

Arthrocentesis techniques applied to arthrogenic temporomandibular joint disorders*

Técnicas de artrocentese aplicadas às disfunções artrogênicas da articulação temporomandibular

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SUMMARY

BACKGROUND AND OBJECTIVES: This is a review of different arthrocentesis techniques used for arthrogenic temporomandibular joint (TMJ) disorders, as well as their indications, their possible action mechanisms and complications.

CONTENTS: Studies have been carried out in recent years in the attempt to standardize different arthrocentesis protocols used for temporomandibular joint disorders (TMD), to define when and how to use them. These are minimally invasive and low cost techniques which may be performed under local anesthesia, with or without sedation, in addition to being replicable and having low morbidity. They are indicated to relief or control pain and arthrogenic disorders.

CONCLUSION: Several arthrocentesis techniques, combined or not with anti-inflammatory, opioids or viscoelastic substances, produce adequate results for arthrogenic TMD, however the therapeutic success depends on disease chronicity, on its clinical and imaging characteristics, on the accurate diagnosis, on patients' cooperation, on professionals' experience and on the technique used.

Keywords: Arthrocentesis, Temporomandibular disorders, Temporomandibular joint.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Realizar uma revisão a cerca das diferentes técnicas de artrocentese empregadas nas disfunções artrogênicas da articulação temporomandibular (ATM), bem como das suas indicações, seu possível mecanismo de ação e complicações.

CONTEÚDO: Pesquisas têm sido realizadas, nesses últimos anos, na tentativa de padronizar diferentes protocolos de artrocentese empregadas nas disfunções temporomandibulares (DTM), no intuito de definir quando e como empregá-las. Essas técnicas são pouco invasivas, de baixo custo, podendo ser realizadas sob anestesia local, com ou sem sedação, replicáveis e de baixa morbidade. São indicadas para aliviar ou eliminar o quadro de dor e disfunção artrogênica presente.

CONCLUSÃO: Várias técnicas de artrocentese combinadas ou não com anti-inflamatórios, opioides, substâncias viscoelásticas, produzem resultados adequados nas DTM artrogênicas, porém o sucesso terapêutico depende da cronicidade da doença, de suas características clínicas e de imagem, do diagnóstico correto, da colaboração do paciente, da experiência do profissional e da técnica empregada.

Descritores: Articulação temporomandibular, Disfunção temporomandibular, Artrocentese.

INTRODUCTION

Temporomandibular joint (TMJ) arthrocentesis was introduced approximately 21 years ago¹. It is considered by many health professionals as the first line of surgical treatment for patients with temporomandibular disorders (TMD) who do not respond to conservative therapy such as interocclusal devices, physical therapy, drugs, light diet, behavioral and lifestyle changes²⁻⁴.

This is a minimally invasive procedure^{5,6}, preferably

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performed under local^{2,6,7} or general⁶ anesthesia, where a fluid, such as saline or lactated Ringer's solution, and/or anti-inflammatory, opioid, steroid drugs and viscoelastic solution is circulated, with low complication rates. It consists in the lavage of the upper TMJ compartment with one needle, or catheter⁸⁻¹⁰, two needles^{1,11-17}, or more needles transcutaneously inserted. There may be just one entry needle or one entry and one exit needle¹⁸.

This study aimed at reviewing the literature on the application of different arthrocentesis techniques applied to arthrogenic TMJ disorders. Aiming at finding adequate and relevant articles, the following keywords were combined: "arthrocentesis", "TMJD", "disc displacement without reduction", "closed lock", "limited mouth opening" and "temporomandibular joint arthrocentesis". The following databases were queried: Pubmed/Medline in the period between 1991 and 2012, supplemented by manual search in Brazilian journals. This research was carried out with humans and was limited to Portuguese and English languages.

INDICATIONS

Arthrocentesis is used for internal TMJ disorders not responding to conservative clinical treatment. It is indicated for patients with anterior disc displacement with and without reduction; for disc adhesions, for early adhesiveness next to the fossa and/or the upper aspect of the articular tubercle, with mouth opening limitation; for cases of synovitis/capsulitis; as palliation for acute degenerative rheumatoid arthritis; patients with painful joint noises occurring during mouth opening and/or closing and for hemarthrosis due to recent trauma, where there is joint aspiration and lavage, which may provide more comfort to patients^{1,11-16,19-24}.

ARTHROCENTESIS TECHNIQUE

With the patient awake, the whole face is cleaned with 2% chlorhexidine solution, aqueous iodophor or similar substance, emphasizing pre-auricular region and ear. Then, the temporal region is isolated with sterile micro-pore at the side where the procedure will be performed. Next, sterile drapes are placed allowing the visualization of the ear, part of the lateral corner of the orbit and of the jaw. We start by blocking the auriculotemporal nerve (ATN) with 2% lidocaine with 1:200000 norepinephrine with a tubet (1.8 mL) followed by posterior deep temporal and masseter nerves anesthesia with one or two tubets, as described by Grossman². With this,

discomfort and/or pressure pain which may occur at the beginning of the joint lavage procedure are prevented. This provides optimal region analgesia, preventing the need for sedation.

A straight line with patent blue and toothpick is drawn close to the skin that goes from the medial portion of the ear tragus to the lateral corner of the eye. In this line, two needle insertion points are marked. The first, more posterior point will be at a distance of 10 mm from the tragus and 2 mm below the cantotragal line. The second point will be 20 mm in front of tragus and 10 mm below this same line^{1,24,25}.

A sterile mouth opener is placed on dental arcades contralateral to the arthrocentesis side to allow jaw head displacement downward and to the front, helping the approach to the posterior recess of upper TMJ compartment. A 30/0.7 or 40/1.2 needle is inserted in the most posterior point, connected to a 5 mL syringe where 1 to 4 mL of 0.9% saline solution (SS) is administered aiming at distending the joint space. Another needle is introduced in the distended compartment, in front of the first needle, connected to a 60 cm solution extensor coupled to a flexible and transparent aspiration rubber, allowing the visualization of the solution, its fluidity as well as orienting the flow of the joint lavage solution. Then, a serum extensor coupled to a 50 mL syringe is connected to the needle.

Extensors have three objectives: help solution injection by the syringe, prevent needles to move from puncture sites and their displacement toward the skin, in addition to speeding the procedure. The amount of SS to remove algogenic substances from the joint space varies from 50 to 500 mL⁶.

In case of adhesions or few adhesivenesses, it is recommended to obstruct one of the needles, increasing the pressure on syringe plunger while patient performs opening and laterality movements. If they are still limited, the assistant surgeon may perform the same movements aiming at breaking possible adhesions, trying to reestablish mouth opening pattern equal to or above 35 mm; of laterality and protrusive of at least 4 mm²⁵.

SINGLE-NEEDLE TECHNIQUE

A possible suggestion to improve TMJ arthrocentesis tolerability might be the introduction of a modified approach which assures the performance of the single-needle technique (SNT). SNT⁹ uses the same substances as arthrocentesis (SS or lactated Ringer's solution) and approaches the posterior recess, that is 10 mm anterior and 2 mm inferior to the tragus line lateral orbit

portion, to inject and aspirate fluids.

There are advantages as compared to traditional two-needle arthrocentesis¹. The first would be faster execution time. The positioning of a single needle may allow safer and more stable access to the joint space, while the positioning of a second needle may interfere with the stability of the first needle.

Risks for nervous injuries, such as facial nerve paresis, may be decreased due to lesser intervention trauma, as well as less postoperative pain due to less joint manipulation. SNT uses fluid injection under pressure with the patient with the mouth open to expand the mandibular fossa. After injection, patient is asked to close the mouth and the fluid is removed with this same needle. All this fluid injection and removal process is performed with 10 repetitions (with a total volume of approximately 40 mL). Fluid injection under pressure is useful to break adhesions which are in general responsible for jaw head translation movement limitation, which especially explains phenomena of disc fixation to the mandibular fossa and/or articular tubercle.

This provides immediate mouth opening improvement, so this technique is indicated for hypomobile joints, with strong adhesions, or for joints with degenerative changes which make difficult the insertion of the second needle. Other SNT advantage as compared to conventional arthrocentesis¹ (two needles) is the lower risk of hyaluronic acid (HA) injection leaking to outside the upper compartment, since there is no second needle. So, SNT allows HA to remain totally close to the upper compartment. SNT has shown promising clinical results and future studies should be carried out to compare the findings of this protocol with those of the traditional two-needle technique¹

DOUBLE-NEEDLE CANNULA

The double-needle cannula⁸ (DNCA) is a technique similar to the others which uses a stainless steel device with two tubes: one irrigation tube and one aspiration tube. The length of the cannula is 80 mm and tube diameters are 1 and 0.5 mm. Trocar diameter is 0.8 mm. The cannula with the trocar is introduced in the upper joint compartment, using as guide the tragus-external orbital cavity corner line. Then, the trocar is removed from the irrigation tube and a syringe with SS is injected to promote joint lavage. This technique provides lavage with and without pressure, respectively with syringe or SS bag fixed one meter above patient's face. It is very safe and does not need another puncture to place the additional needle, such as with classic arthrocentesis.

It is performed with local anesthesia with volumes of 50 to 500 mL, which allows the lysis of adhesions and joint lavage. Major limitation of this technique is when there are major degenerative changes with decreased joint space and presence of osteophytes.

SHEPARD'S SINGLE-CANNULA

Shepard's single-cannula (SSCA) also uses a metal device with two cast needles with independent lumens. Both extremities serve for irrigation and aspiration of the joint lavage fluid associated to algogenic substances present in the upper TMJ compartment. It has follow up of more than ten years in more than 100 procedures with no complications²⁷.

CONCENTRIC NEEDLES UNIT (CNU)

One needle is inserted in the other close to upper TMJ compartment. The first needle is thinner and approximately 50 mm long and remains inside the other, which is thicker and measures less than 38 mm²⁸. The first needle does not obstruct the lumen of the thicker needle allowing the substance to be perfused in the upper joint space to wash the site and leave by the space between needles, reflowing to the skin surface. CNU irrigation allows single TMJ puncture. It is simple, of low cost, virtually atraumatic, with very low risk of nervous injury of facial branches and hemorrhage. It is replicable, uses less local anesthetics and produces mild trans and postoperative discomfort.

After cleaning the TMJ region and placing a gauze tamponade in the external acoustic meatus to make difficult the entrance of irrigation solution in external ear, the auriculotemporal nerve is anesthetized with lidocaine with vasoconstrictor, followed by deep anesthetic puncture of the region where CNU will be inserted. A horizontal line is drawn with patent blue from the tragus to the lateral portion of the orbital cavity, being marked a point 10 mm to the front of the tragus and 0.5 mm below this local line, where CNU will be inserted. To allow its insertion, patient shall open the mouth a little.

When CNU is inside this compartment, lavage is performed with LR, taking care not to displace the needles from the puncture site while irrigating, because fluid may leak to adjacent soft tissues producing pain and local edema, forcing the interruption of the procedure or the replacement of needles in the previously marked site. Irrigation is controlled by the volume of fluid entering and leaving. Lavage is performed with the help

of a 50 mL syringe. If a higher volume is needed, LR bag may be used.

ARTHROCENTESIS COMBINED WITH OTHER THERAPEUTIC MODALITIES

Arthrocentesis with or without non-steroid anti-inflammatory drugs

A study²⁹ has compared clinical and radiological effects of simple arthrocentesis or combined with tenoxicam in patients with disc displacement without reduction (DDWR). Twenty-four TMJ of 21 DDWR patients were studied and randomly distributed in Group A, where only arthrocentesis was performed (14 TMJ in 14 patients) and Group AT, who received injection of 2 mL tenoxicam, in addition to intra-articular arthrocentesis (10 TMJ in 7 patients). Patients were evaluated before the procedure, in the 7th postoperative day, in the 2nd, 3rd and 4th weeks and in the 2nd, 3rd, 4th, 5th and 6th postoperative months. Joint pain intensity was evaluated by the visual analog scale (VAS).

Maximum mouth opening was recorded in each follow up, as well as MRI before and six months after treatment in both groups, to analyze disc position and format with mouth open and closed, presence of joint effusion, changes in TMJ cortical and bone marrow. Both treatments provide increase in maximum mouth opening and decreased joint pain. There has been no statistically significant difference between groups.

ARTHROCENTESIS AND OPIOIDS

Arthrocentesis with intra-articular morphine injection is performed when conservative treatment fails. The technique is similar to the conventional technique¹. Joint is washed with 50 mL of 0.9% SS and at the end of the procedure 1 mL of morphine (10 mg) is introduced followed by delicate manipulation. A study³ has performed 405 arthrocentesis in 298 patients during a 10-year period and has subjectively evaluated pain using VAS before arthrocentesis and one month, six months and one year after the procedure. The combination of TMJ arthrocentesis with intra-articular morphine injection has decreased pain in approximately 90% of patients.

ARTHROCENTESIS WITH VISCOELASTIC SUBSTANCE AND STEROID ANTI-INFLAMMATORY DRUG

A study³⁰ has evaluated 22 patients with internal TMJ

disorders with pain and mouth opening limitations, clinically and radiologically diagnosed as Wikes stage III or IV. Sample was divided in 2 groups.

Ten patients had arthrocentesis close to the upper joint compartment followed by 10 mg hyaluronic acid in five applications once a week. The other 12 patients received arthrocentesis and dexamethasone in a single session. Maximum mouth opening, pain intensity and level of satisfaction during chewing were evaluated with VAS before and six months after arthrocentesis.

Mean maximum mouth opening before and six months after arthrocentesis in the hyaluronic acid group was 24.9 and 39.0 mm, respectively, while in the dexamethasone group it was 25.7 and 41.3, respectively. Mean pain score for the arthrocentesis/hyaluronic acid group before and six months after was 6.7 and 1.8, respectively and for the arthrocentesis/dexamethasone group before and six months after it was 7.0 and 1.8, respectively.

Mean score of satisfaction during chewing by VAS in the arthrocentesis/hyaluronic acid group before and six months after was 2.8 and 7.7, respectively, and for the arthrocentesis/dexamethasone group it was 3.1 and 7.8, respectively. There has been statistically significant difference in all measurements before and six months after arthrocentesis ($p < 0.001$), but there has been no difference in all measurements for the hyaluronic acid and the dexamethasone groups.

ARTHROCENTESIS WITH AND WITHOUT HYALURONIC ACID

A study¹⁶ has evaluated TMJ arthrocentesis with and without hyaluronic acid injection to treat disc displacements with reduction and with closed lock. The sample was made up of 31 individuals with clinical presentation of mouth opening limitation, TMJ pain and sensitivity and joint noises during function. Patients were randomly divided in 2 groups. The first group received arthrocentesis and the second arthrocentesis associated to 1 mL hyaluronic acid injection in upper TMJ compartment. Patients were evaluated before, soon after the procedure and from the 1st to the 24th month of evolution. Mandibular function and TMJ noises were evaluated. Pain intensity was measured by VAS. Maximum mouth opening and lateral jaw movements were also measured every control visit. Both techniques have provided mouth opening gains, lateral jaw movement improvement and have decreased pain and joint noises. The authors have concluded that the combination of arthrocentesis and hyaluronic acid injection was superior as compared to arthrocentesis alone.

ARTHROCENTESIS WITH HYALURONIC ACID OF DIFFERENT MOLECULAR WEIGHTS

Two treatment protocols³¹ were performed using single-needle TMJ arthrocentesis followed by hyaluronic acid injections with two different molecular weights, in five weekly sessions. The objective was to observe the efficacy in patients with degenerative TMJ inflammatory process. Evaluation tool was RDC/TMD (research diagnostic criteria for TMD). Sample was made up of 40 individuals randomly distributed in two groups. The first received arthrocentesis and low molecular weight hyaluronic acid and the other received middle-weight hyaluronic acid.

Maximum pain when chewing was the first considered variable. Maximum pain at rest, masticatory efficiency, functional limitation, tolerability to treatment and perceived efficacy, mandibular function amplitude and amplitude of movements measured in millimeters where the secondary outcomes. All variables were evaluated and compared between groups at the end of the treatment and 3 months later. At the end of the follow up period, all parameters had improved for both groups. Comparison between groups along time has shown no significant difference for any variable, that is pain at chewing and at rest, masticatory efficiency, functional limitation and mouth opening. In addition, there have been no differences between groups as to efficacy and perceived tolerability with regard to treatment. Authors have concluded that there has been similar therapeutic response for both treatment protocols, regardless of hyaluronic acid molecular weight.

ACTION MECHANISM

Arthrocentesis changes synovial fluid viscosity, thus contributing for the translation of the disc and mandible head complex³². In addition, when performed under pressure and combined with shearing forces generated by jaw manipulation it could break down early adhesions, thus improving mouth opening³³. Pain decrease or elimination is possibly due to joint lavage, which eliminates chemical pro-inflammatory mediators³⁴⁻³⁶, associated to the direct action of instilled drugs on intracapsular pain receptors³⁷.

COMPLICATIONS

There may be zygomatic branch or facial nerve temporal branch paresis caused by local anesthetic block or the edema itself; zygomatic or buccal branch paralysis

due to needle trauma; postoperative edema caused by intra-articular solution leakage; periauricular hematoma; perioperative bleeding by vascular injury; bradycardia and extradural hematoma^{7,23,33,38-41}.

DISCUSSION

Classic arthrocentesis is a minimally invasive, short and low cost procedure, performed in the medical office under local anesthesia with or without sedation. It does not leave scars and allows patients to go home soon after its completion. It allows joint space lavage and breakage of adhesions by hydraulic distension of the upper TMJ disc compartment. The traditional technique uses two needles inserted in this compartment. One needle for injecting and the other for aspirating the solution²².

The procedure may pose difficulties since puncture is made blindly, although some points have been established to help the access to TMJ upper compartment^{1,13,14}. There are cases where numerous capsular ligament punctures are performed during a single procedure to reach the upper joint compartment, however this is contraindicated. The cause may be dentist's little experience, failure of professional qualification and/or lack of adequate anatomic knowledge of the region. It may cause transient motor injury, facial zygomatic branch paresis, and may cause irreversible injury by paralysis of this same cranial nerve and/or neuropathic trigeminal pain⁴².

Another complication is the formation of extra and intra-articular microhemorrhages, which may evolve to adhesiveness, TMJ fibrotic ankylosis and even difficult to handle pain such as complex regional pain syndrome type II⁴³. In addition, there is the possibility of solution leakage, be it LR or SS, toward more superficial planes, decreasing intra-articular pressure necessary for adhesions lysis, causing also less removal of algogenic substances present inside the joint capsule, which may make joint lavage ineffective.

SNT⁹ is a simple, low cost and less invasive technique, does not need sophisticated instruments, materials or equipment, poses negligible risk of infection, morbidity or nervous injury. However, it has some limitations: it is hardly able to eliminate algogenic substances present in the synovial fluid of the upper TMJ compartment, responsible for pain and bone and fibrocartilagenous changes, since total circulating volume is very low. Even if the dentist exerts some pressure on the syringe plunger on the fluid, only part will return through the needle, regardless of patients closing their mouth. Part of the fluid may leak from the upper compartment to-

ward the face, producing local edema which may generate intra and postoperative pain.

Adhesions lysis will not be total and since the number of repetitions is approximately ten⁹, procedure time may be equal or longer as compared to arthrocentesis²¹. Both DNCA⁸ and SSCA²⁷ seem to be effective to treat internal TMJ disorders. They use just one entry point and, as a consequence, are easier to perform. There is one inconvenient as compared to classic arthrocentesis: cannulas are not widely available in the market. A disadvantage of this technique is that it may be difficult to inject joint lavage substance under pressure²². On the other hand, cannulas may be sterilized in autoclaves and be reused several times.

New controlled studies should be carried out to evaluate arthrocentesis combined with non-steroid anti-inflammatory drugs and arthrocentesis alone in patients with DDWR²⁹, as well as the use of arthrocentesis with viscoelastic substance and with steroid anti-inflammatory drugs³⁰. A larger sample shall be used, with longer follow up time and preferably with pre and post procedure MRI to explain which change(s) was(were) produced with regard to disc, its positioning, morphology, adjacent structures and the presence or not of a hypersignal (effusion) close to upper, lower or both compartments after these therapies.

This study may be a guide for health professionals to determine whether to use or not such anti-inflammatory substances together with arthrocentesis.

When conventional arthrocentesis¹ with SS and opioid³ is used and the result is poor, the cause might be low solution volume below 50 mL, malposition of needles in the upper compartment and local arthrogenic condition, that is algogenic substances, their concentration and location in the upper, lower or both compartments. In this latter situation, it is mandatory an imaging exam, such as MRI, which may confirm the presence of effusion and its location, being necessary arthrocentesis of the lower compartment.

A disadvantage of CNT²⁸ is when the aim is to wash TMJ joint compartment under high pressure with high volumes. It is better to use classic arthrocentesis^{1,44,45}, Shaper's cannula²⁷ or double-needle cannula⁸ instead of CNT.

Classic arthrocentesis technique¹ and arthrocentesis with SNT⁹ associated to hyaluronic acid seem to be effective for TMD. The former may trigger more pain, possibility of second needle displacement leading to interruption of the procedure with unsatisfactory results; temporary nervous block involving trigeminal nerve branches due to the anesthetic technique itself, the volume used or the leakage of this substance to more su-

perficial and/or deeper planes. It may also induce nervous injury in one or more motor branches involving the facial nerve as from the introduction of one or both needles during surgery. SNT seems to induce less pain, less risk of nervous injury, being clinically easier to be performed^{25,31}. SNT, based on previous clinical trials⁴⁶, uses five sessions both with LR or hyaluronic acid³¹. In this protocol, in addition to performing this number of TMJ punctures, they used hyaluronic acid in all procedures, which generates higher costs in addition to producing more local jaw trauma as a function of the number of repeated punctures. It would be interesting to decrease the number of serial injections, increasing hyaluronic acid effect³¹. Maybe, this protocol should be re-thought as a function of current clinical results and the small dimension of TMJ itself. For such, new clinical trials with more significant samples and longer follow up times are needed.

Different arthrocentesis techniques using LR or SS combined or not with anti-inflammatory drugs, opioids or viscoelastic substances produce excellent results for arthrogenic TMD. The therapeutic success is based on the chronicity of the case and on its clinical and imaging characteristics⁴⁷, on a thorough diagnosis, on patients' cooperation, on professional experience and on the technique(s) used. If the result of conservative technique is poor, one may initially use less invasive and less complex procedures such as arthrocentesis. New studies better designed in terms of methodology are needed before it is possible to precisely determine which is the best arthrocentesis technique – isolated or combined with other therapeutic modalities – to be used for arthrogenic TMJ disorders and their respective sub-groups.

CONCLUSION

Different arthrocentesis techniques, combined or not with anti-inflammatory drugs, opioids or viscoelastic substances, are less invasive, inexpensive, may be performed under local anesthesia, do not generate scars, do not need suture and produce excellent results for arthrogenic TMD. The therapeutic success, however, depends on numerous factors involving chronicity of the disease and its characteristics, on adequate diagnosis, on patients' cooperation, on the technique used and on professional experience.

REFERENCES

1. Nitzan DW, Dolwick MF, Martinez GA. Temporo-

mandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. *J Oral Maxillofac Surg.* 1991;49(11):1163-70.

2. Grossmann E. O uso de artrocentese e da lavagem articulação temporomandibular em pacientes com deslocamento anterior do disco sem redução. *Rev Dor.* 2001;3(3):97-102.

3. Brennan P A, Ilankovan V. Arthrocentesis for temporomandibular joint pain dysfunction syndrome. *J Oral Maxillofac Surg.* 2006;64(6):949-51.

4. Diraçoğlu D, Saral IB, Keklik B, et al. Arthrocentesis versus nonsurgical methods in the treatment of temporomandibular disc displacement without reduction. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2009;108(1):3-8.

5. Nitzan DW. Arthrocentesis--incentives for using this minimally invasive approach for temporomandibular disorders. *Oral Maxillofac Surg Clin North Am.* 2006;18(3):311-28.

6. Monje-Gil F, Nitzan D, González-García R. Temporomandibular joint arthrocentesis. Review of the literature. *Med Oral Patol Oral Cir Bucal.* 2012;17(4):e575-81.

7. Spallaccia F, Rivaroli P, Cascone P. Temporomandibular joint arthrocentesis: long-term results. *Bull Group Int Rech Sci Stomatol Odontol.* 2000;42(1):31-7.

8. Alkan A, Bas B. The use of double-needle canula method for temporomandibular joint arthrocentesis: clinical report. *Eur J Dent.* 2007;1(3):179-82.

9. 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.

10. Rahal A, Poirier J, Ahmarani C. Single-puncture arthrocentesis--introducing a new technique and a novel device. *J Oral Maxillofac Surg.* 2009;67(8):1771-3.

11. Murakami K, Hosaka H, Moriya Y, et al. Short-term treatment outcome study for the management of temporomandibular joint of closed lock. A comparison of arthrocentesis to nonsurgical therapy and arthroscopy lysis and lavage. *Oral Surg Oral Med Oral Pathol.* 1995;80(3):253-7.

12. Hosaka H, Murakami K, Goto K, et al. Outcome of arthrocentesis for temporomandibular joint with closed lock at 3 years follow up. *Oral Surg Oral Med Oral Pathol Radiol Endod.* 1996;82(5):501-4.

13. Nitzan DW, Samson B, Better H. Long-term outcome of arthrocentesis for sudden-onset, persistent, severe closed lock of the temporomandibular joint. *J Oral Maxillofac Surg.* 1997;55(2):151-8.

14. Carvajal WA, Laskin DM. Long-term evaluation

of arthrocentesis for the treatment of internal derangements of the temporomandibular joint *J Oral Maxillofac Surg.* 2000;58(8):852-7.

15. Nitzan DW, Price A. The use of arthrocentesis for the treatment of osteoarthritic temporomandibular joint. *J Oral Maxillofac Surg.* 2001;59(10):1154-60.

16. Alpaslan GH, Alpaslan C. Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in treatment of internal derangements. *J Oral Maxillofac Surg.* 2001;59(6):613-9.

17. Rahal A, Poirier J, Ahmarani C. Single-puncture arthrocentesis--introducing a new technique and a novel device. *J Oral Maxillofac Surg.* 2009;67(8):1771-3.

18. Grossmann E, Grossmann TK. Cirurgia da articulação temporomandibular. *Rev Dor.* 2011;12(2):152-9.

19. Bertolami CN. Efficacy of temporomandibular joint arthrocentesis with and without injection of sodium hyaluronate in treatment of internal derangements: discussion *J Oral Maxillofac Surg.* 2001;59(6):613-9.

20. Yura S, Totsuka Y. Relationship between effectiveness of arthrocentesis under sufficient pressure and conditions of the temporomandibular joint. *J Oral Maxillofac Surg.* 2005;63(2):225-8.

21. Machon V, Hirjak D, Lukas J. Therapy of the osteoarthritis of the temporomandibular joint. *J Craniomaxillofac Surg.* 2011;39(2):127-30.

22. Tozoglu S, Al-Belasy FA, Dolwick MF. A review of techniques of lysis and lavage of the TMJ. *Br J Oral Maxillofac Surg.* 2011;49(4):302-9.

23. Matsa S, Raja, KK, Bhalerao S, et al. Temporomandibular joint arthrocentesis for closed lock - A prospective analysis of 10 consecutive cases. *Univer J of Dent Scienc.* 2010;1(3):225-9.

24. Neeli AS, Umarani M, Kotrashetti SM, et al. Arthrocentesis for the treatment of internal derangement of the temporomandibular joint. *J Maxillofac Oral Surg.* 2010;9(4):350-4.

25. Guarda-Nardini L, Ferronato G, Manfredini D. 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.* 2012;41(4):506-13.

26. Parameters of care for oral and maxillofacial surgery. A guide for practice, monitoring and evaluation (AAOMS Parameters of Care-92). American Association of Oral and Maxillofacial Surgeons. *J Oral Maxillofac Surg.* 1992;50(7 Suppl 2):i-xvi, 1-174.

27. Rehman K-U, Hall T. Single needle arthrocentesis *Brit J of Oral and Maxillof Surg.* 2009;47(5):403-4.

28. Öreroglu AR, Özkaya A, Öztürk MB, et al, Concentric-Needle Cannula method for Single-Puncture Ar-

throcentesis in Temporomandibular Joint Disease: An Inexpensive and Feasible Technique *J Oral Maxillofac Surg.* 2011;69(9):2334-8.

29. Aktas I, Yalcin S, Sencer S. Prognostic indicators of the outcome of arthrocentesis with and without sodium hyaluronate injection for the treatment of disc displacement without reduction: a magnetic resonance imaging study. *Int J Oral Maxillofac Surg.* 2010;39(11):1080-5.

30. Yeo HH, Kwon BG, Kim JS. An effect of hyaluronic acid on the temporomandibular joint arthrocentesis. *J Korean Assoc Maxillofac Plast Reconstr Surg.* 1999;21(4):388-94.

31. Guarda-Nardini L, Cadorin C, Frizziero A, et al. Comparison of 2 hyaluronic acid drugs for the treatment of temporomandibular joint osteoarthritis. *J Oral Maxillofac Surg.* 2012;70(11):2522-30.

32. Nitzan DW, Etsion I. Adhesive force: the underlying cause of the disc anchorage to the fossa and/or eminence in the temporomandibular joint. A new concept. *Int J Oral Maxillofac Surg.* 2002;31(1):94-9.

33. Yura S, Totsuka Y, Yoshikawa T, et al. Can arthrocentesis release intracapsular adhesions? Arthroscopic finding before and after irrigation under sufficient hydraulic pressure. *J Oral Maxillofac Surg.* 2003;61(11):1253-6.

34. Frost DE, Kendell BD. The use of arthrocentesis for treatment of temporomandibular joint disorders. *J Oral Maxillofac Surg.* 1999;57(5):583-7.

35. Emshoff R, Puffer P, Strobl H, et al. Effect of temporomandibular joint arthrocentesis on synovial fluid mediator level of tumor necrosis factor-alpha: Implications for treatment outcome. *Int J Oral Maxillofac Surg.* 2000;29(3):176-82.

36. Kaneyama K, Segami N, Nishimura M, et al. The ideal lavage volume for removing bradykinin, interleukin-6, and protein from the temporomandibular joint by arthrocentesis. *J Oral Maxillofac Surg.* 2004;62(6):657-61.

37. Kunjur J, Anand R, Brennan PA, et al. An audit of 405 temporomandibular joint arthrocentesis with intra-articular morphine infusion. *Br J Oral Maxillofac*

Surg. 2003;41(1):29-31.

38. Stein JI. TJM arthrocentesis – A conservative surgical alternative. *N Y S Dent J.* 1995;61(9):68-76.

39. Dimitroulis G, Dolwick MF, Martinez A. Temporomandibular joint arthrocentesis and lavage for the treatment of closed lock: a follow-up study. *Br J Oral Maxillofac Surg.* 1995;33(1):23-7.

40. Carrol T A, Smith K Jakubowski J. Extradural haematoma following temporomandibular joint arthrocentesis and lavage *Br. J Neurosurg.* 2000;14(2):152-4.

41. Tan DBP, Krishnaswamy GA. Retrospective study of temporomandibular joint internal derangement treated with arthrocentesis and arthroscopy. *Proceed of Singap Health.* 2012;21(1):73-8.

42. Grossmann E, Cousen T, Grossmann TK et al. Neuralgia inducing cavitation osteonecrosis. *Rev Dor.* 2012;13(2):156-64.

43. Cordon FCO, Lemonica L. Complex regional pain syndrome: epidemiology, pathophysiology, clinical manifestations, diagnostic tests and therapeutic proposals. *Rev Bras Anestesiol.* 2002;52(5):618-27.

44. Al-Belasy FA, Dolwick MF. Arthrocentesis for the treatment of temporomandibular joint closed lock: a review article. *Int J Oral Maxillofac Surg.* 2007;36(9):773-82.

45. Grossmann E, Collares MVM. Arthrocentesis and lavage in the treatment of articular disk displacement without reduction. *Braz J Craniomaxillofac Surg.* 2000;3(1):27-31.

46. Navarro-Sarabia F, Coronel P, Collantes E, et al. A 40-month multicentre, randomised placebo-controlled study to assess the efficacy and carry-over effect of repeated intra-articular injections of hyaluronic acid in knee osteoarthritis: The AMELIA project. *Ann Rheum Dis.* 2011;70(11):1957-62.

47. Honda K, Yasukawa Y, Fujiwara M, et al. Causes of persistent joint pain after arthrocentesis of temporomandibular joint. *J Oral Maxillofac Surg.* 2011;69(9):2311-5.

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