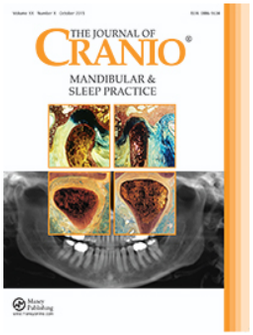

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TMJ

Comparison of two needles arthrocentesis versus double needle cannula arthrocentesis in the treatment of temporomandibular disc displacement

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ABSTRACT

Objective: To compare clinical and imaging results of two needles arthrocentesis (TNA) versus double-needle cannula arthrocentesis (DNCA) in the treatment of temporomandibular joint disc displacement (DD).

Methods: Twenty patients with DD were randomly divided into two groups: TNA and DNCA. Clinical data (pain scores; maximal interincisal distance [MID], and protrusion and laterality movements) were evaluated before and 24 months after the arthrocentesis. Disc and condyle position and joint effusion (JE) were evaluated by magnetic resonance exams.

Results: Both groups presented improvement in the MID, including pain reduction, modifications in disc and condyle positions, and reduction of the presence of JE, without difference between groups ($p > 0.05$). The DNCA was performed significantly faster ($p = 0.0001$).

Conclusion: Both TNA and DNCA are efficient in promoting improvement in the MID: reduction in pain, modifications in disc and condyle positions, and, in part, may account for less JE, without difference between techniques.

KEYWORDS
Temporomandibular joint disorders; disc displacement; arthrocentesis

Introduction

Temporomandibular joint (TMJ) disc displacement can be classified as disc displacement with reduction (DDWR) or disc displacement without reduction (DDWOR) [1,2]. Although conservative treatments are the first option, when those therapies do not produce satisfactory results, TMJ surgical approaches should be considered [3].

Arthrocentesis is a minimally invasive surgical technique that consists of lavage, without direct vision, of the upper TMJ compartment with a biocompatible substance [4,5]. The objective of the procedure is to dilute local algogenic substances and promote the release of the adhesions formed between the surfaces of the articular disc and the mandibular fossa [6]. Usually, the technique consists of the insertion of two needles of the same caliber at two different points [4,5]. The main difficulty of this technique is the insertion of the second needle, as the incorrect introduction of this needle may result in problems during the surgical procedure, such as fluid leakage into the underlying tissues, an increase in the surgery time, possible damage to the local innervation, and consequent discomfort during the postoperative period [7].

In an attempt to overcome these problems and simplify the procedure, modifications in this technique have arisen over the years [8–10], such as the use of a single injection and aspiration cannula [11], the use of the same access to a double cannula [12], the introduction of fused needles, and the use of concentric needles with different guages [13].

The technique modifications described above have been evaluated as clinically successful [9,11], and studies comparing the procedures are now relevant. Therefore, the present study aims to compare clinical and imaging results of two TMJ arthrocentesis techniques: two-needle arthrocentesis (TNA) and double-needle cannula arthrocentesis (DNCA) to treat disc displacement.

Materials and methods

Sample

The current study was approved by the Ethics Committee for Research on Humans of the State University of Maringá (N°: 208.108). All individuals were informed about the research purposes and signed a free informed

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consent form. This clinical trial was conducted following the Helsinki Declaration. Initial clinical examinations and all procedures were conducted by the same surgeon (E.G.). Twenty-six patients of both genders, older than 18 years, diagnosed with unilateral anterior disc displacement (with or without reduction) who did not respond to conservative treatment (occlusal splints, anti-inflammatory drugs, compresses, soft diet, or physiotherapy) for at least three months were invited to participate in this research. The diagnosis of disc displacement was confirmed by clinical examinations, based on axis I of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) [1], and by Magnetic Resonance Imaging (MRI) exams. Patients with rheumatoid arthritis, agenesis, hypoplasia and/or malignant neoplasm of the mandibular condyle, bone ankylosis, previous TMJ surgery, muscular disorders, or those who had previously undergone arthrocentesis alone or in combination with other substances, as well as extremely anxious individuals, were not considered for the study. All individuals were informed about the research purposes and signed a free informed consent form.

The following variables were registered: age (years); gender; impaired joint side; pain scores (0–10) obtained with the visual analog scale (VAS); maximal interincisal distance, measured by a digital calliper (Mitutoyo®, Takatsu-ku, Kawasaki, Kanagawa, Japan) in millimeters (mm); mandibular deviation (movement away from midline followed by a return to center, often described as either a "C" or "S" pattern) or deflection (movement away from the midline during opening without return to center during the movement); and impairment of the movements of protrusion and laterality. The capacity of the maximum mandibular opening movements was considered normal when the measurement was ≥ 40 mm, was considered decreased when the movement was less than this value, and the lateral movements and maximal protrusion were considered normal when the measurements were ≥ 14 mm and 7 mm, respectively; otherwise these parameters were considered to be limited [14]. Clinical data (pain scores, maximal interincisal distance, and protrusion and laterality movements) were evaluated before and 24 months after the arthrocentesis. Joint disc and condyle position and joint effusion were evaluated by MRI exams performed before and 3 months after the arthrocentesis.

Magnetic resonance imaging

Magnetic resonance imaging (MRI) exams confirmed the joint disc position. The images were obtained in a device with a magnetic field of 1.5 tesla (T), General Electric Signa HDX. The following weighted sequences were obtained using the bilateral spherical surface coil over the TMJ (9 cm diameter): T1 (TR: 567 ms and TE: 11.4 ms) and T2 (TR: 5200 ms and TE: 168.5 ms). The matrix used for T1 was 288 × 192.3 NEX; for T2, 288 × 160.4 NEX; and the field of view (FOV) was 11 × 11 cm. Six images of each TMJ were obtained at the oblique sagittal plane, with 3 mm of thickness, in maximum intercuspation position and maximum mouth opening stabilized. The images were printed on film of 45 × 35 cm, with magnification of 1.5 cm. The MRI exams were all analyzed by the same radiologist, who did not know which arthrocentesis technique had been performed on the patients, based on the studies by Ahmad et al. [15].

TMJ arthrocentesis

Before surgical intervention, patients were randomly equally divided into two groups, using a system of sealed brown envelopes that contained the description of the technique to be used: TNA or DNCA. All arthrocentesis procedures were performed by the same surgeon (E.G.). All results were evaluated by another researcher (R.L.P.) who did not know to which group the patient belonged. The arthrocentesis was performed only once in each of the indicated joints, and the procedure followed the technical references found in the literature [4–6,16,17].

Two-needle arthrocentesis (TNA)

The patients were positioned in a dental chair in a supine position and were asked to rotate their head to the asymptomatic side. The head was enclosed in a disposable cap that was fixed with micropore tape, leaving the TMJ exposed. A pen was used to draw a straight line from the middle portion of the tragus to the corner side of the eyeball, and two points were marked on this line for the insertion of the needles. The first, most posterior one, was inserted at a distance of 10 mm from the tragus and 2 mm below the corner-tragus line; the second one was inserted 20 mm anterior to the tragus and 10 mm inferior to the corner-tragus line. Antisepsis was performed with 2% chlorhexidine solution that was used all over the face, mainly in the preauricular area and ear. The next step was the auriculotemporal nerve block (1.8 mL with 2% of lidocaine hydrochloride without vasoconstrictor), followed by the anesthesia of the posterior deep temporal and masseter nerves (one or two tubes). The analgesia was intended to prevent discomfort and/or pain during the procedure, sedation being unnecessary. The patient was then asked to open the mouth to the maximum, which allowed the down and forward displacement of the condyle, which enabled access to the posterior recess of the superior compartment

of the temporomandibular joint where the first needle 40 × 12 mm (18 G) was introduced. The needle was directed anterior, superior, or medially until its tip hit the glenoid fossa inside the superior joint space (Figure 1). The needle was then connected with a 5 mL syringe, and 4 mL physiological solution (FS) at 0.9% was administered in order to distend the joint space. The next step was the removal of the syringe and the connection, in the same needle, of a transparent extender (Compojet®, Compojet Biomédica LTDA, Conceição do Jacuípe – BA, Brazil) with a length of 100 cm. A second needle, with the same dimensions of the previous one, was introduced into the distended compartment, at the point established previously, and connected to a nº 20 long (60 cm) flexible and transparent catheter (Mark Med®, Mark Med LTDA, Bragança Paulista – SP, Brazil) used to visualize the flow of the articular wash. The other extremity of this tube was joined to the tip of the rubber terminal of the aspirator (DabiAtlante®, DabiAtlante LTDA, Ribeirão Preto – SP, Brazil), which was connected to the vacuum pump (PVD700-4 C/DabiAtlante®, DabiAtlante LTDA, RibeirãoPreto – SP, Brazil).

Afterward, 200 mL of 0.9% saline solution was perfused with 60 mL syringes with the extender connected to the first needle and was collected by the catheter connected to the second needle. No other substance or drug was added to the solution being injected. Toward the end of the procedure, the catheter connected to the second needle was occluded for about 10 s, increasing the hydraulic pressure in the interior of the superior compartment while the last 5 mL were perfused. The patient was then asked to open and laterally move the mouth with the objective of breaking up possible adherences, allowing the gain of vertical and lateral movements of the joint, which was measured in the operative procedure. Finally, the surgical area was covered with an antiseptic round dressing (Cremer®, Cremer LTDA, São Paulo – SP, Brazil) that was kept in place for one week. Patients were then instructed to take 750 mg of paracetamol every 6 hrs for three days, apply local intermittent ice in the first 48 hrs, maintain a liquid and soft diet for 5 days, use the interocclusal device, and avoid local heat and physical activities for one week.

Figure 1. Two needles inserted in the upper temporomandibular joint (TMJ) compartment.

Double-needle cannula arthrocentesis (DNCA)

The same procedures described above were used in this technique; however, there was one difference. Instead of using two needles, a modified stainless-steel device was introduced in the TMJ area. It was comprised of two fused needles (1 mm gauge and 0.5 mm gauge) of 45 mm length attached to trocars of 0.8 mm and 0.4 mm, respectively. This device was introduced in the superior compartment of the joint, at a distance of 10 mm from the tragus and 2 mm below the corner-tragus line. After being placed, the trocar of higher diameter was removed, and a 5 mL syringe, with the same amount of saline solution described in the technique above, was introduced to promote the distention of this compartment. Afterward, the same extender and catheter mentioned above were attached to this device; while one allowed the irrigation with the same volume described previously, 60 mL, the other was used to drain the saline solution, with the help of a vacuum aspiration pump (Figure 2). The surgeon followed the same procedures described previously, with the area covered with the same round dressing to guarantee that the second investigator would be totally blind regarding the protocol used during the surgery.

Statistical analysis

Clinical and MRI data were analyzed before and after the arthrocentesis procedure from both TNA and DNCA groups. Student's *t*-test was used to compare pain scores and maximal interincisal distance. Mann-Whitney U test was used to compare protrusion and laterality movements, joint disc and condyle position, and joint effusion. The maximum significance level established was 5% ($p < 0.05$), and SPSS version 20.0 (IBM®, Chicago, IL, USA) was used.

Results

Sample data

After the inclusion and exclusion criteria evaluation, a total of 20 patients were included in the study. Both groups (TNA and DNCA) had 10 patients each. Considering the total sample, most patients were females within a mean age

Figure 2. Double-needle cannula inserted in the upper temporomandibular joint (TMJ) compartment.

of 37.5 years. The main diagnosis was DDWOR, on the right side, with an average interincisal distance of 33.26 mm and ipsilateral deflection (Table 1).

Clinical results

All patients returned for all evaluations, so no one was excluded from the study. Both arthrocentesis procedures were able to improve maximal interincisal distance and reduce the intensity of pain with a statistically significant difference ($p < 0.0001$); however, there was no difference between groups for either variable (maximal interincisal distance, $p = 0.82$; intensity of pain, $p = 0.580$) (Table 2). All the patients presented an improvement of protrusive and lateral movements with a statistically significant difference ($p = 0.0039$); however, there was no difference between groups ($p = 0.552$) (Table 3).

The meantime to perform the DNCA technique was 15.7 minutes, and the meantime to perform the TNA technique was 23.7 minutes. The DNCA technique was performed faster, with a statistically significant difference ($p = 0.0001$). Regarding adverse effects, immediate postoperative results showed that 4 patients (2 in each group) presented temporary and reversible paresis of the facial nerve. In all patients who presented paresis, the maximum duration was 30 min.

Magnetic resonance imaging results

Magnetic resonance imaging (MRI) confirmed the joint disc position and the presence or absence of joint effusion. The arthrocentesis procedures were able to change the disc and condyle positions in most of the patients, with no difference between techniques ($p = 0.90$). Considering the total sample, 11 patients (55%) presented discs and condyles moved for a more anterior position. In 6 cases (30%), the disc remained without movement, along the articular tubercle, and only the condyle moved for a more anterior position. In 3 cases (15%), there was no change in the disc and/or condyle positions (Table 4).

Regarding joint effusion, considering the total sample, at the beginning of the study, there were 2 patients with DDWR (all in the TNA group) and 18 patients with DDWOR (8 in the TNA group and 10 in the DNCA group). Both arthrocentesis procedures were able to reduce the number of TMJs with joint effusion in a statistically significant way ($p = 0.04$). However, there was no difference between TNA and DNCA regarding

Table 1. Baseline characteristics of the sample.

Age (years) n (%)	Sex		Diagnosis		Impaired side	
Mean ± SD	Male	Female	DDWR	DDWOR	Right	Left
37.5 ± 39	5	15	2	18	12	8
Interincisal Distance (mm)	Pain (Initial level)		Presence of deflection		Presence of deviation	
Mean ± SD	Mean ± SD		Ipsilateral	Contralateral	Ipsilateral	Contralateral
33.26 ± 5.43	7.4 ± 1.7		18	0	2	0

DDWR: Disc displacement with reduction. DDWOR: Disc displacement without reduction. SD: Standard deviation.

Table 2. Interincisal distance and intensity of pain, evaluation inter- and intra-group.

	Maximal Interincisal Distance (mm)				Intensity of the Pain (VAS)			
	Before	After	Improvement	Intergroup comparison	Before	After	Reduction	Intergroup comparison
TNA	31.78 ± 2.12	42.37 ± 4.16	10.92 ± 3.30	$p = 0.82$	8 ± 2.0	0.6 ± 0.3	7.4 ± 0.2	$p = 0.580$
DNCA	34.73 ± 2.36	46.40 ± 2.21	11.34 ± 2.96		6.8 ± 3.1	0.4 ± 0.5	6.4 ± 0.4	
Total	33.26 ± 3.06	44.39 ± 3.14	11.13 ± 3.74		7.4 ± 1.7	0.5 ± 0.5	7.1 ± 0.3	
Before X After comparison	$p < 0.0001$				$p < 0.0001$			

TNA: Two needle arthrocentesis; DNCA: Double-needle cannula arthrocentesis; VAS: Visual analog scale; mm: millimeter; SD: Standard deviation.

Table 3. Data of protrusive and lateral movements.

	TNA				DNCA				
	n = 8				n = 10				Intergroup comparison
DDWOR	Before		After		Before		After		$p = 0.552$
	Limited	Normal	Limited	Normal	Limited	Normal	Limited	Normal	
	8	0	0	8	9	1	1	9	
DDWR	n = 2				n = 0				
	Before		After		Before		After		
	Limited	Normal	Limited	Normal	Limited	Normal	Limited	Normal	
	0	2	0	2	0	0	0	0	
Before X After comparison	0.0039				0.0039				

TNA: Two needle arthrocentesis; DNCA: Double-needle cannula arthrocentesis; DDWOR: Disc displacement without reduction; DDWR: Disc displacement with reduction.

Table 4. Final disc and condyle position after arthrocentesis.

Final disc and condyle position	TNA n = 10 (%)	DNCA n = 10 (%)	Total n = 20 (%)
Disc and condyle in a more anterior position	5 (50)	6 (60)	11 (55)
Only condyle in a more anterior position	3 (30)	3 (30)	6 (30)
No change	2 (20)	1 (10)	3 (15)
Intergroup evaluation	p = 0.90		

TNA: Two-needle arthrocentesis; DNCA: Double-needle cannula arthrocentesis.

changes in the joint effusion before and after the arthrocentesis ($p = 0.85$) (Table 5).

Discussion

The present study aimed to compare clinical and imaging results of two TMJ arthrocentesis techniques, two-needle arthrocentesis (TNA) and double-needle cannula arthrocentesis (DNCA) to treat disc displacement. Arthrocentesis has been proposed as an effective approach for the treatment of the TMJ in patients with disc displacement [10]. The procedure is considered successful when the patient reports that the pain is under control and the movements of the jaw are restored [4]. The present results showed a significant increase in the interincisal distance in both groups (TNA: 42.37 ± 4.16 mm; DNCA: 46.40 ± 2.21 mm) (Table 2). Such findings are equivalent to those previously reported (TNA: 41.5037.70 mm; DNCA: 47.20 mm) [7]. The average of the VAS pain intensity after both of the procedures was 0.6 ± 0.3 for TNA and 0.4 ± 0.5 for DNCA, lower than the results found by Şentürk et al. [7] (TNA: 1.0; DNCA: 1.2).

In the present study, only two cases did not reach the results expected regarding pain control. One of these patients was diagnosed with DDWR and the other with DDWOR. Such individual responses were related to the possible presence of adhesions that were aggravated by the chronic aspect of the pain symptoms. Furthermore, therapeutic success is also influenced by the precise insertion of the needle(s), the way the mandible is handled during the surgery [18], and the circulating volume, which is in accordance with the literature [8] and the present study. One of the objectives of arthrocentesis is the release of the articular disc, as the jaw movements may be affected by the adhesion generated between the disc and the glenoid fossa, as any attempt of moving the condyle and the disc would strain the capsule, causing pain and limiting the movements [6]. Therefore, the release of the disc may be expressed by its movement, which may be verified by comparing the MRI from before and after the surgery [4,5].

De Riu et al. [19] found that 26 of 30 patients diagnosed with disc displacement, who underwent arthrocentesis, did not present any change regarding the disc

Table 5. Presence or absence of joint effusion, before and after arthrocentesis, considering the type of disc displacement.

	TNA n = 10				DNCA n = 10				Joint Effusion Before X After comparison
DDWOR	n = 8				n = 10				$p = 0.04$
n = 18	Joint Effusion				Joint Effusion				
	Before		After		Before		After		
	Presence	Absence	Presence	Absence	Presence	Absence	Presence	Absence	
	7	1	1	7	9	1	4	6	
DDWR	n = 2				n = 0				
n = 2	Joint Effusion				Joint Effusion				
	Before		After		Before		After		
	Presence	Absence	Presence	Absence	Presence	Absence	Presence	Absence	
	1	1	0	2	0	0	0	0	
Intergroup Evaluation	$p = 0.82$								

TNA: Two needle arthrocentesis; DNCA: Double-needle cannula arthrocentesis; DDWOR: Disc displacement without reduction; DDWR: Disc displacement with reduction.

position. In the present study, considering the total sample, after the surgery, in 55% of the cases, the condyle and the disc moved more anteriorly in relation to the articular tubercle and, in 30%, only the condyle moved more anteriorly (Table 4). Although previous studies found that the arthrocentesis did not change the disc position inside the glenoid fossa, it promotes some mobility [6,20–22]. Therefore, the articular mobility that was promoted by both techniques in this study, regardless the position of the disc, may be responsible for the disappearance of the pain and the limitation of the articular movement. The change in the disc position depends on the pre-existing condition between the disc and the fossa and/or the articular tubercle, such as the presence or absence of adherences and adhesiveness [4]. Cases without adherences may respond well to the arthrocentesis, but in the presence of adherences and adhesiveness, the answer will depend on the degree of the adhesiveness, even if applying high pressure to the syringe plunger, as it is suggested by some authors [23].

The MRI exam is a valuable instrument for understanding intra-articular changes and their prognosis. The presence of algogenic substances in the TMJ is identified by the hypersignal on T2 weighted images [24]. Although both arthrocentesis techniques aim at eliminating such substances, the hypersignal (joint effusion) was persistent in 5 patients 90 days after the intervention. Studies in this area usually do not state how long follow-up imaging exams should be performed after the surgery [19]. One alternative would be to perform the MRI exam after three or six months, when the recovery of the joint is expected. However, this period could also be long enough to allow the formation of algogenic substances related to chronic cases that were not controlled by the arthrocentesis [24].

The TNA may be susceptible to the leakage of the wash substance due to the difficulty of the circulation of this substance, partly due to obstructions in the superior articular compartment caused by adherence and adhesions or by the difficulty of inserting the second needle in this compartment. The attempt of removing and reinserting the needle may injure the capsular ligament and cause a reduction in the intra-articular pressure that is necessary to the lysis of adherences and to wash the algogenic substances in the interior of the articular capsule [9,25]. Such problems were not observed in this study because, not only was the previous marking used, the saline solution was suctioned by a device connected to the needle and to a vacuum pump, which facilitated the articular wash and the drainage of the saline solution. Within this context, the DNCA seems to be more efficient, as there is only one position for the introduction and removal of the saline solution used, which facilitates the procedure and allows the use of the syringe plunger that promotes a higher intra-articular pressure. The use of DNCA is simpler and faster than one of the other techniques, as the risks of facial nerve and transverse facial artery injuries are decreased using single access, since the point of insertion of the second needle (anterior to the first needle) is just in the glenoid fossa area where those anatomic structures are. Additionally, the risk of injuries is even higher in cases with hypomobile joints that make the correct insertion of the second needle almost impossible; it is also important to note that single puncture arthrocentesis requires a much smaller amount of local anesthesia, reducing the morbidities and complications due to local anesthetics [9,12]. The only drawback faced currently is the fact that the double-needle cannula is not produced commercially.

Although both TNA and DNCA are minimally invasive and do not offer high risks of infection, morbidity, or nerve lesion, the surgeon must have very good anatomical knowledge and experience to manipulate the articular components involved in the procedures.

Conclusion

Considering the proposition and the results obtained in the present study, it can be concluded that both TNA and DNCA techniques were efficient in promoting significant improvement in the maximal incisal distance, reduction in pain, modifications in disc and condyle positions, and, in part, may account for the observation of fewer joint effusions at 3 months in patients with disc displacement without difference between techniques.

Disclosure statement

There is no conflict of interest.

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