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RESEARCH ARTICLE

COMPARATIVE EFFICACY OF ARTHROSCOPY VERSUS ARTHROCENTESIS FOR ADVANCED TEMPOROMANDIBULAR JOINT INTERNAL DERANGEMENT: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Temporomandibular joint internal derangement (TMJID) often leads to orofacial pain and dysfunction, frequently due to abnormal disc-condyle relationships. When conservative treatments fail for advanced TMJID, minimally invasive procedures like arthrocentesis and arthroscopy are considered, but comparative data on their effectiveness remain limited.

Materials and methods: This randomized controlled trial enrolled 26 female patients (18-45 years) with advanced TMJID. Patients were randomly assigned to Group A (n=13, arthroscopy) or Group B (n=13, arthrocentesis). Both groups received intra-articular platelet-rich plasma and hyaluronic acid. Baseline and 6-month follow-up assessments included Visual Analog Scale (VAS) for pain, Maximum Voluntary Mouth Opening (MVMO), Maximum Assisted Mouth Opening (MAMO), joint sounds, and MRI findings (disc position, morphology, osteoarthritic changes). Operative duration was recorded. Statistical analysis used SPSS 26.0.

Results:Both groups showed significant pain reduction over 6 months, with no significant inter-group difference in VAS scores ($p > 0.05$). Group A exhibited significantly greater improvements in both MVMO and MAMO compared to Group B at all postoperative time points ($p < 0.001$). Preoperative clicking (46.2% in both groups) resolved in both groups by 3 months, with no significant inter-group difference at 1 month ($p = 0.141$). MRI showed improved disc position (transition from DDWOR to DDWR) in both groups by 6 months, with no significant inter-group difference ($p = 0.680$). Arthroscopy had a significantly longer operative duration (72.08 ± 6.37 min vs. 27.15 ± 2.88 min; $p < 0.001$).

Conclusion: Both arthrocentesis and arthroscopy effectively reduce pain and improve disc position in advanced TMJID. However, arthroscopy demonstrates superior outcomes in improving maximum mouth opening, likely due to its direct ability to address complex intra-articular pathologies.

Keywords: Temporomandibular Joint, Internal Derangement, Arthrocentesis, Arthroscopy, Pain, Mouth Opening

INTRODUCTION

Temporomandibular joint internal derangement (TMJID) is a common cause of orofacial pain and functional limitation, primarily stemming from an abnormal relationship between the articular disc and the mandibular condyle.[1] Beyond this structural definition, TMJID can be conceptualized as a "system failure" encompassing any impediment to smooth TMJ movement, with functional rehabilitation being the paramount treatment objective. Understanding the TMJ's biomechanical function is crucial for effective management and realistic prognoses.[2]

Diverse classification systems for TMJID exist. Early criteria, established by Wilkes (1978), integrated clinical, surgical, and radiological findings, later incorporating magnetic resonance imaging (MRI).[3] More recently, Hegab et al.[4] developed a novel MRI-based classification correlating with clinical findings to guide non-surgical treatment protocols.

Common clinical manifestations of TMJID include preauricular pain, varied joint sounds (clicking, popping, grating, crepitus), aberrant mandibular movements, reduced range of motion, and masticatory muscle tenderness.[5,6] Accurate diagnosis requires comprehensive history taking and meticulous clinical examination, crucial given TMJID's multifactorial nature and frequent coexistence with other conditions.[7,8] MRI serves as a critical diagnostic tool, offering superior depiction of TMJ anatomy and pathologies.

The natural course of untreated TMJID indicates some patients experience spontaneous symptom resolution, with variable duration influenced by joint adaptation and individual healing capacity, supporting non-surgical management.[9] Treatment modalities span conservative, minimally invasive, and surgical approaches. Surgical management is typically reserved for cases refractory to conservative and minimally invasive therapies.[10] Hegab et al.[i] proposed a non-surgical protocol tailored to their classification stages, aiming to restore joint function. Al-Moraissi et al[11] recommend early implementation of minimally invasive procedures if conservative therapy is ineffective.

TMJ surgical arthroscopy, pioneered by Ohnishi (Japan), revolutionized treatment by enabling direct intra-articular visualization and advanced procedures via accessory portals. It became the primary minimally invasive surgical modality for TMJID[12]McCain categorized arthroscopic intervention into three levels: Level I (diagnostic, lysis, lavage), Level II (surgical, operative cannula for instruments), and Level III (advanced techniques like adhesiolysis, discopexy).[13] Dolwick and Nitzan later showed that simpler arthrocentesis (lysis and lavage without an arthroscope) yielded comparable results.[14]Both arthrocentesis and arthroscopy effectively manage "stuck" joints by lubricating the superior joint space and mobilizing the articular disc. Arthrocentesis is particularly beneficial for acute closed lock, while arthroscopy offers a more robust approach for chronic (>3 months) closed lock cases.[15]

Despite established efficacy in improving pain and function, comparative data on arthroscopy versus arthrocentesis in advanced TMJID remain limited. This study aims to address this gap by comparing the clinical and radiographic outcomes of arthroscopy and arthrocentesis in managing advanced TMJID through a randomized controlled trial.

MATERIALS AND METHODS

Ethical Compliance and Study Design

This investigation adhered strictly to the ethical principles of the Declaration of Helsinki. The study protocol was reviewed and approved by the Institutional Review Board of Al-Azhar University School of Dentistry. A randomized controlled clinical trial design was employed.

Patient Selection and Randomization

From 2022 to 2024, 26 patients (18-45 years old) with advanced TMJID, indicated for intervention, were recruited from the outpatient clinics of Oral and Maxillofacial Surgery at Sayed Galal University Hospital and the Faculty of Dental Medicine (Boys), Al-Azhar University, Cairo, Egypt. A single surgeon performed all procedures.

Following eligibility confirmation and informed consent, patients were randomly assigned to Group A (TMJ arthroscopy, n=13) or Group B (TMJ arthrocentesis, n=13) using a **1:1 allocation ratio**. Randomization was performed via a **computer-generated random sequence** by a research assistant not involved in patient care. Allocation concealment was ensured using **sequentially numbered, opaque, sealed envelopes (SNOSE)**, opened immediately prior to the procedure.

Inclusion and Exclusion Criteria

Inclusion criteria: Clinical and radiographic diagnosis of advanced TMJID requiring intervention; age 18-45 years; normal occlusion without significant malocclusion.

Exclusion criteria: Systemic inflammatory diseases (e.g., polyarthritis, rheumatoid arthritis); contraindications to MRI (e.g., metallic implants, severe claustrophobia); neurological disorders affecting craniofacial/muscular function; history of previous TMJ surgery; congenital/developmental TMJ disorders (e.g., ankylosis, hypoplasia).

Baseline and Follow-up Assessments

All patients underwent comprehensive clinical and radiographic evaluations pre-intervention for baseline data. Medical and dental history, including symptom onset, duration, progression, trauma, prior treatments, systemic illnesses, and parafunctional habits, was recorded.

Key outcome variables were assessed at baseline and postoperatively at 1 week, 1 month, 3 months, and 6 months:

- Pain Assessment: Quantified using a Visual Analog Scale (VAS).
- Maximum Voluntary Mouth Opening (MVMO) Magnetic Resonance Imaging (MRI): Performed preoperatively (Figure 1b, c) to confirm diagnosis and evaluate disc position/displacement, morphology/degeneration, and osteoarthritic changes. A follow-up MRI was conducted at 6 months (Figure 4b, c).
- (Figure 1a) and Maximum Assisted Mouth Opening (MAMO): Measured in millimeters.
- Joint Sound Assessment: Evaluated via palpation, clinician auditory detection, patient self-report, and stethoscope auscultation.
- Magnetic Resonance Imaging (MRI): Performed preoperatively (Figure 1b, c) to confirm diagnosis and evaluate disc position/displacement, morphology/degeneration, and osteoarthritic changes. A follow-up MRI was conducted at 6 months (Figure 4b, c).

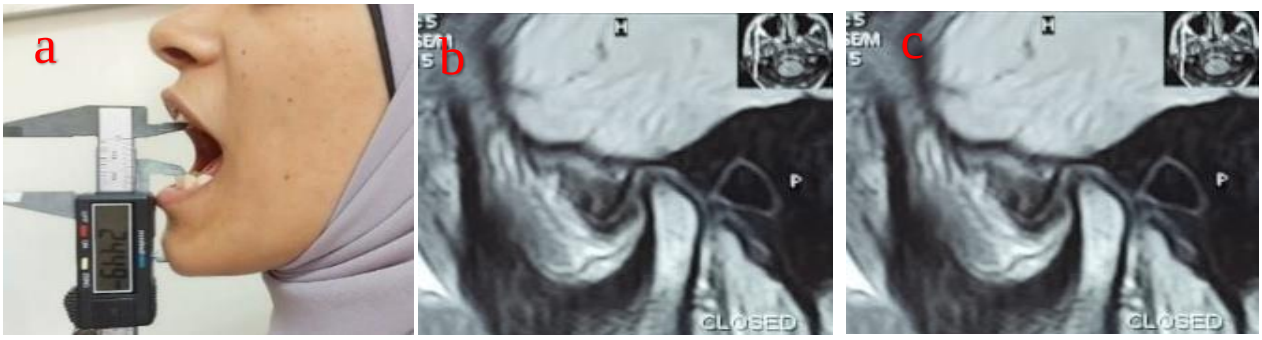

Figure 1. Preoperative photographs showing a. Clinical photograph demonstrating limited voluntary mouth opening. b. MRI in the closed-mouth position showing anterior disc displacement. c. MRI in the open-mouth position showing persistent anterior disc displacement and osteoarthritic changes of the condylar head

Surgical Procedure Standardization

All patients were hospitalized. Standard preoperative laboratory investigations and multi-specialty consultations ensured surgical fitness. All interventions were performed under general anesthesia by the same surgeon. Patients were supine with the head rotated contralaterally for optimal access. A sterile gauze pack protected the external auditory canal. The surgical site was meticulously prepared with antiseptic solution and sterile draping.

Platelet-Rich Plasma (PRP) and Hyaluronic Acid (HA) Preparation

Venous blood sample was collected into vacuum tubes containing (3.2% sodium citrate as anticoagulant). Samples underwent a single-step centrifugation at 3000 rpm for 10 minutes. After separation into layers, the uppermost platelet-poor plasma (PPP) was carefully removed. The remaining platelet-rich plasma (PRP), which included the buffy coat and the plasma immediately above it, was then aspirated. A total 4 ml intra-articular injectate was prepared by combining 2 ml PRP with 2 ml hyaluronic acid (Optivisc 20mg/2ml) for a homogeneous mixture.

Arthroscopy Procedure (Group A)

Arthroscopy utilized the Holmlund-Hellsing line. Two points were marked: Point A (2 mm inferior, 10 mm anterior to tragus–canthus line) for inflow, and Point B (10 mm inferior, 20 mm anterior) for outflow. The mandibular condyle was palpated with contralateral traction to locate the puncture site.

Group A underwent double-puncture arthroscopy (Level II). After anatomical landmark definition, two puncture sites were identified: one for the arthroscope (inflow) and one for outflow/instrumentation. A 3-mm vertical skin incision was made at Point A. A sharp trocar within a protective outer cannula was introduced, advanced anteromedially-superiorly to the inferior zygomatic arch, then carefully along the temporal fossa contour until capsular penetration

("loss of resistance"). The sharp trocar was immediately replaced with a blunt obturator, advanced for safe intra-articular placement, then removed. A 2.3 mm arthroscope (30° viewing angle) replaced the obturator, providing real-time superior joint space visualization for assessing synovitis, adhesions, or disc pathology (Figure 2 b). A second needle was inserted at Point B under direct arthroscopic visualization for continuous Ringer's lactate lavage outflow. After confirming needle position, a second 3-mm vertical skin incision was made at Point B.

Operative instruments (e.g., blunt probes, graspers, punches) were introduced through this portal for adhesiolysis, biopsy, and fibrotic tissue release (Figure 2 c, d).

Post-adhesiolysis and debridement, the joint space was thoroughly irrigated. After adequate lavage, the arthroscope was withdrawn. Skin incisions were closed with 5-0 polypropylene sutures. Subsequently, 2 ml of the PRP/HA mixture was injected into the superior joint space. total surgical duration were recorded.

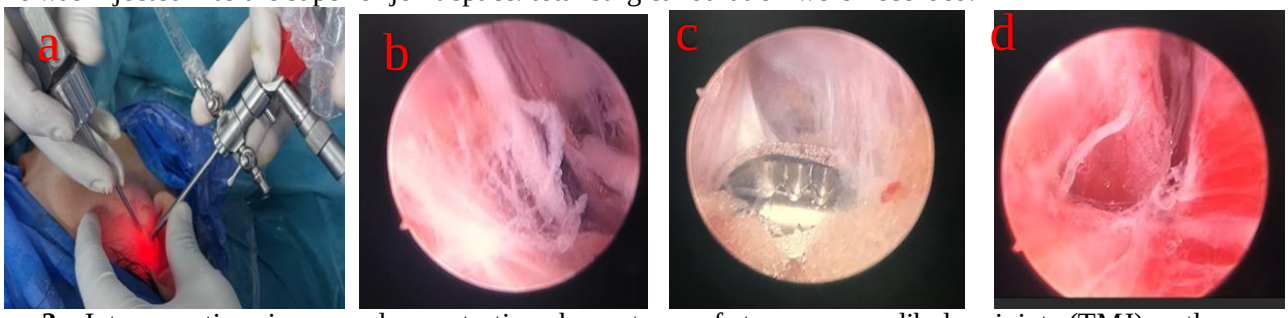

Figure 2. Intraoperative images demonstrating key steps of temporomandibular joint (TMJ) arthroscopy. a. showing proper positioning of the arthroscope and working instruments. b. Arthroscopic view revealing intra-articular adhesions. c. Use of a shaver for mechanical debridement and adhesiolysis. .Post-adhesiolysis arthroscopic image showing a cleared superior joint space following complete debridement ml hyaluronic acid (Optivisc 20mg/2ml) for a homogeneous mixture (fig2a,b).

Arthrocentesis Procedure (Group B)

The first needle (inflow, Ringer's lactate) was inserted at Point A, directed anteromedially-superiorly to contact the inferior zygomatic arch and then advanced along the fossa contour into the superior joint space. Correct placement was confirmed by contralateral mandibular movement upon infusion and solution return into the syringe upon mouth closure.

After confirming the first needle's position, the second needle was inserted at Point B for outflow. An extension line to the first needle facilitated continuous Ringer's lactate infusion under pressure (120 ml total) (Figure 3a). Post-lavage, needle and extension were removed, and 2 ml of the PRP/HA mixture was injected into the superior joint space (Figure 3b). Mandibular manipulation was performed to enhance mobility and address adhesions.

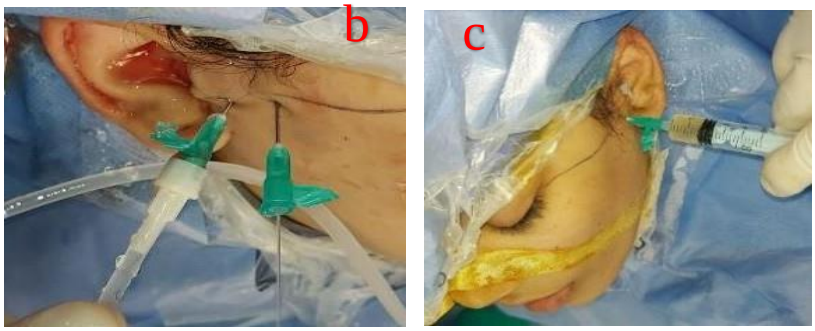

Figure 3. Intraoperative photographs showing a. double needle arthrocentesis b. injection of PRP and HA

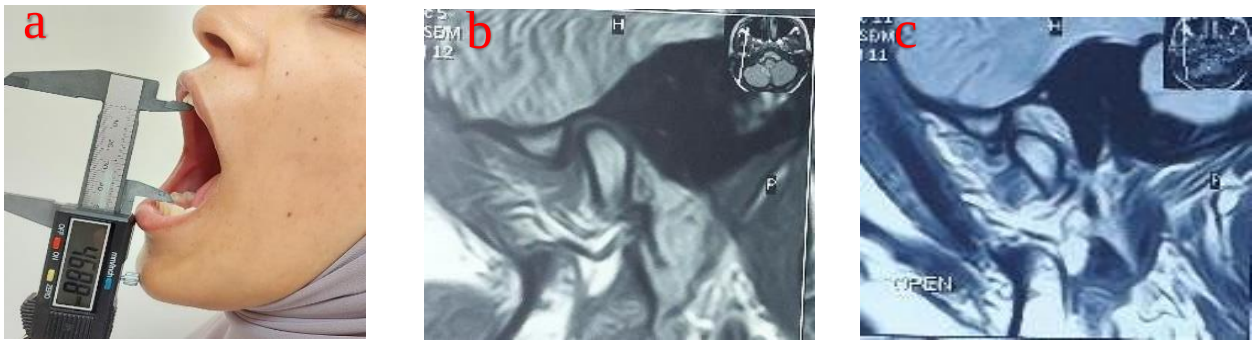

Figure 4. Postoperative photographs showing a. Clinical photograph showing improved maximum voluntary mouth opening b. MRI in the closed-mouth position demonstrating proper disc position c. MRI in the open-mouth position showing disc recapture and improvement in osteoarthritic changes of the condylar head.

Statistical Analysis

Data were analyzed using SPSS (version 26.0). Quantitative data were presented as mean ± SD and ranges (parametric) or median with IQR (non-parametric). Qualitative variables were summarized as frequencies and percentages. Normality was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests.

RESULTS

This randomized controlled trial comprised 26 patients, equally distributed into the Arthroscopy Group (Group A, n=13) and the Arthrocentesis Group (Group B, n=13), with comparable inclusion/exclusion criteria.

Demographic Characteristics

Demographic analysis revealed no significant age difference between groups (Group A: 33.19 ± 4.61 years; Group B: 32.70 ± 5.91 years; $p = 0.196$). All patients in both groups (100%) were female.

Pain Assessment (VAS)

Both groups demonstrated significant pain reduction over 6 months. No statistically significant differences in pain reduction were observed between Group A and Group B at any time point (all $p > 0.05$).

Mandibular Mobility

Maximum Voluntary Mouth Opening (MVMO): Group A exhibited significantly greater improvement in MVMO compared to Group B across all postoperative time points (1 day to 6 months) ($p < 0.001$). Baseline MVMO was comparable.

Maximum Assisted Mouth Opening (MAMO): Group A similarly showed significantly greater MAMO than Group B at all post-procedure intervals (1 day to 6 months) ($p < 0.001$). No significant baseline difference existed.

Joint Clicking

Preoperatively, 46.2% of patients in each group presented with joint clicking. At 1 month, clicking was eliminated in Group A (0%), while 15.4% in Group B still reported clicking; this difference was not statistically significant ($p = 0.141$). By 3 months, clicking resolved in both groups and remained absent at 6 months.

MRI Findings: Disc Displacement

At baseline, both groups had similar disc displacement distributions (69.2% DDWOR, 30.8% DDWR). At 6 months, Group A showed 30.8% DDWOR and 69.2% DDWR, while Group B had 38.5% DDWOR and 61.5% DDWR. No statistically significant inter-group differences in disc position changes were detected at 6 months ($p = 0.680$).

Operative Duration

The mean operative duration was significantly longer in Group A (arthroscopy) (72.08 ± 6.37 min) compared to Group B (arthrocentesis) (27.15 ± 2.88 min), with a highly significant difference ($p < 0.001$).

DISCUSSION

TMJID is a complex, multifactorial disorder affecting the structural and functional integrity of the TMJ. Advanced stages, characterized by disc displacement without reduction, degenerative changes, adhesions, and chronic inflammation, often necessitate minimally invasive surgical interventions like arthrocentesis and arthroscopy when conservative therapies fail, preceding open joint surgery.

Pain Management Outcomes

Both arthrocentesis and arthroscopy significantly reduced pain (VAS scores), with no statistically significant differences between groups at any follow-up. These findings align with literature demonstrating comparable analgesic efficacy for both techniques.[18,19] Arthrocentesis likely achieves pain relief by irrigating the superior joint space, reducing inflammatory cytokines.[20] Arthroscopy, in addition to lavage, allows mechanical debridement of adhesions and inflamed synovial tissue, enhancing its effect in more fibrotic joints.[21,22] Some authors, however, propose arthroscopy offers more consistent long-term pain control due to synovial debridement capacity.[23]

Our results revealed significantly superior MVMO and MAMO in the arthroscopy group across all postoperative time points. This corroborates reports by Murakami et al.[24] and Sanromán[25], highlighting arthroscopy's greater effectiveness in improving mandibular mobility, particularly in advanced internal derangement. This enhanced efficacy is attributed to arthroscopy’s direct visualization and therapeutic interventions (adhesiolysis, synovectomy, mechanical manipulation). In contrast, arthrocentesis primarily relies on hydraulic distension and lavage, which may be insufficient for dense fibrotic tissue or extensive intra-articular pathology.[19]

Conversely, some studies report comparable mouth opening improvements between the two techniques. Nitzan et al.[16] and Yoshida et al.[26] found no significant difference, suggesting lavage alone may resolve hypomobility in select cases, particularly with less fibrotic adhesion. Alkan et al.[27] similarly concluded that arthroscopy's additional complexity and operative time might not always yield superior functional outcomes.

Preoperative joint clicking (46.2% in both groups) resolved in both by 3 months. Although arthroscopy showed earlier resolution, the difference was not statistically significant. These results are consistent with Machon V and Guarda-Nardini L[28,29], demonstrating effective resolution of joint sounds after both procedures, likely due to joint decompression and improved disc-condyle coordination.

MRI findings at 6 months indicated improved disc position in both groups (transition from DDWOR to DDWR), with no statistically significant inter-group differences.

This aligns with studies like Kiliç et al.[30], who observed improved disc positioning post-procedure due to joint space widening and inflammation reduction. While arthroscopy offers mechanical manipulation, both interventions appear capable of favorable radiographic changes in disc alignment, mediated by joint decompression and improved intra-articular dynamics. The arthroscopy group had a significantly longer operative duration than the arthrocentesis group, expected due to additional time for portal placement and intra-articular instrumentation. Dimitroulis and McCain[ii, iii] emphasized that despite being more time-consuming, arthroscopy provides superior diagnostic and therapeutic capabilities, especially for chronic TMJID with advanced pathological changes.

CONCLUSION

Both temporomandibular joint arthrocentesis and arthroscopy are effective modalities for managing advanced TMJID, notably in reducing joint pain and improving overall function. However, arthroscopy consistently demonstrated superior outcomes in enhancing maximum mouth opening, likely due to its capacity for direct intervention, enabling mechanical debridement and manipulation of intricate intra-articular pathologies. Consequently, arthroscopy appears particularly advantageous in more advanced disease stages where joint structures are severely compromised.

Limitations

This study's limitations include its relatively small sample size and the exclusive inclusion of female patients, which may restrict result generalizability. Furthermore, the comparatively short 6-month follow-up period may not sufficiently capture long-term outcomes, such as recurrence or progressive joint degeneration.

Future research should involve larger, more diverse populations and extended observation periods to assess treatment durability.

DECLARATIONS

Ethical statement

This study was performed in line with the principles of the Declaration of Helsinki.

Funding

This research did not receive any specific funding.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Patient Consent Statement

Written informed consent was obtained from all participating patients for the use of their anonymized medical records for research purposes.

REFERENCES

1. Dolwick MF, Katzberg RW, Helms CA. Internal derangements of the temporomandibular joint: fact or fiction? J Prosthet Dent. 1983;49(3):415–8.
2. De Leeuw R. Internal derangements of the temporomandibular joint. Oral Maxillofac Surg Clin North Am. 2008;20(2):159–68.
3. Wilkes CH. Structural and functional alterations of the temporomandibular joint. Northwest Dent. 1978;57(5):287–94.
4. Hegab AF, Al Hameed HI, Karam KS. Classification of temporomandibular joint internal derangement based on magnetic resonance imaging and clinical findings of 435 patients contributing to a nonsurgical treatment protocol. Sci Rep. 2021;11(1):20917.
5. Palmer J, Durham J. Temporomandibular disorders. BJA Educ. 2021;21(2):44–50.
6. Guarda-Nardini L, De Almeida AM, Manfredini D. Arthrocentesis of the temporomandibular joint: systematic review and clinical implications of research findings. J Oral Facial Pain Headache. 2021;35(1).
7. Ferrillo M, Giudice A, Marotta N, Fortunato F, Di Venere D, Ammendolia A, et al. Pain management and rehabilitation for central sensitization in temporomandibular disorders: a comprehensive review. Int J Mol Sci. 2022;23(20):12164.
8. Brochado FT, Jesus LH, Carrard VC, Freddo AL, Chaves KD, Martins MD. Comparative effectiveness of photobiomodulation and manual therapy alone or combined in TMD patients: a randomized clinical trial. Braz Oral Res. 2018;32:e50.
9. Tomas X, Pomes J, Berenguer J, Quinto L, Nicolau C, Mercader JM, et al. MR imaging of temporomandibular joint dysfunction: a pictorial review. Radiographics. 2006;26(3):765–81.
10. Kurita K, Westesson PL, Yuasa H, Toyama M, Machida J, Ogi N. Natural course of untreated symptomatic temporomandibular joint disc displacement without reduction. J Dent Res. 1998;77(2):361–5.
11. Warburton G, Patel N, Anchlia S. Current treatment strategies for the management of the internal derangements of the temporomandibular joint: a global perspective. J Maxillofac Oral Surg. 2022;21(1):1–13.
12. Hegab AF, Al Hameed HI, Karam KS. Classification of temporomandibular joint internal derangement based on magnetic resonance imaging and clinical findings of 435 patients contributing to a nonsurgical treatment protocol. Sci Rep. 2021;11(1):20917.

12. Al-Moraissi EA, Wolford LM, Ellis E 3rd, Neff A. The hierarchy of different treatments for arthrogenous temporomandibular disorders: a network meta-analysis of randomized clinical trials. J Craniomaxillofac Surg. 2020;48(1):9–23.
13. Ohnishi M. Clinical application of arthroscopy in the temporomandibular joint diseases. Bull Tokyo Med Dent Univ. 1980;27(3):141–50.
14. Lanz J. Discitis mandibularis. Zentralbl Chir. 1909;9:289.
15. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. J Oral Maxillofac Surg. 1991;49(11):1163–7.
16. Ritto FG, Cueto AP, Canellas JV, Zuniga JR, Tiwana PS, Pimentel T, et al. Arthrocentesis versus nonsurgical methods in the management of temporomandibular joint closed lock and pain: a double-blind randomized controlled trial. Oral Surg OralMed Oral Pathol OralRadiol.2022;133(4):369–76.
17. Al-Moraissi EA, Wolford LM, Perez D, Laskin DM, Ellis E. Does arthroscopy or arthrocentesis of the temporomandibular joint reduce pain more effectively in patients with internal derangement? A systematic review and meta-analysis. J Oral Maxillofac Surg. 2015;73(3):482–91.
18. Guarda-Nardini L, Manfredini D, Ferronato G. Arthrocentesis of the temporomandibular joint: a proposal for a single-needle technique. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;106(4):483–6.
19. Nitzan DW. The process of lubrication impairment and its restoration in the temporomandibular joint—a look at the relationship between structure and function. J Oral Rehabil. 2001;28(6):571–9.
20. McCain JP, de la Rua H. TMJ arthroscopic surgery: a review of 2,581 cases. J Oral Maxillofac Surg. 1992;50(9):926–30.
21. Miloro M, Ghali GE, Larsen PE, Waite PD. Peterson's Principles of Oral and Maxillofacial Surgery. 2nd ed. Hamilton: BC Decker Inc; 2004. p. 1091–100.
22. Dimitroulis G. A review of the clinical and surgical aspects of temporomandibular disorders. Aust Dent J. 2005;50(4):259–64.
23. Murakami K, Hoshino K, Goto K, Nishida M. Treatment of internal derangement of the temporomandibular joint by arthroscopic surgery: analysis of 1820 cases. J Oral Maxillofac Surg. 2000;58(9):895–900.
24. Sanromán JF. Closed lock (MRI diagnosed) temporomandibular joint internal derangement: arthroscopic treatment vs. arthrocentesis outcome. Med Oral Patol Oral Cir Bucal. 2005;10(Suppl 1):E419–25.
25. Yoshida H, Tsuyama M, Yamaguchi R, Ishikawa Y, Maki K. Clinical outcomes of arthrocentesis versus arthroscopic surgery for internal derangement of the temporomandibular joint: a comparative study. Cranio. 2013;31(4):251–6.
26. Alkan A, Baş B, Ozer M, Bayram M, Arslan A. Comparison of arthrocentesis with and without injection of sodium hyaluronate in treatment of internal derangement of temporomandibular joint. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;103(6):e6–9.
27. Machon V, Levorova J, Hirjak D, Foltan R. Arthrocentesis of the temporomandibular joint: a review. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2015;159(1):31–4.
28. Guarda-Nardini L, Rossi A, Arboretti R, Bonnini S, Manfredini D. Single-needle temporomandibular joint arthrocentesis: a randomized controlled trial on additional drugs. J Oral Maxillofac Surg. 2012;70(2):337–43.
29. Kiliç C, Güven O, Aydemir S. Long-term evaluation of disc position after arthroscopic lysis and lavage. Br J Oral Maxillofac Surg. 2010;48(2):119–22.
30. Dimitroulis G. A review of the clinical and surgical aspects of temporomandibular disorders. Aust Dent J. 2005;50(4):259–64.
31. McCain JP. TMJ arthroscopy. In: Fonseca RJ, editor. Oral and Maxillofacial Surgery. Vol. 4. Philadelphia: Saunders; 2000; 378–403.