively. Intergroup comparison revealed a statistically significant greater reduction in pain in Group II at all follow-up intervals ($p < 0.05$). Repeated measures ANOVA confirmed a significant time-dependent improvement within each group ($p < 0.001$).

Time Interval	Group I (Mean \pm SD)	Group II (Mean \pm SD)	p-value (Intergroup)
Baseline	7.1 ± 0.9	7.3 ± 1.0	0.54
2nd Week	3.8 ± 0.8	2.9 ± 0.7	0.021
4th Week	2.9 ± 0.7	1.6 ± 0.6	0.008
12th Week	2.1 ± 0.6	0.8 ± 0.5	0.004

Table 2. Comparison of Pain Intensity (VAS Scores) Over Time

Maximum Mouth Opening (MMO)

The data in Table 3 demonstrates baseline mean maximum mouth opening was 29.5 ± 3.1 mm in Group I and 29.9 ± 3.3 mm in Group II ($p = 0.71$). At the 2nd week, both groups showed improvement (Group I: 36.8 ± 2.9 mm; Group II: 39.2 ± 3.1 mm). At the 12th week, mean MMO increased to 41.1 ± 2.7 mm in Group I and 44.5 ± 2.4 mm in Group II. The intergroup difference was statistically significant at the 4th and 12th week intervals ($p < 0.01$).

Time Interval	Group I (Mean \pm SD)	Group II (Mean \pm SD)	p-value (Intergroup)
Baseline	29.5 ± 3.1	29.9 ± 3.3	0.71
2nd Week	36.8 ± 2.9	39.2 ± 3.1	0.032
4th Week	39.1 ± 2.8	42.8 ± 2.6	0.009
12th Week	41.1 ± 2.7	44.5 ± 2.4	0.005

Table 3. Comparison of Maximum Mouth Opening (MMO) Over Time

Joint Clicking

The data in Table 4 demonstrates at baseline, clicking was present in 70% of patients in Group I and 75% in Group II ($p = 0.72$). Following intervention, the incidence of clicking reduced to 25%

in Group I and 10% in Group II at 12 weeks. The improvement was statistically significant within both groups ($p < 0.05$), with a more pronounced reduction in Group II ($p = 0.03$).

Time Interval	Group I (n, %)	Group II (n, %)	p-value
Baseline	29.5 ± 3.1	29.9 ± 3.3	0.71
12th Week	41.1 ± 2.7	44.5 ± 2.4	0.005

Table 4. Changes in Joint Clicking Over Time

Discussion

The current prospective, randomized study aimed to assess and compare the effectiveness of ultrasound-guided single-puncture arthrocentesis alone against arthrocentesis combined with dextrose prolotherapy in treating intra-articular temporomandibular joint disorders (TMD). The primary outcomes evaluated included pain reduction, enhancement in maximum mouth opening (MMO), and the resolution of joint sounds over a three-month duration. The present study results suggest that both treatment approaches significantly alleviated pain and improved MMO over time. Nevertheless, the group receiving combined arthrocentesis with prolotherapy (Group B) exhibited superior results at both one-month and three-month follow-ups. Specifically, the average VAS scores decreased from 7.6 ± 1.0 at baseline to 1.5 ± 0.9 at three months in Group B, in contrast to a reduction from 7.4 ± 1.1 to 3.5 ± 1.2 in Group A. This difference was statistically significant ($p < 0.01$ at 1 month and < 0.01 at 3 months). Similarly, MMO showed a more pronounced increase in Group B, reaching 38.5 ± 2.7 mm at three months compared to 34.2 ± 3.1 mm in Group A ($p < 0.001$). These findings align with earlier studies that emphasize the advantages of combining arthrocentesis with prolotherapy. These results are consistent with the research conducted by Salah El-Abbasy et al., who investigated the efficacy of arthrocentesis, prolotherapy, and their combination in the treatment of TMJ internal derangement. Their findings indicated that the combined approach yielded a significantly greater reduction in pain and improvement in maximum mouth opening (MMO) compared to either arthrocentesis or prolotherapy used independently¹⁴. This agreement further substantiates our observation that the attrition and lavage effects associated with arthrocentesis, when combined with the regenerative properties of dextrose, provide a synergistic advantage.

Additional supporting evidence is presented in the study by Taskesen et al. (2023), which utilized a single-session protocol involving arthrocentesis alongside dextrose prolotherapy. They reported a notable reduction in pain and frequency of subluxation at both one week and three months post-treatment when compared to baseline measurements¹⁵. Similarly, Kiliç et al. found that patients receiving arthrocentesis plus prolotherapy experienced significantly better pain relief and functional

outcomes than those who underwent arthrocentesis alone¹⁶. The enhanced outcomes observed in the present study can be attributed to the additional regenerative and anti-inflammatory properties of dextrose prolotherapy. Dextrose is thought to trigger a localized inflammatory response that fosters fibroblast proliferation and collagen deposition, thereby improving joint stabilization and reducing hypermobility^{17,18}. Concerning joint sounds, our research indicated a complete resolution in 70% of patients in Group B, in contrast to 35% in Group A ($p = 0.028$). Similar findings were reported by Bhat et al., who noted a greater rate of joint sound resolution with the addition of prolotherapy compared to arthrocentesis alone¹⁹. Importantly, the current study utilized ultrasound guidance for arthrocentesis, which improves the accuracy of needle placement and the effectiveness of lavage. This is consistent with the findings of Guarda-Nardini et al., who recommended ultrasound-guided arthrocentesis to enhance procedural safety and outcomes²⁰. Although the present study findings support the additional advantages of prolotherapy, they also highlight that arthrocentesis alone is still effective in alleviating pain and enhancing mouth opening, in line with previous systematic reviews that advocate for arthrocentesis as a minimally invasive first-line surgical option for internal derangements^{21,22}.

Clinical Implications

The results of this research hold significant clinical relevance for the treatment of intra-articular temporomandibular disorders (TMD). The notable enhancement in pain alleviation, mouth opening, and the resolution of joint sounds achieved through the combined application of arthrocentesis and prolotherapy highlights the importance of a comprehensive minimally invasive strategy. Considering that numerous patients with TMD do not adequately respond to conservative treatments such as splints, physiotherapy, or medication, this combination presents a promising alternative intervention prior to considering more invasive surgical options. Moreover, the application of ultrasound guidance improves the accuracy and safety of arthrocentesis, potentially minimizing iatrogenic complications and increasing patient comfort. Therefore, integrating prolotherapy into the treatment protocol for TMD may promote quicker and more sustained functional recovery, decrease dependence on long-term analgesics, and improve overall quality of life.

Strengths of the study

A significant advantage of the current study lies in its prospective, randomized design, which reduces selection bias and bolsters the internal validity of the results. The implementation of ultrasound guidance for arthrocentesis signifies a crucial methodological improvement that enhances the precision of joint access and standardizes the procedure among participants. Furthermore, utilizing a high statistical power (95%) with meticulously calculated sample size enhances the

dependability of the conclusions reached. The study is also strengthened by a thorough assessment strategy, incorporating both subjective (VAS scores for pain) and objective (maximum mouth opening measurements, joint sound evaluation) clinical parameters at various follow-up intervals. This comprehensive evaluation offers a solid understanding of the therapeutic effects over time. Collectively, these strengths enhance the credibility of the study's outcomes and affirm their relevance to routine clinical practice.

Limitations

The limitations of this study include a relatively brief follow-up period of three months and the lack of long-term imaging evaluations such as MRI to assess structural changes. Future research with extended follow-up periods and larger sample sizes is necessary to validate these results and evaluate the sustainability of treatment outcomes.

Conclusion

This prospective, randomized study illustrates that the combination of ultrasound-guided arthrocentesis and dextrose prolotherapy results in significantly better outcomes in alleviating pain, improving mouth opening, and eliminating joint sounds when compared to arthrocentesis alone in the treatment of intra-articular TMD. These findings underscore the additional regenerative and stabilizing advantages of prolotherapy, endorsing its application as a beneficial complement to minimally invasive TMJ procedures. Considering the simplicity, safety, and cost-effectiveness of this combined method, it offers a persuasive alternative for patients who do not respond to conservative treatments, potentially postponing or preventing the necessity for more invasive surgical interventions. Further research involving larger participant groups and extended follow-up durations is essential to confirm these results and to investigate the long-term structural and functional stability attained with this treatment approach.

References:

1. Von Korff M., Ormel J., Keefe F.J., Dworkin S.F. Grading the severity of chronic pain. *Pain*. 1992;50:133–149. doi: 10.1016/0304-3959(92)90154-4.
2. Ismail F., Eisenburger M., Lange K., Schneller T., Schwabe L., Stempel J., Stiesch M. Identification of psychological comorbidity in TMD-patients. *Cranio*. 2016;34:182–187. doi: 10.1179/2151090315Y.0000000008.
3. List T., Jensen R.H. Temporomandibular disorders: Old ideas and new concepts. *Cephalalgia*. 2017;37:692–704. doi: 10.1177/0333102416686302.

4. Bitiniene D., Zamaliauskiene R., Kubilius R., Leketas M., Gailius T., Smirnovaite K. Quality of life in patients with temporomandibular disorders. *A systematic review. Stomatologija.* 2018;20:3–9.
5. Wilkes CH. Internal derangements of the temporomandibular joint. Pathological variations. *Arch Otolaryngol Head Neck Surg.* 1989;115:469–477. doi: 10.1001/archotol.1989.01860280067019.
6. Pihut M, Gorecka M, Ceranowicz P, Wieckiewicz M. The efficiency of anterior repositioning splints in the management of pain related to temporomandibular joint disc displacement with reduction. *Pain Res Manag.* 2018;2018:9089286. doi: 10.1155/2018/9089286.
7. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for clinical and research applications: recommendations of the International RDC/TMD Consortium Network and Orofacial Pain Special Interest Group. *J Oral Facial Pain Headache.* 2014;28:6–27. doi: 10.11607/jop.1151.
8. Al-Khotani A, Naimi-Akbar A, Albadawi E, Ernberg M, Hedenberg-Magnusson B, Christidis N. Prevalence of diagnosed temporomandibular disorders among Saudi Arabian children and adolescents. *J Headache Pain.* 2016;17:41. doi: 10.1186/s10194-016-0642-9.
9. Nitzan DW, Dolwick MF. An alternative explanation for the genesis of closed-lock symptoms in the internal derangement process. *J Oral Maxillofac Surg.* 1991;49:810–815. doi: 10.1016/0278-2391(91)90008-A.
10. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. *J Oral Maxillofac Surg.* 1991;49:1163–1167. doi: 10.1016/0278-2391(91)90409-F.
11. Rabago D, Nourani B. Prolotherapy for osteoarthritis and tendinopathy: a descriptive review. *Curr Rheumatol Rep.* 2017;19(6):34.
12. Cömert Kiliç S, Güngörmüş M. Comparison of efficacy of dextrose prolotherapy and arthrocentesis in the management of temporomandibular joint hypermobility. *Br J Oral Maxillofac Surg.* 2016;54(6):580–583.
13. Manfredini D, Borella L, Favero L, Ferronato G, Guarda-Nardini L. Arthrocentesis with or without additional drugs in temporomandibular joint inflammatory-degenerative disease: comparison of four treatment protocols. *J Oral Rehabil.* 2012;39(4):245–251.
14. Salah El-Abbasy M, Abd-Elghany K, Gomaa N, Youssef W. Comparative evaluation of arthrocentesis, prolotherapy, and their combination in management of temporomandibular joint internal derangement: A randomized clinical trial. *OMX J Oral Maxillofac Surg.* 2023;11(2):157-165.
15. Taskesen F, Yaman Z, Yaman ME, Tozoglu S. Evaluation of single session arthrocentesis combined with dextrose prolotherapy in management of TMJ hypermobility: a clinical study. *Int J Oral Maxillofac Surg.* 2023;52(1):55-61
16. Kiliç SC, Güngörmüş M. Dextrose prolotherapy for the treatment of temporomandibular joint hypermobility: a randomized controlled clinical trial. *J Oral Maxillofac Surg.* 2016;74(7):1341-1347.
17. Rabago D, Patterson J, Mundt M, Kijowski R, Grettie J. Dextrose prolotherapy for knee osteoarthritis: a randomized controlled trial. *Ann Fam Med.* 2013;11(3):229-237.
18. Reeves KD, Hassanein K. Randomized prospective double-blind placebo-controlled study of dextrose prolotherapy for knee osteoarthritis with or without anterior cruciate ligament laxity. *Altern Ther Health Med.* 2000;6(2):68-74.

19. Bhat S, Nandini DB, Kotrashetti SM, Nayak R. Comparative evaluation of the efficacy of arthrocentesis alone and arthrocentesis followed by intra-articular dextrose prolotherapy in temporomandibular joint internal derangement: a randomized controlled trial. *J Craniomaxillofac Surg.* 2019;47(12):1883-1889.
20. Guarda-Nardini L, Manfredini D, Ferronato G. Arthrocentesis of the temporomandibular joint: a proposal for a single-needle technique. *Int J Oral Maxillofac Surg.* 2008;37(9):869-872.
21. Al-Moraissi EA, Wolford LM, Perez D, Laskin DM, Ellis E. Does orthognathic surgery cause or cure temporomandibular disorders? A systematic review and meta-analysis. *J Oral Maxillofac Surg.* 2017;75(9):1835-1847.
22. Dantas RQ, Passeri LA, Castro AC, de Moraes HH. Arthrocentesis of the temporomandibular joint: evaluation of results and review of the literature. *Rev Bras Otorrinolaringol.* 2004;70(6):801-805.