EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 71, 2907:2916, OCTOBER, 2025
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
ORAL SURGERY
Submit Date : 25-05-2025 • Accept Date : 18-07-2028 • Available online: 01-10-2025 • DOI : 10.21608/edj.2025.388628.3496

ULTRASOUND-GUIDED VERSUS CONVENTIONAL NONGUIDED AUTOLOGOUS BLOOD INJECTION FOR TREATMENT OF PATIENTS WITH CHRONIC RECURRENT TEMPOROMANDIBULAR JOINT DISLOCATION (A RANDOMIZED CLINICAL TRIAL)

Mohamed Abbas Morsy [*], Nour Mohamed Kandil [**], Rania Zeitoun[**], Walaa Kadry [***] *and* Hassan Abdel-Ghany [****]

ABSTRACT

Aim This research aims to compare and evaluate the efficacy of ultrasound (US) guided autologous blood injection (ABI) to the non-guided approach in chronic recurrent temporomandibular joint (TMJ) dislocation. **Patients and methods** Twenty eligible patients suffering from chronic TMJ dislocations were randomized equally into two groups. Ten patients (the study group) received autologous blood injections (ABIs) under US guidance, while the remainder (the control group) received AB injections without guidance. They were clinically assessed for pain intensity using VAS at intervals of two weeks, three-months and six-months following the injection. And radiographically after 6 months of injection by double lateral TMJ radiograph in open and closed position regarding the position of condylar head in relation to the articular eminence in wide mouth openings. **Results** The mean pain score remains high in study group after 3 and 6 months of intervention compared to control group but there was non-significant difference between groups either pre - operatively, after 2 weeks, 3 months and after 6 months of intervention. At the end of 6 months follow up, In the study group, the condylar head was still displaced out of glenoid fossa, anterior to the articular eminence in wide mouth opening in 9 patients, and the other 1 patient had the condylar head posterior to the articular eminence in maximum mouth opening position. In control group, the condylar head of all 10 patients of this group was still moved anterior to the articular eminence in wide open mouth position. **Conclusion** Although US -guided ABI is a minimally invasive procedure that involves radiation-free exposure, real-time vision of needle advancement and could afford accurate access to the joint cavity, it was not more successful than the conventional technique and produces more postoperative pain.

KEYWORDS: Autologous blood injection, ultrasound guidance, temporomandibular joint, chronic recurrent dislocation.

* Principal researcher at Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Cairo University, Cairo, Egypt.
** Associate Professor of Diagnostic and Interventional Radiology Department, Kasr Al-Ainy, Faculty of Medicine, Cairo University, Cairo, Egypt.
*** Associate Professor at department of oral and Maxillofacial Surgery, Faculty of Dentistry, Cairo University, Cairo, Egypt.
**** Professor of Oral and Maxillofacial Surgery, Faculty of Dentistry, Cairo University, Cairo, Egypt.

INTRODUCTION

When the condylar head moves out of the glenoid fossa and it is difficult for the patient to reduce it due to additional complications from muscle spasm it is called temporomandibular joint (TMJ) dislocation (Chan et al., 2008; Krishnakumar Raja, 2021). this condition has traumatic and non-traumatic causes during everyday activities such as speaking, yawing, vomiting, laughing or chewing. Additionally, interventional procedures like laryngoscopy, endoscopy, or dental treatments may cause It (Akinbami, 2011; Okoje et al., 2017; Tarhio et al., 2023).

This may affect the patient's life as it has a significant effect on the airway, nutrition and social communication which makes it necessary for medical manipulation to restore the condyle to its normal position (Hillam & Isom, 2025; White et al., 2016).

If this condition tends to occur repeatedly it is named chronic recurrent dislocation (Yang et al., 2001) Several surgical and conservative techniques have been proposed to treat it (Ertaş et al., 2022). non or minimally invasive methods are usually attempted first before any surgical intervention. One of the minimally invasive methods for treating mandibular dislocation is Injections of autologous blood (AB), it was initially documented by Brachmann (Krishnan et al., 2020; Varedi & Bohluli, 2015). The exact mechanism of action of ABI is still unknown but it was believed that after the joint is injected by blood, an inflammatory reaction occurs, platelets released Inflammatory mediators. Following this, an organized blood clot and loose fibrous tissue are formed and matured to maintain the joint stiffness and limit translation of the condyles.(Machon et al., 2009)

The complex anatomy of TMJ may affect the accuracy of non-guided injection and require a high experience to avoid damage of discal ligament as it depends only on the anatomical landmarks for injection(Dayisoylu et al., 2013). Hence, image guidance is required for intra-articular blood injection.

Magnetic resonance image (MRI) and cone beam computed tomography (CBCT) had been used as guiding tools for arthrocentesis or TMJ injection and led to promising result. However, High cost, CBCT radiation, or patient-related (claustrophobic, in the case of MRI) make the use of MRI or CBCT as a guiding tool not feasible for routine TMJ injection. On the other hand, the ultrasound (US) is an applicable method, cost effective without ionizing radiation for image-guided access to the TMJ (Hu et al., 2023).

The US-guided technique was compared in literature to the conventional one, but for TMJ lavage in managing disc derangement disorders rather than TMJ hypermobility.(Dayisoylu et al., 2013; Parra et al., 2010) authors compared the two techniques and reported a significant difference regarding pain scores and explained that to the usage of US as a guided technique reduced needle trauma.(Antony et al., 2019)

However, it is still unknown if US-guided technique improved post-operative outcomes, especially in terms of reduced pain as compared to the conventional procedure(Hu et al., 2023)

A prospective cohort study by Gagnani et al, used US guidance for AB injection into superior joint space (SJS) and pericapsular tissue (PT) in chronic recurrent TMJ dislocation and the authors reported a high success rate and reduced postoperative pain and explained that the active visualization of needle insertion and advancement by US reduced the risk of incorrect ABI (Gagnani et al., 2020).

The current study is the first randomized controlled study, as far as we are aware, that compares US-guided versus a non-guided approach for ABI in TMJ hypermobility and evaluate the efficacy of ultrasound (US) guidance technique in reduction of

pain after ABI. The Authors hypothesized that the ultrasound (US) guided autologous blood injection (ABI) would result in better clinical outcomes in term of reduced postoperative pain as it would decrease manipulation during injection.

PATIENTS AND METHODS

Study design

This parallel randomized clinical trial (allocation ratio 1:1) was approved by the Research Ethics Committee at the Faculty of Dentistry, Cairo University, Cairo, Egypt (IRB number 291123). Patients were chosen from the Faculty of Dentistry's outpatient clinic at Cairo University, Egypt where they received treatment in cooperation with the Diagnostic and Interventional Radiology Department of the Faculty of Medicine, Cairo University.

Eligibility criteria

Participants in this study were selected according to certain criteria

Inclusion criteria:

- Patients who suffered from chronic recurrent TMJ dislocation.
- Radiological evidence of condylar head anterior to the articular eminence on wide mouth opening.
- Unilateral or bilateral dislocation.
- Male or female patients.
- age ranges from 18-45 years

Exclusion criteria:

- Patients suffering from rheumatoid arthritis, epilepsy, Parkinson's disease or Ehlers-Danlos syndrome.
- Dystonia.
- Patient on anti-depressants or anti-psychotics drugs.
- Patients with history of condylar fracture, TMJ surgical interference or with history of previous treatment of dislocation.
- Patients with bleeding disorders, blood diseases, pregnancy or bony pathology of TMJ.

Twenty individuals with recurrent TMJ dislocations participated in this study: 10 female study group patients received intra-articular and capsular autologous blood injections under real-time US guidance, while 9 female and 1 male control group patients received the same treatment but only anatomical landmarks and tactical sense were followed (without US guidance).

Prior to treatment, patients were told about any potential complication and written informed consent was obtained.

Randomization:

Principal investigator carried out the randomization process using randomization site; www.random.org with 1:1 allocation ratio.

Allocation concealment mechanism:

Each participant selected one envelope on the day of the process. The opaque, sealed envelopes with the sequential numbers for each card were put in a container.

Preoperative evaluation:

- **Medical and dental history**:

Patient's medical history was reviewed to rule out the presence of any underlying diseases that might have an effect on the TMJ. Data concerning the chief complaint, precipitating factors like eating, talking, and yawning., parafunctional habits like bruxism are collected

- **Clinical examination:**

It includes general examination of the TMJ and assessing pain score using visual analogue scale (VAS). Examination of TMJ dislocation signs like

inability to close the mouth, visible and palpable preauricular depression, difficulty in speaking, drooling of saliva and if dislocation was unilateral or bilateral. A double lateral TMJ radiograph in open and closed mouth position was taken to show the relationship between the condylar head and the articular eminence. Figure (1).

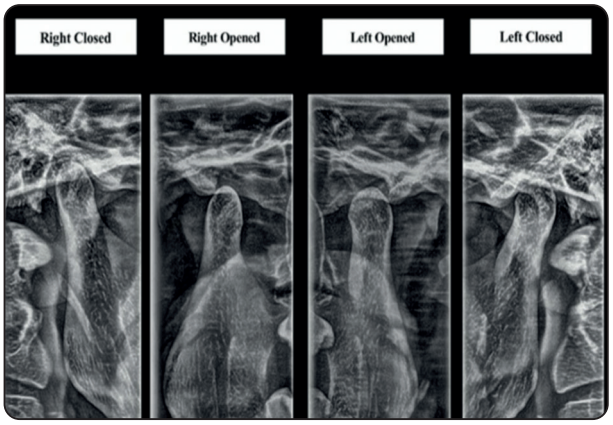

Fig. (1) TMJ tomogram in open and closed mouth position showing both condyles anterior to the articular eminence in wide mouth opening.

Treatment procedure

Povidone iodine 10% (Betadine) was applied to the skin covering the affected TMJ, and a cotton plug was used to block the external auditory canal. The procedure was carried out under local anesthesia (Auriculo-temporal nerve block was performed).

For the Study group

In supine position, an 18 MHz linear, sterile US probe was placed in a coronal orientation and positioned in the pre-auricular region, 1cm in front of the ear, parallel to the ramus (Fig. 2)**.** The condylar surface (cortical bone), outer capsule and metallic needle appeared as hyperechoic white lines in sonogram

Approximately 3 ml of venous blood was withdrawn from patient's cubital fossa using plastic syringe, of which 2 ml was injected into SJS and the remaining 1 ml in the pericapsular area, after changing the needle of blood withdrawal with 25 gauge, 1-inch-long needle, inserted and advanced under real-time US guidance towards the glenoid fossa in upward direction parallel to the transducer (ultrasound beam) with an angulation ranging from 30°-60°with the skin until contact was made with the bone of the fossa while patient mouth was closed. If bilateral participation was present, the steps were repeated on the opposite side (Fig. 2,3).

Fig. (2) US-guided approach: A clinical photo showing needle angulation with US probe placed over the TMJ parallel to the ramus and perpendicular to zygomatic arch

Fig. (3) US-guided approach: Ultrasonography image of TMJ during AB injection, the inserted needle (arrow), the condylar head (blue star) and the outer capsule (green star) and joint space (red star).

For the Control group

The canthus tragal line was drawn using a marking pen. The glenoid fossa was identified by

marking a point 2 mm below the canthus tragal line and 10 mm anterior to the tragus. Patients were instructed to close their posterior teeth on a bite block while the injection was being administered in an open-mouth position.

3 ml of blood was withdrawn from the patient's cubital fossa using plastic syringe, then the needle of blood withdrawal was changed with 25 gauge, 1-inch-long needle, inserted into the forementioned mark. Following the anatomical landmarks without US guidance, the needle was directed anteriorly, superiorly and medially towards the glenoid fossa and advanced about 2cm of its length to enter the SJS.

Two ml of blood was injected into SJS, then the needle was pulled out about 1cm to be in the outer capsule to inject the remaining 1 ml into the pericapsular area. This process was repeated on the opposing joint in case of bilateral involvement (Fig. 4)

Fig. (4) Cantho-tragal line and autologous blood injection into superior joint space in patient suffering from chronic recurrent TMJ dislocation

Follow up:

A gauze head bandage was placed over each patient's head in both groups for three days. Patients were instructed to consume a soft diet and to limit their mouth opening. Antibiotic (Amoxicillin 500 mg capsule every 8 hours for 5 days) and analgesic (Paracetamol 500 mg tablet every 8 hours for 3 days) were prescribed. Patients were recalled at intervals of 2 weeks, 3 months and 6 months after injection.

Outcomes:

Primary outcome:

Intensity of pain: evaluated (by blind outcome assessor) during opening and closing the mouth using visual analogue scale (1-10)/VAS) at intervals of 2 weeks, 3months, and 6 months post-injection.

Radiographic outcome:

At the end of 6 months follow up, a double lateral TMJ radiograph in open and closed mouth position was requested from all patients and compared to the preoperative radiograph to show if changes occurred in position of the condylar head in relation to the articular eminence in wide mouth opening.

Sample size calculation:

Sample size was calculated according to the statistical unit of the faculty of dentistry, Cairo University, a prior study was used to determine the sample size (Pandey et al., 2022) as a reference. The minimum acceptable sample size was 10 per group, the power was 80%, the type I error probability was 0.05, and the control group's mean ± standard deviation was 38.5 ± 1.89 with an estimated mean difference of 2.5. To account for a 20% dropout rate, the total sample size was raised to 12 each group. The P.S. power 3.1.6 was used to conduct the independent t test.

Statistical analysis

IBM SPSS software, version 20.0, was used to import and analyze the data. Quantitative data was characterized by Range (minimum and maximum), median, interquartile range (IQR), mean and standard deviation. (IBM Corp., Armonk, NY) Numerical and percentages values were utilized to convey the qualitative data. Significance of results

was assessed by the 5% level. The Shapiro-Wilk test was applied to confirm and verify the normality of distribution. For categorical data, comparison between groups was applied through the chi-square test and chi-square adjustment was performed using Monte Carlo correction or Fisher's Exact when more than 20% of the cells had an expected count of less than 5. Student t-test was utilized to compare between two groups under study for regularly distributed quantitative variables.

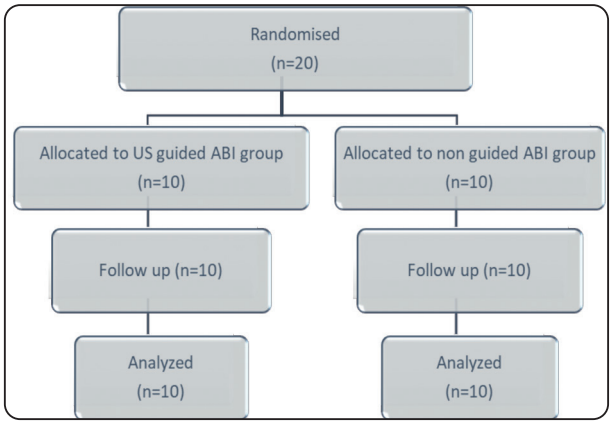

Fig (5) Consort flow chart

RESULTS

Twenty patients with recurrent TMJ dislocations were recruited From November 2023 to July 2024. (Figure.5). Ten of them received treatment by autologous blood injection under US guidance, while ten received treatment using a non-guided procedure. The research group's patients ranged in age from 20 to 43 (mean: 29.20 ± 7.80 years), whereas the control group's patients ranged in age from 20 to 40 (mean: 25.90 ± 6.74 years). The two groups' differences were not statistically significant (p value >0.05).

Pain intensity score

Even though the study group's mean pain score remained high after three and six months of intervention (4.40 ± 2.32, 3.80 ± 2.57, respectively) when compared to the control group (3.10 ± 1.45, 1.60 ± 1.96, respectively), there was no significant difference in pain scores between the groups either pre - operatively, after two weeks, three and six months of intervention (p value >0.05) (Table 1)

Radiographic result

At the end of 6 months follow up, In the study group, the condylar head was still displaced out of glenoid fossa, anterior to the articular eminence in wide mouth opening in 9 patients, and the other 1 patient had the condylar head posterior to the articular eminence in maximum mouth opening position. Figure (7).

In control group, the condylar head of all 10 patients of this group was still moved anterior to the articular eminence in wide open mouth position.(8)

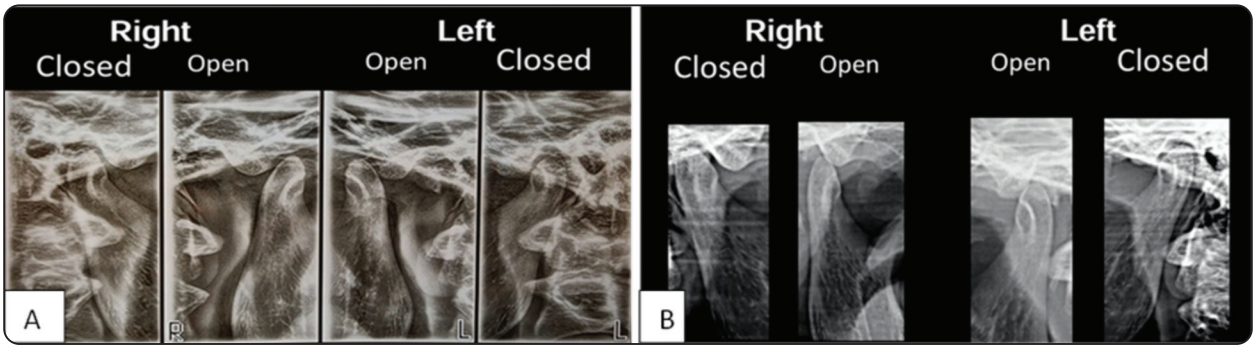

Fig (6) TMJ tomogram of case of study group: A) preoperative: condylar head anterior to the articular eminence in mouth opening, B) postoperative: condylar head posterior to the articular eminence in maximum mouth opening.

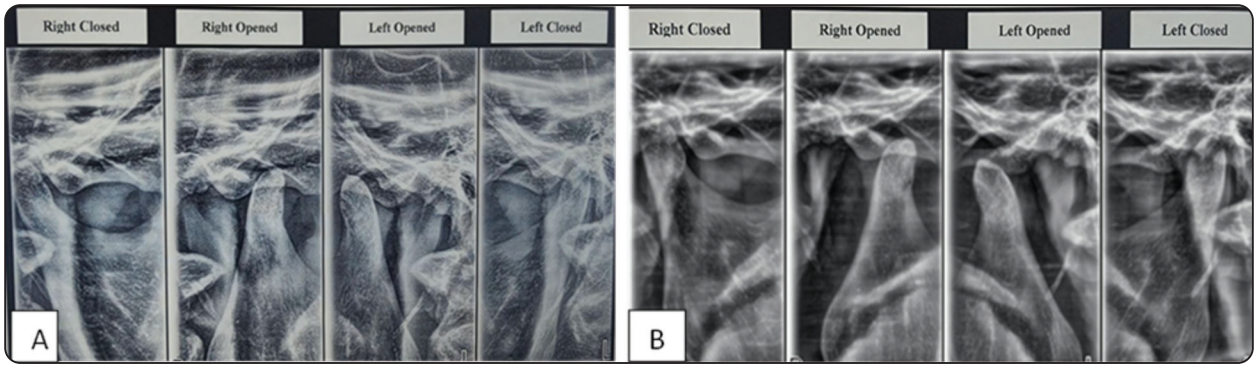

Fig (7) TMJ tomogram of case of control group A) preoperative. B) postoperative. The condyles were anterior to the articular eminence in maximum mouth opening.

TABLE (1) Comparison between the two studied groups according to pain intensity score

Pain (VAS)	Study (n = 10)	Control (n = 10)	U	P
Pre				
Min. – Max.	1.0 – 9.0	1.0 – 8.0	34.0	0.247
Mean ± SD.	6.40 ± 2.22	5.60 ± 1.96		
Median (IQR)	7.0(6.0 – 8.0)	5.50(5.0 – 7.0)		
2weeks				
Min. – Max.	0.0 – 6.0	0.0 – 6.0	41.50	0.529
Mean ± SD.	4.60 ± 1.84	4.20 ± 1.87		
Median (IQR)	5.0(4.0 – 6.0)	4.50(3.0 – 6.0)		
3 months				
Min. – Max.	0.0 – 7.0	0.0 – 5.0	31.0	0.165
Mean ± SD.	4.40 ± 2.32	3.10 ± 1.45		
Median (IQR)	5.0(3.0 – 6.0)	3.0(3.0 – 4.0)		
6 months				
Min. – Max.	0.0 – 7.0	0.0 – 5.0	25.50	0.063
Mean ± SD.	3.80 ± 2.57	1.60 ± 1.96		
Median (IQR)	4.0(2.0 – 6.0)	0.50(0.0 – 3.0)		

DISCUSSION

Abscence of established evidence in the literature about the efficacy of using US guidance for intra-articular injection in general and ABI in particular prompted the authors to compare US guidance to the traditional blind technique in TMJ hypermobility using ABI.

For the treatment of TMJ hypermobility, conventional ABI injection has been utilized extensively as a straightforward, noninvasive and economical approach(Varedi & Bohluli, 2015). Clinicians employ image-guided approaches to facilitate intra-articular injections due to the intricate anatomical structure of the TMJ. Additionally, image-guided techniques are thought to increase the success rate and decrease postoperative pain of non-guided approach (Hu et al., 2023).(Wiler et al., 2010)

In the present study, US-guided ABI was compared to blind (non-guided) injection into SJS and PT. Regarding pain score, after six months of intervention, the guided group's pain score remained high in comparison to the control group without significant difference between both groups. This is in line with a clinical trial by sivri et al who assessed the two techniques for TMJ arthrocentesis and did not find any significant differences between the groups regarding the pain.(Sivri et al., 2016) Sibbitt et al. stated that US-guided arthrocentesis produced less procedural pain(Sibbitt et al., 2012) On the other hand Wiler et al, reported that US-guided arthrocentesis reduced pain when compared to the conventional method (Wiler et al., 2010).

It has been suggested that the concept of ABI to the TMJ follows the pathophysiology of bleeding in the TMJ area, such as trauma to the condylar region, so blood infusion into the TMJ cavity and pericapsular region may then create a bed for fibrous tissue and scar formation in the TMJ area, leading to adhesion in the joint and permanent limitation of movement of the condyle.(Arafat & Elbaz, 2019; Daif, 2010) However in this study the radiographic images after 6 months of injection revealed that the condylar head was anterior to the articular eminence in wide mouth opening in all patients of the control group and 9 patients of the study group.

Some authors believed that the condylar position anterior to the articular eminence when the mouth is widely opened is considered variant of normal and sometimes referred to as elapsioprearticularis and cannot differentiate between Subluxation and dislocation radiographically.(Kuttenberger & Hardt, 2003) This could explain the findings of this study as condylar head was anterior to the articular eminence in wide mouth opening after 6 months of injection even in cases that show no recurrence of TMJ dislocation.

The authors used in-plane approach for guided injection with US (US probe was positioned perpendicular to the zygomatic arch and parallel to the ramus) so the needle was parallel to the ultrasound beam and continuously seen along its entire length during insertion and injection.

Numerous factors, including US probe angulation, frequency, and design, contact pressure, and acoustic shadow, can impact the joint structure imaging process and the quality of the US images(Almeida et al., 2019). This could explain the findings of the current study that the articular disc was not easy identifiable using US and a high frequency US probe. This is consistent with certain authors like Champs et al, who stated that they were unable to differentiate between the superior and inferior joint spaces with US(Champs et al., 2019).

This study has some limitations, like the absence of assessment of procedure duration and number of needle relocation.

CONCLUSION

Although US -guided ABI is a minimally invasive procedure that involves radiation-free exposure, real-time vision of needle advancement and could afford accurate access to the joint cavity, it was not more successful than the conventional technique and produces more postoperative pain.

Clinical trial registration:

The trial was registered on ClinicalTrials.gov (registration number: NCT06244134).

Funding

This study is self-funded.

Conflict of interest

No conflict of interest.

REFERENCES

- Akinbami, B. O. (2011). Evaluation of the mechanism and principles of management of temporomandibular joint dislocation. Systematic review of literature and a proposed new classification of temporomandibular joint dislocation. *Head Face Med*, *7*, 10. https://doi.org/10.1186/1746-160x-7-10
- Almeida, F. T., Pacheco-Pereira, C., Flores-Mir, C., Le, L. H., Jaremko, J. L., & Major, P. W. (2019). Diagnostic ultrasound assessment of temporomandibular joints: a systematic review and meta-analysis. *Dentomaxillofac Radiol*, *48*(2), 20180144. https://doi.org/10.1259/dmfr.20180144
- Antony, P. G., Sebastian, A., D, A., Varghese, K. G., S, M., N, J.,…John, B. (2019). Comparison of clinical outcomes of treatment of dysfunction of the temporomandibular joint between conventional and ultrasound-guided arthrocentesis. *Br J Oral Maxillofac Surg*, *57*(1), 62-66. https://doi.org/10.1016/j.bjoms.2018.11.007
- Arafat, S., & Elbaz, M. (2019). Assessment of The Therapeutic Effects of Autologous Blood Versus Dextrose Prolotherapy For The Treatment of Temporo- Mandibular Joint Hypermobility. A Randomized Prospective Clinical Study. *Egyptian Dental Journal*, *65*, 2125-2131. https://doi.org/10.21608/edj.2019.72230
- Champs, B., Corre, P., Hamel, A., Laffite, C. D., & Le Goff, B. (2019). US-guided temporomandibular joint injection: Validation of an in-plane longitudinal approach. *J Stomatol Oral Maxillofac Surg*, *120*(1), 67-70. https://doi.org/10.1016/j.jormas.2018.10.008
- Chan, T. C., Harrigan, R. A., Ufberg, J., & Vilke, G. M. (2008). Mandibular reduction. *J Emerg Med*, *34*(4), 435-440. https://doi.org/10.1016/j.jemermed.2007.06.037
- Daif, E. T. (2010). Autologous blood injection as a new treatment modality for chronic recurrent temporomandibular joint dislocation. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*, *109*(1), 31-36. https://doi.org/10.1016/j.tripleo.2009.08.002
- Dayisoylu, E. H., Cifci, E., & Uckan, S. (2013). Ultrasound-guided arthrocentesis of the temporomandibular joint. *Br J Oral Maxillofac Surg*, *51*(7), 667-668. https://doi.org/10.1016/j.bjoms.2013.05.144
- Ertaş, Ü., Aşçl, Y. E., Yalçın, E., & Urvasizoğlu, G. (2022). Evaluation of Intermaxillary Fixation (IMF) Screw Therapy with Craniomandibular Index Analysis for Chronic Recurrent Dislocation in the Temporomandibular Joint. *Nigerian Journal of Clinical Practice*, *25*(1).
- Gagnani, S. P., Kholakiya, Y. R., Arora, A., Bhutia, O., Seith, A., Khandelwal, R. K., & Roychoudhury, A. (2020). Ultrasound-guided autologous blood injection in patients with chronic recurrent temporomandibular joint dislocation. *Natl J Maxillofac Surg*, *11*(1), 34-39. https://doi.org/10.4103/njms.NJMS_57_18
- Hillam, J., & Isom, B. (2025). Mandible Dislocation. In *StatPearls*. StatPearls Publishing
- Copyright © 2025, StatPearls Publishing LLC.
- Hu, Y., Zhang, X., Liu, S., & Xu, F. (2023). Ultrasound-guided vs conventional arthrocentesis for management of temporomandibular joint disorders: A systematic review and meta-analysis. *Cranio*, *41*(3), 264-273. https://doi.org/10.1080/08869634.2020.1829870
- Krishnakumar Raja, V. B. (2021). Temporomandibular Joint Dislocation. In K. Bonanthaya, E. Panneerselvam, S. Manuel, V. V. Kumar, & A. Rai (Eds.), *Oral and Maxillofacial Surgery for the Clinician* (pp. 1381-1399). Springer Nature Singapore. https://doi.org/10.1007/978-981-15-1346-6_64
- Krishnan, S., Periasamy, S., & Murugaiyan, A. (2020). Autologous Blood Transfusion for Chronic Recurrent TMJ Dislocation:A Literature Review. *Journal of Research in Medical and Dental Science*.
- Kuttenberger, J. J., & Hardt, N. (2003). Long-term results following miniplate eminoplasty for the treatment of recurrent dislocation and habitual luxation of the temporomandibular joint. *Int J Oral Maxillofac Surg*, *32*(5), 474-479.
- Machon, V., Abramowicz, S., Paska, J., & Dolwick, M. F. (2009). Autologous blood injection for the treatment of chronic recurrent temporomandibular joint dislocation. *J Oral Maxillofac Surg*, *67*(1), 114-119. https://doi.org/10.1016/j.joms.2008.08.044
- Okoje, V. N., Aladelusi, T. O., & Abimbola, T. A. (2017). MANAGING TEMPOROMANDIBULAR JOINT DISLOCATION IN IBADAN: A REVIEW OF 11 CASES. *Ann Ib Postgrad Med*, *15*(2), 96-102.
- Pandey, S. K., Baidya, M., Srivastava, A., & Garg, H. (2022). Comparison of autologous blood prolotherapy and 25% dextrose prolotherapy for the treatment of chronic recurrent temporomandibular joint dislocation on the basis of clinical parameters: A retrospective study. *Natl J Maxillofac Surg*, *13*(3), 398-404. https://doi.org/10.4103/njms.njms_509_21

- Parra, D. A., Chan, M., Krishnamurthy, G., Spiegel, L., Amaral, J. G., Temple, M. J., Connolly, B. L. (2010). Use and accuracy of US guidance for image-guided injections of the temporomandibular joints in children with arthritis. *Pediatr Radiol*, *40*(9), 1498-1504. https://doi.org/10.1007/s00247-010-1581-2
- Sibbitt, W. L., Jr., Kettwich, L. G., Band, P. A., Chavez-Chiang, N. R., DeLea, S. L., Haseler, L. J., & Bankhurst, A. D. (2012). Does ultrasound guidance improve the outcomes of arthrocentesis and corticosteroid injection of the knee? *Scand J Rheumatol*, *41*(1), 66-72. https://doi.org/10.3109/03009742.2011.599071
- Sivri, M. B., Ozkan, Y., Pekiner, F. N., & Gocmen, G. (2016). Comparison of ultrasound-guided and conventional arthrocentesis of the temporomandibular joint. *Br J Oral Maxillofac Surg*, *54*(6), 677-681. https://doi.org/10.1016/j.bjoms.2016.04.004
- Tarhio, R., Toivari, M., Snäll, J., & Uittamo, J. (2023). Causes and treatment of temporomandibular luxation-a retrospective analysis of 260 patients. *Clin Oral Investig*, *27*(7), 3991-3997. https://doi.org/10.1007/s00784-023-05024-z
- Varedi, P., & Bohluli, B. (2015). Erratum to: Autologous blood injection for treatment of chronic recurrent TMJ dislocation: is it successful? Is it safe enough? A systematic review. *Oral Maxillofac Surg*, *19*(3), 329-331. https://doi.org/10.1007/s10006-015-0508-3
- White, T., Hedderick, V., & Ramponi, D. R. (2016). Dislocation of the Temporomandibular Joint and Relocation Procedures. *Adv Emerg Nurs J*, *38*(3), 177-182. https://doi.org/10.1097/tme.0000000000000110
- Wiler, J. L., Costantino, T. G., Filippone, L., & Satz, W. (2010). Comparison of ultrasound-guided and standard landmark techniques for knee arthrocentesis. *J Emerg Med*, *39*(1), 76-82. https://doi.org/10.1016/j.jemermed.2008.05.012
- Yang, X., Pemu, H., Pyhtinen, J., Tiilikainen, P. A., Oikarinen, K. S., & Raustia, A. M. (2001). MRI findings concerning the lateral pterygoid muscle in patients with symptomatic TMJ hypermobility. *Cranio*, *19*(4), 260-268. https://doi.org/10.1080/08869634.2001.11746177