Journal of Maxillofacial and Oral Surgery
https://doi.org/10.1007/s12663-026-02958-1

TECHNICAL NOTE

An Adapted Single-Needle Arthrocentesis Technique for the Temporomandibular Joint to Enhance Circuit Stability and Enable Synovial Fluid Sampling

Nicolás P. Skármeta[1,6] · **Giannina Katzmann**[1,2] · **Begoña Moreno**[1,3] · **Luca Guarda-Nardini**[4] · **Daniele Manfredini**[5]

Received: 22 September 2025 / Accepted: 21 January 2026

Abstract

Background Temporomandibular joint (TMJ) arthrocentesis is an effective procedure for lysis and lavage of the joint, typically performed using either double-puncture (DPA) or single-puncture arthrocentesis (SPA) techniques. The SPA technique described by Guarda-Nardini et al. has become one of the most studied and widely used approaches due to its procedural simplicity and reduced trauma.

Objective To describe an adaptation of the single-puncture arthrocentesis technique that enhances circuit stability and enables integrated synovial fluid sampling by relying on intra-articular pressure generation.

Technique This adaptation uses intra-articular pressure-driven fluid dynamics to maintain consistent lavage with minimal needle repositioning and reduced patient involvement. A straightforward push-and-pull protocol enables macroscopic analysis and semi-qualitative biomarker detection (presence/absence). The technique retains the original benefits of reduced trauma, lower anesthesia requirements, and procedural efficiency while adding diagnostic potential.

Conclusion This adaptation enhances single-puncture TMJ arthrocentesis by enabling synovial fluid sampling while maintaining procedural advantages. Further validation is recommended to assess efficacy across different anatomical variants and clinical conditions.

Keywords Temporomandibular joint · Arthrocentesis · Synovial fluid · Single-needle arthrocentesis

Introduction

Arthrocentesis of the temporomandibular joint (TMJ) is a widely accepted procedure for joint lysis and lavage. The traditional double-puncture arthrocentesis (DPA) technique, first described by Nitzan [1], involves irrigating the upper joint compartment using two needles at separate insertion points [2]. Since its introduction, this procedure has become widely popular among clinicians due to its predictable and positive patient outcomes [3].

While DPA enables high-volume irrigation to clear inflammatory cytokines and metabolic detritus, positioning two needles can be challenging due to condylar movements and anatomic variability [2], potentially increasing the risk of complications. These limitations led to the development of single-puncture arthrocentesis (SPA) techniques [4].

The single-needle technique, first described by Guarda-Nardini et al. [4], has proven advantageous by simplifying

✉ Nicolás P. Skármeta
nicolas.skarmeta@gmail.com

1 Orofacial Pain Unit, Hospital del Salvador, SSMO, 7500922 Providencia, Chile

2 Facultad de Odontología, Universidad de los Andes, 7620001 Santiago, Chile

3 Orofacial Pain and TMD Program, Faculty of Odontology, Andrés Bello University, 8370133 Santiago, Chile

4 Unit of Oral and Maxillofacial Surgery, Ca'Foncello Ospedale Treviso, ASL 2 Marca Trevigiana, 31100 Treviso, Italy

5 Department of Medical Biotechnologies, School of Dentistry, University of Siena, 53100 Siena, Italy

6 Clínica Oph, Vitacura, Santiago, Chile

Published online: 27 February 2026

the procedure, reducing anesthetic requirements and procedural time, and improving patient tolerability [4–6]. In this SPA technique [5–8], the fluid inflow is typically performed with the patient's mouth open to facilitate joint space expansion, while outflow occurs when the patient closes their mouth, ejecting lavage solution through the same needle.

However, maintaining circuit stability during condylar motion remains challenging for thorough joint lavage. The proposed adaptation relies on intra-articular pressure generated by injection, minimizing needle repositioning and ensuring stable inflow/outflow for lavage. This technique also enables synovial fluid (SF) sampling using a method similar to the push-and-pull principle described by Alstergren et al. [9], facilitating semi-qualitative assessments of dilution.

Technique Description

1. Preparation: Disinfect the skin with 70% ethanol or 5% chlorhexidine. Administer local anesthesia, including an auriculotemporal nerve block and subcutaneous anesthesia at the puncture site.
2. Landmarks and Needle Insertion: Using the same landmarks as Guarda-Nardini's technique [4], identify the puncture site 10 mm from the middle of the tragus and 2 mm below the canthotragal line. Insert a single 21-gauge x 1½" needle at a 30°-45° angle into the upper joint compartment in a superior-medial-anterior direction towards the superior joint space, achieving osseous contact with the posterior slope of the articular eminence or medial wall of the glenoid fossa in open-mouth position (Fig. 1). Correct positioning can be confirmed by osseous contact, a vacuum sound, or observing ejection of anesthesia or a droplet of synovial fluid through the needle hub.

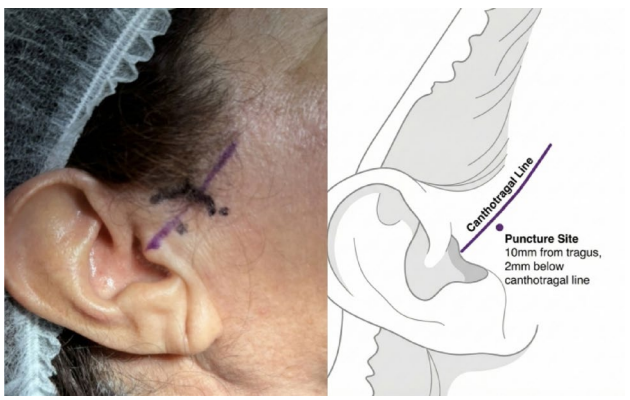

Fig. 1 Landmarks for needle placement in the upper TMJ joint compartment. Puncture site: 10 mm from tragus, 2 mm below canthotragal line

3. Initial Inflow and Synovial Fluid Sampling: Attach a 3 mL Luer slip syringe with sterile saline and inject approximately 1–2 mL under slight positive pressure. Correct insertion can be confirmed by the plunger's pumping effect as described by Murakami et al. [10]. Perform initial pumping to generate turbulence and mix fluid.
   If SF sampling is warranted (e.g., for semi-qualitative analysis), employ the push-and-pull technique (3–5 cycles of ~0.5 mL) with the same syringe to collect 0.5-1 mL of synovial fluid-saline mixture. Transfer to a sterile, labeled 1.5 mL microcentrifuge tube and note the macroscopic appearance (e.g., cloudiness/color indicating inflammation) (Fig. 2). Within 1 h, transfer the sample to the lab for centrifugation at 1000–3000 rpm for 5–10 min at 4 °C, according to manufacturer's instructions, to clarify the supernatant. Aliquot and store at − 80 °C to preserve biomarkers for downstream immunoassay analysis (e.g., ELISA or multiplex bead-based assays for cytokines such as IL-1β, IL-6, TNF-α; chemokines such as RANTES/CCL5, MCP-1; growth factors such as VEGF; or degenerative markers such as aggrecanases and matrix metalloproteinases, potentially enabling endotyping of TMJ disease).
4. Lavage Technique: Switch to a 5–10 mL Luer slip syringe with sterile saline. Inject under slight positive pressure to create intra-articular pressure, breaking adhesions and expanding the joint space. Remove the syringe to allow passive ejection due to increased intracapsular pressure and capsular tissue distension. Repeat cycles until sufficient irrigation is achieved (ideally 40 mL total, as in Guarda-Nardini et al. [4]), or until effluent is clear. (Fig. 3 and Video 1). Excess fluid can be expelled by instructing the patient to close their mouth if needed.
5. Post-Lavage Medication: Administer intra-articular medication if required (e.g., hyaluronic acid, corticosteroids, or orthobiologics depending on Wilkes staging or degenerative/inflammatory TMJ status).

Discussion

This single-puncture arthrocentesis technique builds on the original method by Guarda-Nardini et al. [4] by emphasizing intra-articular pressure for circuit stability during lavage and integrated SF sampling. The adapted SPA technique retains the advantages of the original method [5, 6, 8], including procedural simplicity, reduced trauma, lower anesthetic requirements, enhanced retention of

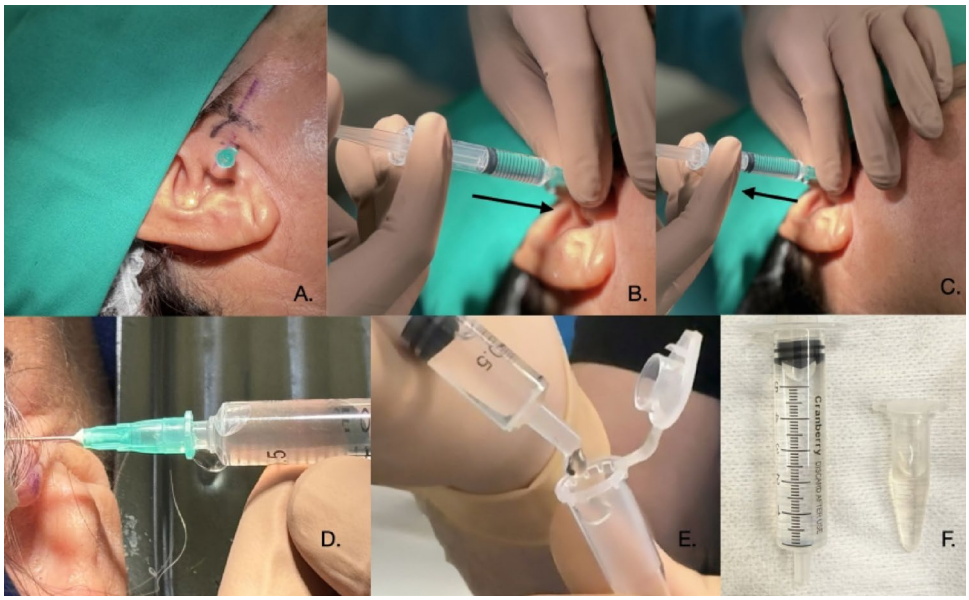

Fig. 2 Step-by-step illustration of the adapted single-puncture arthrocentesis technique, focusing on needle insertion, initial inflow with push-and-pull synovial fluid (SF) sampling, and sample handling. Panels demonstrate procedural stability and SF collection for semi-qualitative analysis. **A** Needle insertion into the upper joint compartment using landmarks (10 mm from tragus, 2 mm below canthotragal line) in open-mouth position. **B** After achieving repeated pumping in the superior joint space, initiate push-and-pull cycles (0.5-1 mL per cycle); this panel illustrates the pushing phase. **C** Illustration of the pulling phase to collect the synovial fluid-saline mixture sample. **D** 3 mL syringe after push-and-pull cycles, showing the collected SF sample. **E** Transfer of the SF sample to a sterile 1.5 mL microcentrifuge tube. **F** Macroscopic difference between saline (clear) and SF sample (cloudy/amber, indicating potential inflammation or cellular content)

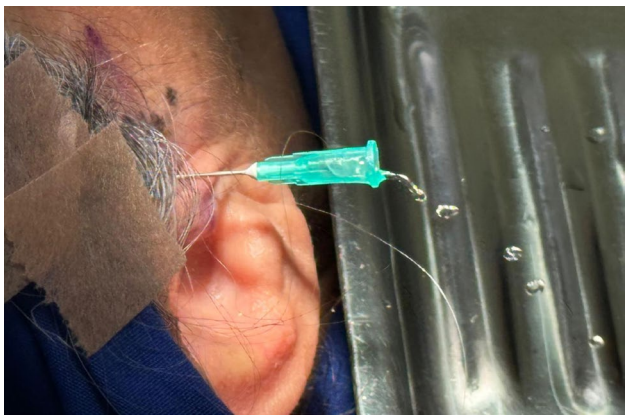

Fig. 3 Lavage technique showing saline ejection after positive intra-articular pressure, effectively expanding the joint space and performing lavage

intra-articular medication, and maintenance of adequate intra-articular pressure to facilitate effective lavage and adhesion breakage. By minimizing condylar movements and relying on intra-articular pressure, the technique reduces the need for needle repositioning and simplifies procedural complexity while ensuring a consistent lavage performance. Although capsular distention during lavage may cause transient discomfort and reversible malocclusion, these effects are typically managed through patient reassurance, short-term analgesics, and post-procedure care (see comparison between both techniques, Table 1).

Table 1 Comparison of original and adapted SPA techniques

Aspect	Original SPA (Guarda-Nardini 2008) [4]	Adapted SPA (this note)
Puncture Sites	Single needle	Single needle
Ejection Mechanism	Primarily throughout mouth closure	Passive pressure release + optional closure
Circuit Stability	Condylar motion-dependent	Pressure-enhanced, motion-minimized
SF Sampling	Not integrated	Push-pull semi-qualitative
Trauma/Anesthesia	Reduced vs. DPA	Similar or further reduced
Lavage Volume	~40 mL (10 repetitions)	~40 mL (up to 300 mL if needed)
Indications	TMJ lavage, lysis fibrous adhesions, improve joint mobility, reduce pain	Similar + diagnostic (e.g., TMJ disease endotyping via immunoassays)

Unlike Guarda-Nardini's original technique [4], which primarily relies on mouth closure for fluid ejection, our adaptation prioritizes passive pressure release from capsular distention, enabling consistent lavage with less patient involvement. Additionally, this adaptation facilitates synovial fluid sampling, which may improve clinical research and diagnostic capabilities, particularly in identifying potential endotypes in different intra-articular pathologies. This straightforward push-and-pull method builds on Alstergren et al. [9] but is streamlined for clinical use

without mandatory dilution correction, allowing detection of disease biomarkers which can further potentiate the value of this technique for diagnostic or research purposes.

While the technique offers promising advantages, its reliance on intra-articular pressure and capsular distention may limit its applicability in patients with advanced joint damage or distended capsular spaces. In our experience with over 100 patients, the technique achieves a 95% success rate, with circuit loss or inability to perform occurring in approximately 5% of cases, often due to anatomic variability. Such conditions, particularly in cases involving severe osteoarthritis or fibrotic capsular changes, could reduce its therapeutic effectiveness. Future studies should prioritize identifying clinical conditions where this technique is most advantageous and explore its adaptability to varying joint morphologies.

Conclusion

This technical note introduces an adaptation of the SPA technique proposed by Guarda-Nardini et al. [4]. The adaptation maintains the clinical outcomes and advantages of the original technique while improving circuit stability and allowing synovial sampling, opening avenues for clinical endotyping and research.

Further studies are needed to validate the efficacy of this modified approach compared to the original SPA technique, particularly its effectiveness across different anatomical variants and clinical conditions, as well as its overall role in TMJ management.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12663-026-02958-1.

Author Contributions Conception and design of study, Acquisition of data: laboratory or clinical: Skármeta, NP, Katzmann, G, Moreno, B., Guarda Nardini, L, Manfredini, D. Drafting of article and/or critical revision: Skármeta, NP, Katzmann, G, Moreno, B., Guarda Nardini, L, Manfredini, D. Analysis of data: Guarda Nardini, L, Manfredini, D. Drafting of article and/or critical revision: Skármeta, NP, Katzmann, G, Moreno, B., Guarda Nardini, L, Manfredini, D. Final approval of manuscript: Skármeta, NP, Guarda Nardini, L, Manfredini, D.

Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

Informed consent was obtained from patients for images, video, and preliminary applications.

Ethical statement The authors did not receive support from any organization for the submitted work, and no funding, grants, or other financial assistance was provided for the preparation of this manuscript or for conducting the described technical adaptation. The authors have no relevant financial or non-financial interests to disclose, including no affiliations with or involvement in any organization or entity that could influence the content of this article. Ethics approval is not applicable, as this manuscript is a technical note describing a procedural adaptation based on existing literature and does not involve studies with human participants, their data, or biological material; it adheres to ethical standards for procedural guidelines in accordance with the 1964 Helsinki Declaration and its amendments. Informed consent to participate is not applicable, given the absence of human research participants. All authors contributed to the study and review and approval of the final manuscript.

References

1. Nitzan DW, Dolwick MF, Martinez GA (1991) Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. J Oral Maxillofac Surg 49:1163–1167
2. Grossmann E, Ferreira LA, Poluha RL, Setogutti E, Iwaki LCV, Iwaki Filho L (2022) Comparison of two needles arthrocentesis versus double needle cannula arthrocentesis in the treatment of temporomandibular disc displacement. Cranio 40:358–364
3. Bouloux GF, Greene CS, Mercuri LG (2024) Intraarticular TMJ pain and dysfunction—2024—invited guest editorial. Cranio 42:481–482
4. Guarda-Nardini L, Manfredini D, Ferronato G (2008) Arthrocentesis of the temporomandibular joint: a proposal for a single-needle technique. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 106:483–486
5. Guarda-Nardini L, Ferronato G, Manfredini D (2012) Two-needle vs. single-needle technique for TMJ arthrocentesis plus hyaluronic acid injections: a comparative trial over a six-month follow up. Int J Oral Maxillofac Surg 41:506–513
6. Guarda-Nardini L, Meneghini M, Zegdene S, Manfredini D (2021) Temporomandibular joint arthrocentesis in patients with degenerative joint disease: a 10- to 22-year follow-up. J Oral Facial Pain Headache 35:113–118
7. Manfredini D, Rancitelli D, Ferronato G, Guarda-Nardini L (2012) Arthrocentesis with or without additional drugs in temporomandibular joint inflammatory-degenerative disease: comparison of six treatment protocols. J Oral Rehabil 39:245–251
8. Guarda-Nardini L, De Almeida A, Manfredini D (2021) Arthrocentesis of the temporomandibular joint: systematic review and clinical implications of research findings. J Oral Facial Pain Headache 35:17–29
9. Alstergren P, Appelgren A, Appelgren B, Kopp S, Lundeberg T, Theodorsson E (1995) Determination of temporomandibular joint fluid concentrations using vitamin B12 as an internal standard. Eur J Oral Sci 103:214–218
10. Murakami KI, Matsuki M, Iizuka T, Ono T (1987) Recapturing the persistent anteriorly displaced disk by mandibular manipulation after pumping and hydraulic pressure to the upper joint cavity of the temporomandibular joint. Cranio 5:17–24