

Double-Puncture Versus Single-Puncture Arthrocentesis: A Randomized Controlled Trial with 3 Years of Follow-Up

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Aims: To compare the clinical effectiveness of conventional double-puncture vs single-puncture type 2 arthrocentesis for management of temporomandibular joint (TMJ) disc displacement without reduction (DDWOR) after 3 years of follow-up. **Methods:** A total of 26 patients with DDWOR were randomly and blindly allocated into two treatment groups (n = 13 each): group 1 = conventional double-puncture arthrocentesis; group 2 = single-puncture type 2 arthrocentesis. Data on gender, side of painful joint complaint, age (years), duration of joint pain (months), maximum interincisal distance (MID, mm), and pain intensity (self-reported with a 0–10 visual analog scale [VAS]) were collected. VAS scores and MID were measured before (baseline) and 3 years after (final) the arthrocentesis. **Results:** Twenty-three patients completed the study (group 1, n = 11; group 2, n = 12). Both techniques resulted in significantly reduced VAS scores and increased MID ($P = .001$) after the 3 years of follow-up; however, there were no statistically significant differences between techniques ($P > 0.05$). **Conclusion:** The two arthrocentesis methods tested were both effective in reducing VAS scores and increasing MID in patients with DDWOR. *J Oral Facial Pain Headache* 2022;36:141–146. doi: 10.11607/ofph.3074

Keywords: arthrocentesis, disc displacement without reduction, temporomandibular joint disorders

Temporomandibular joint (TMJ) disc displacement without reduction (DDWOR) is one of the most common TMJ internal derangements, with a clinical prevalence of 35.7%.^{1,2} In DDWOR, the disc remains anteriorly displaced in relation to the condyle both in MRI and clinical examinations of the TMJ, either with the mouth open or closed. Pain and limitation in mouth opening are the main clinical features.^{3–6}

DDWOR treatment should initially be conservative with the use of reversible therapeutic modalities such as drugs, interocclusal devices, and physiotherapy. When these approaches do not produce the expected results, surgical alternatives should be considered.⁷ TMJ arthrocentesis is a minimally invasive surgical intervention that consists of washing the TMJ upper compartment without direct visualization.^{8,9} The main objectives of this procedure are to dilute the local algogenic substances and to remove adhesions.^{10–13}

Although the conventional double-puncture technique for TMJ arthrocentesis presents good results with low morbidity rates,¹⁴ variations such as the single-puncture type 2 technique^{15,16} have been used in an attempt to optimize treatment and reduce surgical time and morbidity.^{17,18} Both TMJ arthrocentesis techniques can be performed without statistically significant differences.^{10,11,19–21} TMJ arthrocentesis presents a success rate ranging between 70% and 91%¹³; however, the research usually presents a short follow-up period (mean of 6 to 24 months).^{22–24} Only one recent study showed that the procedure, performed with two needles or with one needle, is effective in the management of degenerative joint diseases in the long term²⁵; however, studies with a DDWOR population and using a double-needle cannula are still missing. Such analysis could be useful for consolidating the results of the literature.

Therefore, the present study aimed to compare the clinical efficacy of the conventional double-puncture vs single-puncture type 2

arthrocentesis techniques for management of TMJ DDWOR. The results were compared over a 3-year follow-up period. The null hypothesis was that there would be no differences between techniques and that positive results would be maintained after 3 years of procedures without any additional treatment.

MATERIALS AND METHODS

This randomized controlled trial was conducted in accordance with the ethical standards of the Helsinki Declaration of 1975 and approved (no. 2.224.751) by the Ethics and Research Committee of the Faculty of Medicine of the Federal University of Rio Grande do Sul, Porto Alegre, Brazil. All patients signed a free informed consent form before participating in the study.

Sample

G*Power version 3.1.9.2 software was used for sample size calculation. Sample size calculation was conducted with 80% power and a 5% significance level. After adding 10% to compensate for possible losses and refusals, the final sample size was 26, which was equally divided into two groups ($n = 13$ each): group 1 = conventional double-puncture arthrocentesis; group 2 = single-puncture type 2 arthrocentesis. Patients were blinded to the procedures and allocated to the groups by a computer-generated randomization draw (<https://random-allocation-software.software.informer.com/2.0/>) performed immediately before the procedure. All patients were evaluated, diagnosed, and treated between August 2017 and November 2017 and were followed up until April 2021 at the Orofacial Pain and Deformity Center (CENDDOR) in Porto Alegre, Brazil. All arthrocentesis procedures were conducted by a single experienced professional (E.G.). After arthrocentesis, 1 mL of sodium hyaluronate (SH) 10 mg (Osteonil Mini, TRB Pharma) was infiltrated in the upper TMJ compartment of all patients. Besides the SH injections, no other treatment was applied after arthrocentesis during the follow-up period.

The sample was composed of individuals of either gender older than 18 years with clinical signs and symptoms compatible with unilateral DDWOR associated with painful joint complaint (acute or chronic) who had not responded to conservative treatment (eg, occlusal splint, anti-inflammatory drugs, warm compresses, light diet, and/or physiotherapy) for at least 3 months previously. DDWOR diagnosis was confirmed by a combination of clinical examinations based on the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) Axis I³ and MRI scan reports.^{4,26} Individuals were excluded

if they had any pain other than articular pain (such as myofascial pain); rheumatoid arthritis, agenesis, hypoplasia, and/or malignant neoplasm of the mandibular condyle; bone ankylosis; previous TMJ surgery; or had previously undergone arthrocentesis alone or in combination with other substances. Extremely anxious individuals were also not considered for the study.

A second evaluator who did not know to which groups the patients belonged collected the following data (R.L.P.): gender, age (years), duration of joint pain (months), side of painful joint complaint, maximum interincisal distance (MID) measured in millimeters with a digital caliper (Mitutoyo), and pain intensity self-reported with a 0 to 10 visual analog scale (VAS). Data for the variables MID and VAS were collected before (baseline) and 3 years after (final) arthrocentesis.

Conventional Double-Puncture Arthrocentesis

Double-puncture arthrocentesis was performed only once at the affected TMJ in accordance with the literature.^{8,9,27} With the patient awake, a straight line was drawn with a marker pen along the skin from the middle portion of the auricular tragus to the lateral corner of the eyeball. Two points were marked on this line for insertion of the needles. The first posterior-most point was marked at a distance of 10 mm from the tragus and 2 mm below the tragus-cantal line, while the second point was marked 20 mm in front of the tragus and 10 mm below the tragus-cantal line. Next, antisepsis of the whole face was performed with 2% chlorhexidine solution, with emphasis on the preauricular region and ear. Then, auriculotemporal nerve block followed by masseteric and posterior deep temporal nerve block were conducted with lidocaine hydrochloride without vessel, 1:100.00, with a total volume of 3.6 mL.

Patients were asked to open their mouths to the maximum, and a sterile mouth opener was placed between the dental arches on the contralateral side of the arthrocentesis to maintain the mandibular condyle down and forward and to facilitate access to the upper TMJ compartment recess. A 40 × 12 mm needle connected to a 5-mL syringe was inserted into the first posterior-most point, and 4 mL of saline solution 0.9% was administered in order to distend the joint space. The other needle was inserted into the same distended compartment in front of the first needle and connected to a 60-cm-long naso-probe attached to a suction pump (KaVo) in such a way that the fluidity and flow of the solution used for the joint lavage could be visualized. Subsequently, a 120-cm 15C infusion extender (Compojet) was attached to the posterior needle and coupled to a 60-mL syringe to initiate lavage and joint lysis. A total of 300 mL of

Table 1 Descriptive Variables for Each Group

Variable		Double puncture (n = 11)	Single puncture type 2 (n = 12)	P value
Gender, n (%)	Female	10 (90.91)	10 (83.3)	.981
	Male	1 (9.09)	2 (16.7)	
Mean ± SD age, y		29.63 ± 7.59	35.16 ± 10.95	.080
Mean ± SD pain duration, mo		8.09 ± 2.05	15.66 ± 22.17	.274
Side of complaint	Right	4 (36.36)	8 (66.66)	.314
	Left	7 (63.64)	4 (33.34)	

saline solution was used to perform the TMJ arthrocentesis. At the end of the procedure, after occluding the exit of one of the needles with a sterile disposable plastic device, 1 mL of SH 10 mg was injected into the upper TMJ compartment through the other needle. Once the needles were removed, the jaw was manipulated with vertical, protrusive, and lateral movements to facilitate lysis of possible adhesions. The final step comprised local dressing with sterile gauze and Micropore surgical tape.

Single-Puncture Arthrocentesis Type 2

Single-puncture arthrocentesis type 2 was also performed in accordance with the literature.^{17,27–30} Preparation and antisepsis of the face and the intervention side of the TMJ, as well as all the markings and anesthetic block, were identical to those performed with the conventional technique. A double-needle cannula was inserted 10 mm from the tragus and 2 mm below the tragus-cantal line. When in place, the patient was asked to open the mouth, and with one of the entries occluded, the upper TMJ compartment was distended with 4 mL of 0.9% saline solution. The second needle in the cannula was then opened, and the upper compartment was rinsed with 300 mL of saline solution. After that, 1 mL of SH 10 mg was injected. After the double-needle cannula was removed, the same mandibular movements and local dressing with sterile gauze and Micropore surgical tape were conducted as described for the conventional arthrocentesis technique.

Statistical Analyses

Fisher exact test and chi-square test were used to analyze the variables gender and side of complaint, considering the individual as the observational unit. The variable age (which presented normal distribution) was evaluated using Student *t* test, while pain duration (which presented asymmetric distribution) was analyzed using nonparametric Mann-Whitney *U* test. Wilcoxon nonparametric test was used to compare the variables of interest (MID and VAS) between the two test groups and between the data collected before (baseline) and 3 years after (final) the proce-

dure. Spearman correlation was performed among the set of variables.

All statistical analyses were conducted with SPSS version 18.0 for Windows, with a maximum significance level established at 5% ($P < .05$).

RESULTS

Regarding the initial 26 patients, only 23 completed the study after 3 years. Two patients in group 1 moved to another city and were unable to attend the reassessment, and 1 patient in group 2 could not be located and was therefore also excluded from the study. For the 3-year comparison, the sample was therefore composed of 23 patients (group 1, $n = 11$; group 2, $n = 12$).

No interurrences or complications were observed during or after the procedures. Frequency distribution (%) for the variables gender and side of complaint, as well as the mean and SD values of the variables age and joint pain duration, are shown in Table 1. No statistically significant differences were observed between the groups for any of the studied variables ($P > .05$).

When the data collected at the two evaluation times (baseline and final) were compared, both techniques resulted in significantly reduced VAS scores (Table 2; $P = .001$) and significantly increased MID values (Table 3). However, there were no statistically significant differences between techniques ($P > .05$). No patients had complaints after 3 years.

When Spearman correlation analysis was performed considering the duration of pain before the procedure, significant correlations were observed between the variables final MID and VAS score, with variable coefficients depending on the stratification performed. In group 1, it was observed that the longer the pain duration before treatment, the lower the final MID ($r = -0.517$; $P = .035$). In group 2, it was observed that the longer the individual experienced pain before treatment, the higher the baseline and final VAS scores ($r = 0.652$ and 0.688 , respectively).

Table 2 Baseline and Final (3-y Follow-up) Visual Analog Scale (0–10) Pain Scores

Group	Moment	Median (interquartile interval)	P value
Double puncture (n = 11)	Baseline	7.00 (5.00–9.00)	.001*
	Final	0.00 (0.00–1.00)	
Single puncture type 2 (n = 12)	Baseline	8.00 (7.00–10.00)	.001*
	Final	0.00 (0.00–1.00)	

*Statistically significant.

Table 3 Baseline and Final (3-y Follow-up) Maximum Interincisal Distance (mm)

Group	Moment	Median (interquartile interval)	P value
Double puncture (n = 11)	Baseline	31.15 (29.17–33.15)	.001*
	Final	44.71 (35.65–48.86)	
Single puncture type 2 (n = 12)	Baseline	31.28 (29.10–32.32)	.001*
	Final	43.55 (35.26–48.24)	

*Statistically significant.

DISCUSSION

In the present study, both TMJ arthrocentesis techniques were able to significantly reduce pain and significantly increase MID, demonstrating favorable results even after the long-term follow-up (3 years).

TMJ arthrocentesis has been proposed as an effective approach for treatment of patients with DDWOR.⁷ In the present study, both TMJ arthrocentesis techniques showed effective results without statistically significant differences between these techniques. This fact is also supported by previous studies that could not find differences when comparing TMJ arthrocentesis performed with conventional double-puncture vs single-puncture type 2 techniques,^{22–24} supporting the evidence that this is an effective treatment option for DDWOR regardless of the technique.^{10–12} Additionally, one of the most important outcomes of the present study is that the positive results were maintained after 3 years following the procedures without any additional treatment.³¹ Therefore, the null hypotheses were accepted.

The significant reduction in self-reported pain and the significant increase in MID found in the present study (Tables 2 and 3) were expected results, since abundant irrigation with biocompatible substances allows for the partial removal of debris from degenerating joint tissues and subsequent elimination of algogenic substances, especially inflammatory mediators.^{8,32} In addition, an increase in mandibular mobility can result from the removal of adhesions, the reduction or elimination of negative pressure within the joint, the distension of the joint space, and/or alterations to the viscosity of the

synovial fluid, aiding the translation of the articular disc and mandibular condyle. All these effects are part of TMJ arthrocentesis regardless of the technique.^{8,22,24} It is also important to consider that the positive results obtained with both techniques in the present study may be derived from the use of SH immediately after arthrocentesis. Procedures combining TMJ arthrocentesis and SH seem to show better results regarding TMJ pain reduction and improved mouth opening.¹² Additionally, the positive natural course of the condition should be taken into account, since the literature shows that patients with DDWOR tend to improve in relation to pain and mouth opening even in the absence of treatment.^{33,34}

Despite the similar results between the two TMJ arthrocentesis techniques compared in this study, single-puncture type 2 arthrocentesis presents some advantages in comparison to the conventional double-puncture arthrocentesis, such as increased ease of execution and reduced procedural time and trauma limitation, since only a single puncture is necessary. This also reduces the risk of nerve damage, as the insertion of a second needle may cause trauma to the facial nerve.^{18,28,29} The main disadvantages of type 2 single-puncture arthrocentesis are that the device needs to be specially manufactured, which can make the procedure more expensive,³⁰ and also that autoclaving adds costs to this process. Although DDWOR presents a favorable natural course, evidencing that the treatment should be as conservative as possible,^{33,35} the Spearman correlation analyses in the present study showed that pain duration is a very important influencer of

the results, and delay in seeking treatment for TMJ arthrocentesis may significantly interfere with the treatment outcome.²²

Although TMJ imaging exams, especially MRI, can elucidate additional important information regarding TMJ structures,³⁶ MRI exams were performed only before treatment in the present study, and only clinical variables (pain and MID) were evaluated in the follow-up. Some factors can explain this situation: first, the real need for a second MRI was questionable, since after the procedures the patients had no more complaints or relevant sign/symptoms that would justify an imaging analysis; and second, the operational cost was not justifiable, since MRI exams are still expensive. Although dropouts in any study are unfortunate, when taking into account the type of study and the follow-up period and considering the initial sample ($n = 26$) and the final sample ($n = 23$), the present study had a lower percentage (11.5%) of dropouts, and thus this did not likely compromise the results.^{14,37} The fact that this was a monocentric study with a restricted population can also be included as a limitation.

Future research is encouraged and should also include a control group free of interventions in order to evaluate the synovial fluid concentration and composition. Similarly, studies without SH administration will be important for evaluating the effect of arthrocentesis only. In addition, a postoperative MRI evaluation after a longitudinal follow-up could be performed to understand tissue responses to different arthrocentesis techniques. Although these findings could not detect differences at the group level, the clinical findings still need to be validated by further studies.

CONCLUSIONS

Considering the objectives, results, and limitations of the present study, it can be concluded that the conventional double-puncture and single-puncture type 2 arthrocentesis techniques were equally effective in reducing VAS scores and increasing MID in patients with DDWOR, and both showed good results after 3 years of follow-up.

KEY FINDINGS

Both arthrocentesis techniques were effective in reducing TMJ pain and increasing mouth opening in patients with TMJ DDWOR, suggesting that performing TMJ arthrocentesis with one needle or with two needles is an effective treatment.

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REFERENCES

1. Lazarin Rd, Previdelli IT, Silva Rd, Iwaki LC, Grossmann E, Filho LI. Correlation of gender and age with magnetic resonance imaging findings in patients with arthrogenic temporomandibular disorders: A cross-sectional study. *Int J Oral Maxillofac Surg* 2016;45:1222–1228.
2. Poluha RL, Canales GT, Costa YM, Grossmann E, Bonjardim LR, Conti PCR. Temporomandibular joint disc displacement with reduction: A review of mechanisms and clinical presentation. *J Appl Oral Sci* 2019;27:e20180433.
3. Dworkin SF, LeResche L. Research diagnostic criteria for temporomandibular disorders: Review, criteria, examinations and specifications, critique. *J Craniomandib Disord* 1992;6:301–355.
4. Ahmad M, Hollender L, Anderson Q, et al. Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD): Development of image analysis criteria and examiner reliability for image analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2009;107:844–860.
5. Poluha RL, Grossmann E. Inflammatory mediators related to arthrogenic temporomandibular dysfunctions. *Br J Pain* 2018;1:60–65.
6. Poluha RL, De la Torre Canales G, Bonjardim LR, Conti PCR. Clinical variables associated with the presence of articular pain in patients with temporomandibular joint clicking. *Clin Oral Investig* 2021;25:3633–3640.
7. Tatli U, Benlidayi ME, Ekren O, Salimov F. Comparison of the effectiveness of three different treatment methods for temporomandibular joint disc displacement without reduction. *Int J Oral Maxillofac Surg* 2017;46:603–609.
8. Nitzan DW. Arthrocentesis—incisives for using this minimally invasive approach for temporomandibular disorders. *Oral Maxillofac Surg Clin North Am* 2006;18:311–328.
9. 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; discussion 1168–1170.
10. Grossmann E, Poluha RL, Iwaki LCV, Santana RG, Iwaki Filho L. The use of arthrocentesis in patients with temporomandibular joint disc displacement without reduction. *PLoS One* 2019;14:e0212307.
11. Grossmann E, Poluha RL, Leite JPB. Temporomandibular joint arthrocentesis: A technique proposal. Case report. *Br J Pain* 2019;2:293–295.
12. 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;35:17–29.
13. Emshoff R. Clinical factors affecting the outcome of arthrocentesis and hydraulic distension of the temporomandibular joint. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;100:409–414.
14. Bell ML, Kenward MG, Fairclough DL, Horton NJ. Differential dropout and bias in randomised controlled trials: When it matters and when it may not. *BMJ* 2013;346:e8668.

15. Şentürk MF, Cambazoğlu M. A new classification for temporomandibular joint arthrocentesis techniques. *Int J Oral Maxillofac Surg* 2015;44:417–418.
16. Şentürk MF, Yazıcı T, Gülşen U. Techniques and modifications for TMJ arthrocentesis: A literature review. *Cranio* 2018;36:332–340.
17. Alkan A, Baş B. The use of double-needle cannula method for temporomandibular joint arthrocentesis: Clinical report. *Eur J Dent* 2007;1:179–182.
18. Rahal A, Poirier J, Ahmarani C. Single-puncture arthrocentesis—introducing a new technique and a novel device. *J Oral Maxillofac Surg* 2009;67:1771–1773.
19. Grossmann E, Guilherme Vargas Pasqual P, Poluha RL, Iwaki LCV, Iwaki Filho L, Setogutti ÊT. Single-needle arthrocentesis with upper compartment distension versus conventional two-needle arthrocentesis: Randomized clinical trial. *Pain Res Manag* 2017;24:35263.
20. Pasqual PGV, Poluha RL, Setogutti ÊT, Grossmann E. Evaluation of effusion and articular disc positioning after two different arthrocentesis techniques in patients with temporomandibular joint disc displacement without reduction. *Cranio* 2020;38:256–263.
21. Grossmann E, Poluha RL. Comparison between TMJ arthrocentesis techniques with different needle positions: A randomized single-blind controlled clinical trial. *J Craniomaxillofac Surg* 2021;49:368–372.
22. Folle FS, Poluha RL, Setogutti ET, Grossmann E. Double puncture versus single puncture arthrocentesis for the management of unilateral temporomandibular joint disc displacement without reduction: A randomized controlled trial. *J Craniomaxillofac Surg* 2018;46:2003–2007.
23. Grossmann E, Poluha RL, Iwaki LCV, Iwaki LCV. Arthrocentesis with different irrigation volumes in patients with disc displacement without reduction: One-year follow-up. *Cranio* 2018;38:122–127.
24. Grossmann E, Ferreira LA, Poluha RL, Setogutti E, Iwaki LCV, Iwaki Filho L. Comparison of two needles arthrocentesis versus double needle cannula arthrocentesis in the treatment of temporomandibular disc displacement. *Cranio* 2020;1:1–7.
25. Guarda-Nardini L, Meneghini M, Zegdene S, Manfredini D. Temporomandibular joint arthrocentesis in patients with degenerative joint disease: A 10- to 22-year follow-up. *J Oral Facial Pain Headache* 2021;35:113–118.
26. Poluha RL, Cunha CO, Bonjardim LR, Conti PCR. Temporomandibular joint morphology does not influence the presence of arthralgia in patients with disk displacement with reduction: A magnetic resonance imaging-based study. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2019;129:149–157.
27. Şentürk MF, Yıldırım D, Bilgir E, Fındık Y, Baykul T. Long-term evaluation of single-puncture temporomandibular joint arthrocentesis in patients with unilateral temporomandibular disorders. *Int J Oral Maxillofac Surg* 2018;47:98–102.
28. Rehman KU, Hall T. Single needle arthrocentesis. *Br J Oral Maxillofac Surg* 2009;47:403–404.
29. Singh S, Varghese D. Single puncture arthrocentesis of temporomandibular joint; introducing a novel device: A pilot study. *Natl J Maxillofac Surg* 2013;4:193–197.
30. Talaat W, Ghoneim MM, Elsholkamy M. Single-needle arthrocentesis (Shepard cannula) vs. double-needle arthrocentesis for treating disc displacement without reduction. *Cranio* 2016;34:296–302.
31. Schiffman EL, Ahmad M, Hollender L, et al. Longitudinal stability of common TMJ structural disorders. *J Dent Res* 2017;96:270–276.
32. Poluha RL, De la Torre Canales G, Bonjardim LR, Conti PCR. Can concomitant masticatory muscle contraction interfere with temporomandibular joint arthralgia evaluation? *J Oral Facial Pain Headache* 2021;35:72–76.
33. Zhuo Z, Cai XY. Radiological follow-up results of untreated anterior disc displacement without reduction in adults. *Int J Oral Maxillofac Surg* 2016;45:308–312.
34. Poluha RL, Grossmann E, Iwaki LCV, Uchimura TT, Santana RG, Iwaki Filho L. Myofascial trigger points in patients with temporomandibular joint disc displacement with reduction: A cross-sectional study. *J Appl Oral Sci* 2018;26:e20170578.
35. Miernik M, Więckiewicz W. The basic conservative treatment of temporomandibular joint anterior disc displacement without reduction—review. *Adv Clin Exp Med* 2015;24:731–735.
36. Dong M, Sun Q, Yu Q, Tao X, Yang C, Qiu W. Determining the optimal magnetic resonance imaging sequences for the efficient diagnosis of temporomandibular joint disorders. *Quant Imaging Med Surg* 2021;11:1343–1353.
37. Poluha RL, De la Torre Canales G, Bonjardim LR, Conti PCR. Somatosensory and psychosocial profile of patients with painful temporomandibular joint clicking. *J Oral Rehabil* 2020;47:1346–1357.