RESEARCH PAPER

Evaluation of MSCT accuracy as a guide for superior joint space puncture of the temporomandibular joint and outcomes following image guided arthrocentesis.

Mustafa G Khallaf [1], Shahad Azawi [2], Hussein Elrawy [3], Ahmed Omar Ahmed Abdelrahman [4], Arafa Gad Allah Ibrahim Ahmed [5], Abdullah Ibrahim Abd Rabbouh Ali [6], Mahmoud Ahmed Mizar [7], Ahmed Mohamed Abd Al Rahman [8], Ibrahim Sabry Elsayed [9], Ahmed M Saaduddin Sapri [10].

[1] Lecturer, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Al-Azhar University, Cairo, Egypt. E-mail: M.khallaf@cdiohio.org

[2] DDS, GPR Resident Dentist at Cleveland Dental Institute. Cleveland, Ohio, USA. E-mail: S.azawi@cdiohio.org

[3] Chairman, Cleveland dental institute. E-mail: H.elrawy@cdiohio.org

[4] Assistant professor of oral and maxillofacial surgery department, Faculty of Dental Medicine Al-Azhar University, Assiut Branch, Egypt. E-mail: ahmedaboziad81aaa@gmail.com

[5] Lecturer of oral and maxillofacial surgery, Faculty of Dental Medicine Al-Azhar University, Assiut Branch, Egypt. E-mail: arafagadebrahim@gmail.com

[6] Lecturer, Department of oral medicine, periodontology, oral diagnosis and dental radiology, Faculty of Dental Medicine, Al-Azhar University (Assiut Branch), Assiut, Egypt. E-mail: Abdullahbeshrah923.el@azhar.edu.eg

[7] Lecturer, Department of oral medicine, periodontology, oral diagnosis and dental radiology, Faculty of Dental Medicine, Al-Azhar University (Assiut Branch), Assiut, Egypt. E-mail: mahmoudmizar4@gmail.com

[8] Lecturer, Department of oral medicine, periodontology, oral diagnosis and dental radiology, Faculty of Dental Medicine, Al-Azhar University (Assiut Branch), Assiut, Egypt. E-mail: dentistahmed200@gmail.com

[9] Associate professor of oral medicine, periodontology, oral diagnosis and oral radiology, Faculty of Dental Medicine, Al-Azhar University, Cairo, Boys, Egypt. E-mail: ibrahimelbatanony.209@azhar.edu.eg

[10] Oral and Maxillifacial Surgery and Diagnostic Sciences Department, College of Dentistry, King Saud bin Abdulaziz University for Health Sciences (KSAU-HS), Riyadh 11426, Saudi Arabia.

[10] Associate Clinical Professor, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Mansoura University, Mansoura, Dakahlia Governorate, Egypt. E-mail: sapria@ksau-hs.edu.sa

ahmedsaaduddin@mans.edu.egEmail : cynthiamilton@sriramachandra.edu.in Orchid Id : 0000-0002-7162-8693

Received: 27th Oct, 2025; Revised: 25th Nov, 2025; Accepted: 02h Dec, 2025; Available Online: 12th Feb, 2026

ABSTRACT

Objective: The objective of the current trial was to assess the reliability of multi-slice computed tomography (MSCT) in guiding superior joint space puncture of the temporomandibular joint (TMJ) during arthrocentesis.

Study design: Arthrocentesis with mandibular manipulation (MM) was performed under MSCT guidance in 28 joints with varying durations of closed lock and MRI-confirmed dislocation of the anterior disc with no diminution. Clinical evaluation included maximum opening of the mouth (MOM), a visual analog scale (VAS) for pain, and self-reported questionnaires for malfunction of the jaw and daily life activities (DLA). Postoperative MRI was obtained at one month, with a total six-month follow-up interval.

Results: MOM rose considerably from a 24.7 +/- 5.9 mm to 39.6 +/- 6.2 mm at the six-month examination (P=.01). Significantly lower VAS pain (from 6.2 to 2.8) was linked to enhanced function with mean of 3.4 +/- 2 ,subjective pain (from 11.7 to 4)with mean of 7.7 +/- 3, dysfunction (from 8.6 to 3.2)with mean of 5.4 +/-1, and DLA scores (from 13.9 to 4.4)with mean of 9.5 +/-2 , all with (P= .01). The total rate of success in term of those got improved with treatment was 98%; acute cases had a greater percentage (100%) than chronic cases (97%). In 2 joints where the locking period was below one month (acute individuals), the disc had been recovered (the disc was positioned amongst the condyle and the eminence on close and open-field MRI photos). Needle insertion inside the upper joint space was done without correcting the needle position in 100% of patients with the aid of MSCT.

Conclusions: MSCT guided arthrocentesis, in association with manipulation and arthrocentesis for disc displacement was efficient at enhancing performance and lowering discomfort in individuals with closed locks or limited mouth opening. Marginally acute closed lock patients yielded more favorable outcomes than chronic individuals in regard to MOM, VAS, and survey ratings. Only 2 joints in individuals having acute closed lock were able to recapture the anteriorly misplaced disc.

Keywords: Temporomandibular joint; TMJ arthrocentesis; MSCT-guided puncture; superior joint space; closed lock;

disc displacement; mandibular manipulation; mouth opening; pain assessment; image-guided intervention.
How to cite this article: Khallaf MG, Azawi S, Elrawy H, Abdelrahman AOA, Ahmed AGAI, Ali AIAR, Mizar MA, Al Rahman AMA, Elsayed IS, Sapri AMS. Evaluation of MSCT accuracy as a guide for superior joint space puncture of the temporomandibular joint and outcomes following image guided arthrocentesis. Int J Drug Deliv Technol. 2026;16(50s): 1631-1635. DOI: 10.25258/ijddt.16.50s.163
Source of support:. None
Conflict of interest: None

INTRODUCTION

Conventional radiology, arthroscopic magnetic resonance imaging (MRI), computerized tomography (CT), cone-beam CT (CBCT), and arthroscopic are some of the options available for diagnostic imaging of the temporomandibular joint (TMJ).[1-6] Due to the invasive nature and technical complexity of these treatments, TMJ arthrography and arthroscopy have been less common among individuals having TMJ issues after the advent of MRI.[7] A common clinical procedure for the diagnosis and treatment of TMJ diseases is puncturing the TMJ cavity. Joint puncture has been used in previous studies of, medicine injections, arthrocentesis, pumping adjustment, arthroscopy, and collecting fluid through the joint cavity [8-13]; Nevertheless, consequences including injury to the facial nerves, invasion of the middle cranial fossa, or permanent alterations to the TMJ itself might result from puncturing the TMJ cavity. [14-17] Methods like arthrocentesis, arthroscopic surgical procedures, and TMJ disk inspection are helpful and have a big impact on the medical treatment of conditions like synovial chondromatosis and extensive temporomandibular osteoarthritis.[8-12,16-18] TMJ cavity punctures that are safer, more dependable, and simpler may reduce the risk of inaccurate puncture and therefore improve outcomes. The medical community has frequently documented the effectiveness of image-based surgical methods, including safer techniques continue to be developed, [19,20] but few such reports relate to the TMJ. [21-23] The efficacy of the image guided puncture technique (IGPT), and CBCT use as well as ultrasound have been described, [21] However, there are currently no published clinical comparison between IGPT and the traditional puncture procedure (CPT), neither has MSCT been described. The objective of the current trial was to assess the reliability of MSCT as a new IGPT according to the precision of needle insertion and improvements in maximum opening of the mouth and pain following arthrocentesis and pumping adjustment management for TMJ internal dysfunction.

METHODOLGY

Materials And Methods:

28 individuals were recruited according to the clinical and MRI evaluations showing intrinsic TMJ dysfunction and closed lock. Before receiving the IGPT in the form of MSCT for pumping adjustment treatment, every individual underwent the CPT procedure. In CPT, anatomical markers were employed, and in IGPT, the superior TMJ cavity was securely punctured using MSCT. Single oral radiologist (AZ), who was skilled in MSCT and TMJ puncture, carried out each treatment. The Al-Azhar University School of Dentistry in Cairo, Egypt's Bioethics Committee examined and authorized the research's usage of participants. Written informed permission was obtained from every participant to take part in the current investigation.

CPT Technique:

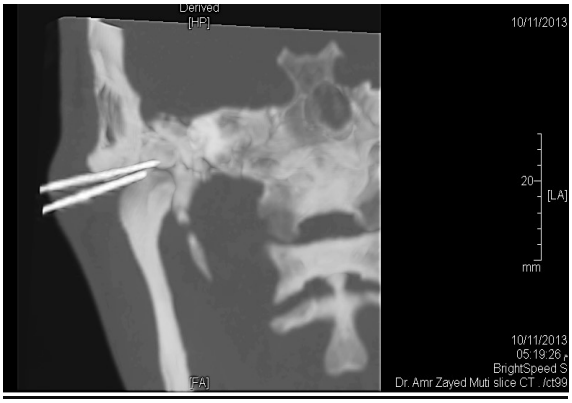
The mandibular fossa and head locations were verified by palpation prior to surgery using the CPT technique as anatomic signal regions, based on two points detected on cantho-tragal line (Holmlund-Hellsing line), a line drown from the outer canthus of the eye to the middle of tragus The insertion points were 10 mm anterior to the tragus and 2 mm beneath for the first needle while the second one was injected 20 mm and 10 mm below{Fig.1}.A marker was used to trace the outline of the punctured spot on the skin. The fossa or the posterior slope of the tubercle was used to pierce the upper joint cavity. Iodine and 8% hypoalcohol were used to sterilize a large area of skin surrounding the preauricular area. A subcutaneous injection of 2% lignocaine was used to provide infiltration anesthesia. Arthrocentesis was carried out for the superior joint cavity utilizing a blind technique using 150 ml of ringer,s lactate solution.

(Fig.1)Needles placed into the upper joint space

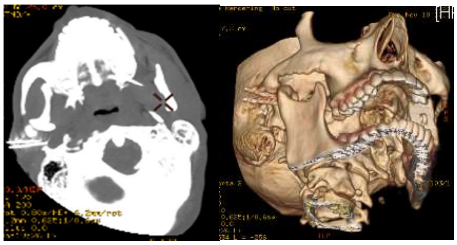
IGPT Method:

In the IGPT method, palpation was used to identify the condyle and fossa contour, which was then sketched on the skin with a medical highlighter. Furthermore, axial planes that pass across the top of the condyle and reference lines (the Frankfort horizontal [F-H] plane) were painted on the skin. The patient was positioned on MSCT machine lying in supine position. Iodine and 8% hypoalcohol were used to sterilize a large area of skin surrounding the preauricular

zone. 2% lignocaine was injected subcutaneously to provide infiltration anesthesia. The first needle was inserted based on a tactile sense of the condyle during forced mouth opening then MSCT was then performed. The depth of the needle was confirmed based on back flow of fluid. Considering the three-dimensional characteristics and this set point in addition to MIP of the coronal slice and the location of the second needle's skin penetration was determined by the participant shape of the mandibular fossa and condyle and confirmed by MSCT{Fig.2 a&b}. Using a 26-G needle arthrocentesis was done using 150 ml of ringer,s lactate solution.



(Fig.2a) confirmation of the needles position using MSCT coronal cut.



(Fig.2b) confirmation of the needles position using MSCT axial cut& 3D.

Pumping manipulation method:

Following confirmation of blood flowing into the superior joint cavity, pumping manipulations therapy was administered to all individuals using the two puncture techniques. 150 milliliters of ringer lactate were used to cleanse the joint cavity. Lastly, the cavity was filled with 1.0 mL of sodium hyaluronate.

Explanation of variables:

Three factors were measured in order to evaluate the efficacy of IGPT: (A) the quantity of repunctures, or if it was possible to get accessibility to the superior joint cavity without repairing the puncture sites from the first trial, (B) The space among the central incisors, which has been defined as the opening distance that occurred when the individual cannot no longer tolerate the discomfort, is the measurement of maximum opening of the mouth and (C) Self-evaluation utilizing a visual analogue scale (VAS) yielded the pain threshold, which ranges from zero (no pain) to Ten (the most excruciating agony conceivable).

Statistical analysis:

Utilizing SPSS for Windows 8, the Mann-Whitney U test was used to statistically analyze the variations in puncture point among IGPT and CPT. Utilizing SPSS for Windows, the maximum opening of the mouth and pain thresholds throughout IGPT and CPT were compared utilizing the unpaired 2-group T test. (P) Statistical significance was defined as values below.05.

Results:

In 83% of participants who had CPT and 99% of participants who had IGPT, accessibility to the superior joint cavity was obtained without repairing the puncture sites. The amount of altering puncture locations varied significantly among IGPT and CPT (P<.05).

The mean maximum mouth openness within the IGPT group was 27 mm prior to therapy and 36 mm 3 weeks following intervention. Following 6 months of monitoring, the maximum mouth openness increased to 41 mm, and in the following 12 months, it was 41 mm.

The mean maximum mouth openness in the CPT was 23 mm prior to therapy and 25 mm 3 weeks following intervention. Following 6 weeks, the maximum mouth openness increased to 27 mm (not significant) and remained stable at 12 weeks. Among IGPT and CPT, there was a significant change in the maximum opening of the mouth after 3 weeks (P <.05).

The mean VAS score throughout the IGPT was 2.5 mm 3 weeks following therapy and 5.8 mm prior to intervention. Following 3 months, the pain level decreased to 0.8, and in the following 12 months, it was 0.5.

Prior to therapy, the mean VAS score within the CPT group was 6.8, and 3 weeks following intervention, it was 6.2. Following 6 weeks, the pain level decreased to 5.9, and following 12 weeks, it decreased to 5.8. IGPT and CPT showed significant variations in 3 weeks VAS (P<.05).

Discussion:

A fundamental technique in TMJ operations is puncturing the TMJ cavity. When conservative measures failed to significantly improve pain and function, surgery for the TMJ must be considered. Less invasive treatments have been developed to reduce morbidity associated with open surgery. One of the smallest-invasive methods for treating TMJ disorders is arthrocentesis. Since the process of pumping manipulations or arthrocentesis is so straightforward, the prognosis and treatment results may be impacted by the puncture's precision. In the current research, participants who had TMJ internal derangements were treated with pumping manipulation using two different puncturing procedures. The puncture needles failed to reach the superior TMJ cavity upon the initial try in (1%) among our 28 IGPT instances and 17% of our CPT participants. According to the research's statistical results, IGPT outperformed CPT in terms of puncture accuracy. This lends credence to the idea that IGPT with MSCT is appropriate for image-directed TMJ puncture with the least amount of patient surgical intervention. In the one case when IGPT was unsuccessful, the participant's inaccurate angle calculation after movement was the cause. To prevent similar issues in the future and to guarantee the proper puncture angle, additional tools that keep the head or needle in position must be designed.

Precise insertion of the needle may be aided by knowledge of the morphologic characteristics of each patient, such as

the distance and angle among skin and cavity puncture locations, as well as the form of bone components. Image-directed puncture procedures have been documented in the medical sector, namely for needle biopsies, utilizing CT, ultrasonography, and MRI [19,20]. The effectiveness of an image-directed TMJ puncture have been reported utilizing CBCT, [21] In contrast, Fritz et al. [23] used real-time MRI scanning and obtained a 100% puncture efficiency frequency. Yeung et al. [22] developed an automated puncture approach for the TMJ's superior and inferior joint cavities with the aid of 3-D MRI and a unique navigation technology; the approach's clinical results are still unknown. MRI-assisted techniques might be more appropriate for TMJ puncture planning because CBCT is unable to see soft tissue, such as disk or retrodiscal tissues. However, previous MRI exams for the dimension, shape, and location of the disk and joint components have identified many individuals who need TMJ surgical intervention. The existence of disc adhesion or puncture may only be reliably detected by arthrography or arthroscopy. Therefore, we think that MSCT's assessment of images and puncture scheduling are sufficient, secure, and worthwhile.

In the initial phases of management, the current clinical investigation has shown that pumping manipulation with IGPT is beneficial for improving mouth opening and reducing pain. Brief periods of therapy and precise punctures may help with earlier reduction of pain in IGPT instances; as a result, earlier pain reducing could help with earlier mouth opening enhancement. Despite the short term effect of Sodium hyaluronate can additionally serve to alleviate discomfort. There have been no prior studies comparing postoperative pain alleviation for various TMJ puncture techniques. These findings point to a significant relationship between precise TMJ puncture and post-operative pain reduction.

Conclusion:

According to the current study, IGPT might be the most dependable technique for TMJ superior joint space puncture. In individuals who have interior derangement, IGPT arthrocentesis effectively lead to pain reduction and enhances mouth opening following pumping manipulation therapy and permits accurate and precise placement of injectable material. The outcomes are better than using a blind puncture technique. Future research must enhance techniques for automating, standardizing, and generating consistent outcomes for puncturing the joint cavity, but the current trial suggests that IGPT employing MSCT is a safe therapy for correcting interior derangement of the TMJ.

REFERENCE

1. Krisjane Z, Urtane I, Krumina G, Bieza A, Zepa K, Rogovska I. Condylar and mandibular morphological criteria in the 2D and 3D MSCT imaging for patients with Class II division 1 subdivision malocclusion. J. Stomatologija 2007;9:67-71.
2. Larheim TA. Current trends in temporomandibular joint imaging. J. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995;80:557-76.
3. Brooks SL, Brand JW, Gibbs SJ, Hollender L, Lurie AG, Omnell KA, et al. Imaging of the temporomandibular joint: a position paper of the American Academy of Oral and Maxillofacial Radiology. J. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83:601-18.
4. Westesson PL. Reliability and validity of imaging diagnosis of temporomandibular joint disorders. Adv Dent Res. J. 1993; 7:135-51.
5. Honda K, Arai Y, Kashima M, Takano Y, Sawada K, Ejima K, et al. Evaluation of the usefulness of the limited cone-beam CT (3DX) in the assessment of the thickness of the roof of the glenoid fossa of the temporomandibular joint. Dentomaxillofac. Radiol. J. 2004;33:391-5.
6. Honda K, Larheim TA, Maruhashi K, Matsumoto K, Iwai K. Osseous abnormalities of the mandibular condyle: diagnostic reliability of cone beam computed tomography compared with helical computed tomography based on an autopsy material. Dentomaxillofac Radiol J. 2006;35:152-
7. Lewis EL, Dolwick MF, Abramowicz S, Reeder SL. Contemporary imaging of the temporomandibular joint. Dent Clin North Am J. 2008;52:879-90.
8. Ohnishi M. Clinical application of arthroscopy in the temporomandibular joint diseases. Bull Tokyo Med Dent Univ J. 1980;27:141-50.
9. Murakami K, Matsuki M, Iizuka R, Ono T. Recapturing the persistent anteriorly displaced disc by mandibular manipulation after pumping and hydraulic pressure to the upper joint cavity of the temporomandibular joint. J Craniomandib Pract.1987; 5:17-24.
10. McCain JP. Arthroscopic surgery of the human temporomandibular joint.
J Oral Maxillofac Surg 1988;46:648-55.
11. Nitzan DW, Dolwick MF, Martinez GA. Temporomandibular joint arthrocentesis: a simplified treatment for severe, limited mouth opening. J Oral Maxillofac Surg 1991;49:1163-7.
12. Kobayashi K, Yuasa M, Imanaka M, Igarashi C, Yamamoto A. Development of interventional radiology for the internal derangements of the temporomandibular joint. Dent Jpn. J. 1999;35:97-9.
13. Matsumoto K, Honda K, Ohshima M, Yamaguchi Y, Nakajima I, Micke P, et al. Cytokine profile in synovial fluid from patients with internal derangement of the temporomandibular joint: a preliminary study. Dentomaxillofac Radiol J. 2006;35:434-41.
14. Westesson PL, Eriksson L, Liedberg J. The risk of damage to facial nerve, superficial temporal vessels, disk, and articular surfaces during arthroscopic examination of the temporomandibular joint. J Oral Surg 1986;62:124-7.
15. Green MW, Hackney FL, Van Sickels JE. Arthroscopy of the temporomandibular joint: an anatomic perspective. J Oral Maxillofac Surg 1989;47:386-9.
16. Sugisaki M, Ikai A, Tanabe H. Dangerous angles and

depths for middle ear and middle cranial fossa injury during arthroscopy of the temporomandibular joint. J Oral Maxillofac Surg 1995; 53:803-10.
17. Bjørnland T, Rørvik M, Haanæs HR, Teige J. Degenerative changes in the temporomandibular joint after diagnostic arthroscopy. An experimental study in goats. Int J Oral Maxillofac Surg 1994;23:41-5.
18. Honda K, Hamada Y, Ejima K, Tsukimura N, Kino K. Interventional radiology of synovial chondromatosis in the temporoman- dibular joint using a thin arthroscope. Dentomaxillofac Radiol J. 2008;37:232-5.
19. Seibel RM. Image-guided minimally invasive therapy. J. Surg Endosc 1997;11:156-62.
20. Perrin DP, Vasilyev NV, Novotny P, Stoll J, Howe RD, Dupont PE, et al. Image guided surgical interventions. J. Curr Probl Surg. 2009;46:736-66.
21. Honda K, Bjørnland T. Image-guided puncture technique for the superior temporomandibular joint space: value of cone beam computed tomography (CBCT). J. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102:281-6.
22. Yeung RW, Xia JJ, Samman N. Image-guided minimally invasive surgical access to the temporomandibular joint: a preliminary report. J Oral Maxillofac Surg 2006;64:1545-52.
23. Fritz J, Thomas C, Tzaribachev N, Horger MS, Claussen CD, Lewin JS, et al. MRI-guided injection procedures of the TMJ in children and adults: technique, accuracy, and safety. Am J Roentgenol 2009;193:1145-54.
24. Dixon AS, Jacoby RK, Berry H, Hamilton EB. Clinical trial of intra-articular injection of sodium hyaluronate in patients with osteoarthritis of the knee. Curr Med Res. J. 1988;11:201-13.
25. Bjørnland T, Gjærum AA, Møystad A. Osteoarthritis of the TMJ: an evaluation of the effects and complications of corticosteroid injection compared with injection with sodium hyaluronate. J Oral Rehabil 2007;34:583-9.