Original Article

Ultrasound-guided autologous blood injection in patients with chronic recurrent temporomandibular joint dislocation

ABSTRACT

Objective: To evaluate the accuracy and effectiveness of ultrasound (US) guided autologous blood injection (ABI) for the treatment of chronic recurrent TMJ dislocation.

Design: Prospective cohort study.

Setting: Centre for medical education and research.

Participants (or Animals, Specimens, Cadavers): Ninteen patients with chronic recurrent TMJ dislocation (Fifteen bilateral and fourteen unilateral).

Interventions: Autologous blood injected, 2ml in superior joint space (SJS) and 1 ml in peri-capsular tissue (PT) under ultra sound guidance.

Main Outcome Measure(s): Reduction in number of dislocation episodes, maximal mouth opening, pain (visual analogue scale) and TMJ sounds (present or absent) at the end of 2 weeks, 3 months, 6 months and 1 year.

Results: At 2 weeks post operatively 18 patients (95%) were asymptomatic only one patient (5%) complained of Recurrence of dislocation and was treated successfully by a 2nd injection. At subsequent follow up visits none reported dislocation.

Conclusion(s): US guided ABI for patients with chronic recurrent TMJ dislocations serves as an alternative, minimally invasive, highly effective and accurate modality of treatment since it includes exposure without radiation, real-time visualization of soft tissues, visualization of the needle tip advancement, local anesthetic spread relevant to the surrounding structures which can be performed on an outpatient basis.

Keywords: Autologous blood, temporomandibular joint dislocation, ultrasound guidance

INTRODUCTION

Dislocation of the temporomandibular joint (TMJ) is the dislodgement of the head of the condyle from its normal position in the glenoid fossa to anterior of articular eminence during the mandibular opening. It represents 3% of all reported dislocated joints in the body[1] and can be partial (subluxation) or complete (luxation), bilateral or unilateral, acute, chronic protracted, or chronic recurrent.[2]

TMJ dislocation has a diverse etiology and can either be spontaneous or induced by trauma due to forceful mouth opening during endotracheal intubation, ENT/dental procedures, endoscopy, excessive mouth opening from yawning, laughing, vomiting, and also during seizures.[2]

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Anterior dislocations are most common and occur when the masseter and temporalis muscles elevate the mandible before the lateral pterygoid muscle relaxes, resulting in the mandibular condyle being pulled out anterior to the articular eminence.[2]

Different surgical and nonsurgical methods have been used for the treatment of TMJ hypermobility,[3] prolotherapy using autologous blood injection (ABI) being one of them. However, due to nonestablished landmarks,[4] blind technique, unpredictable results, and risk of damage to the collateral ligaments of the disc, it did not gain much popularity until the description of landmarks for arthrocentesis by Nitzan *et al.*[5] Recently, it has got prominence after its reintroduction by Hasson and Nahlieli.[4]

The use of ultrasound (US) as a highly accurate imaging tool for guided injection has been well used in various tendon and ligament disorders,[6] but its use in TMJ disorders is limited to its diagnostic implications.[7,8] To the best of our knowledge, the use of US as a guiding tool for ABI in chronic recurrent TMJ dislocation has never been reported in the literature. This study was the first such attempt to evaluate the accuracy and effectiveness of US-guided ABI for chronic recurrent TMJ dislocation.

MATERIALS AND METHODS

A total of 19 patients who presented to our unit, and diagnosed with chronic recurrent TMJ dislocation based on the clinical and radiographic criteria of Nitzan[9] [Figure 1] were included in this institutional review board approved the prospective study. Informed written consent was obtained and routine blood investigations were carried out. The patients were advised to get a double lateral TMJ radiograph to evaluate the position of the condyles [Figure 2]. The patients with bleeding disorders, pregnancy, bony pathology of TMJ, allergy to local anesthetic and those on narcotics or anti-depressants were excluded.

The patient was made to lie supine and the skin overlying the TMJ was scrubbed by an antiseptic solution and local anesthetic was administered to the auriculotemporal nerve. The auriculotemporal nerve is the posterior branch of the mandibular branch of the trigeminal nerve. It passes between the external auditory canal and the TMJ and passes through the parotid gland to ascend with the superficial temporal artery over the zygomatic arch. It gives sensation to the external auditory meatus, tympanic membrane, portions of the pinna, and the TMJ, as well as the skin of the temporal region and lateral part of the scalp. Technique palpation of the temporal artery as it crosses the zygomatic arch near the root of the zygoma is given for the approximate location of the nerve. Infiltration with 3 ccs of local anesthetic in this area is given for anesthesia to the nerve and to its smaller peripheral branches. A sterile US probe was placed over the TMJ, parallel to the zygomatic arch and was tilted toward the

Figure 1: Preoperative mouth opening (approximately 60 mm)

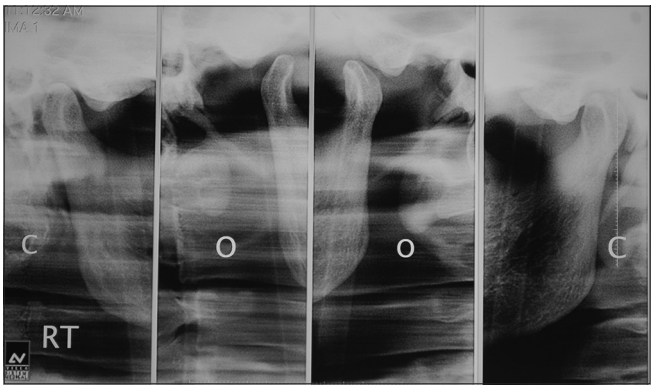

Figure 2: Double lateral temporomandibular joint radiograph showing bilateral condyles traversing ahead of articular eminence

Figure 3: Ultrasound probe placed over the temporomandibular joint parallel to the zygomatic arch

ramus until the best visualization of the roof of glenoid fossa was achieved [Figure 3]. Static and dynamic evaluations were performed after positioning the probe. Examinations were performed with the Diasonics (Milpitas, CA) CV 400, with a 10 MHz probe, which has the largest resolution power for examination of the superficial structures.

Cortical bone tissues and the metallic instruments such as needle were generally hyperechoic and appeared white on US images [Figure 4], while the connective and muscular tissues were isoechoic and appeared gray in US images. The articular disk appeared as a thin area of hypoechogenity with hyperechoic area within.

The articular fossa was then located at a point 10 mm anterior to the tragus of the ear and 2 mm inferior to the canthotragal line. The patient was made to close the anterior teeth on a small bite block to translate the mandibular condyles partway down the glenoid slope to allow access to the superior joint space (SJS).

The joint capsule was then distended with 5-ml Ringer's lactate. At this location, a 16-gauge needle of 1-inch length was inserted into the SJS under the US guidance and the lactated Ringer's solution was drained out which confirmed the position of needle in the SJS.

About 3 ml of blood was withdrawn from patient's antecubital fossa, of which 2 ml was injected into the SJS and 1 ml in the pericapsular tissue (PT) in a peppering fashion with needle touching the bone at all times. The procedure was repeated on the opposite side in case of bilateral involvement. An elastic head bandage was applied and the patient was advised to wear it for 24 h forthe 1st week and nocturnally for the 2nd week to restrict the mouth opening to 20 mm.

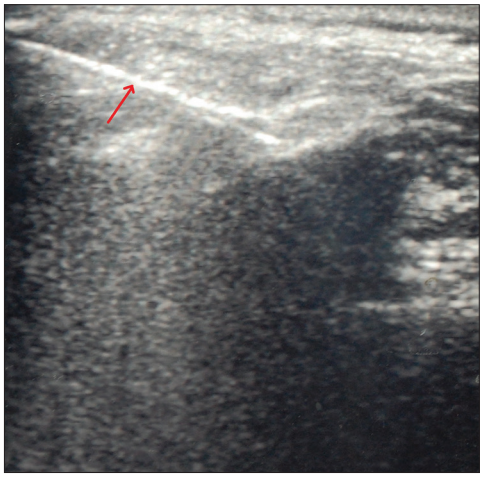

Figure 4: Ultrasound image showing needle in the joint cavity as a hyperechoic line

Antibiotics and analgesics were prescribed followed by soft diet for 2 weeks. At the end of 2 weeks, the patients began controlled range of motion exercises in front of a mirror and advanced their diet as tolerated.

The patients were evaluated for the reduction in number of dislocation episodes, maximal mouth opening, pain (visual analog scale [VAS]),[10] and TMJ sounds (present or absent) at the end of 2 weeks, 3 months, 6 months, and 1 year.

The collected data were statistically analyzed to assess the accuracy and effectiveness of this technique.

RESULTS

The study included 14 females and 5 males with an average age of 28.58 ± 7.53 years (range, 18–42 years).

A total of 15 patients had bilateral chronic recurrent dislocation, whereas 4 had the problem unilaterally. 14 of the patients were able to self-reduce their dislocation, whereas 5 required assistance. The duration of the symptoms was found to have a mean of 12.74 ± 4.70 months (range 06–24 months) with a mean of 10.15 ± 3.86 episodes/week (6–20/weeks) preoperatively. At 2-week postoperatively, 18 patients (95%) were asymptomatic with only one patient (5%) complained of recurrence of dislocation and was treated successfully by a second injection. At subsequent follow-up visits, none reported dislocation [Table 1].

The mean preoperative mouth opening of the patients was found to be 53.84 ± 5.65 mm (range 47–62 mm). At 1-year postoperatively, mouth opening was found to be 36.79 ± 3.95 mm (31–45 mm). The mean difference between the pre- and post-procedure maximal incisal opening (MIO) was 17.05 ± 1.70 mm and was assessed by paired *t*-test; the difference was statistically significant at $P < 0.001$ [Table 1].

Eleven patients (57.8%) complained of pain along with dislocation of TMJ with an average VAS score of 2.68 ± 2.19 which reduced to a score of 0 at the end of 1-year follow-up, the difference was found to be statistically significant at $P < 0.0001$ [Table 1]. Seven (36.8%) of them had associated clicking or gritting sound which was completely resolved at the end of 1-year follow-up.

No incidence of facial nerve weakness, permanent deviation on mouth opening, severe reduction in mouth opening, or scars was observed in the patients. Postoperative pain flare was witnessed in two patients, which was successfully treated

Table 1: Details of the patients-Preoperative and Postoperative

Patient no.	Age (years)	Sex	TMJ Sounds	Involvement (side)	Dislocation episodes (per week)			Duration (month)	Mouth opening (mm)		VAS score	
					Pre-op	Post-op (2 weeks)	Post-op (1 year)		Pre-op	Post- op (1 year)	Pre-op	Post-op (1 year)
1	29	F	Present	Bilateral	10	Nil	Nil	12	51	34	6	0
2	19	M	Absent	Bilateral	6	Nil	Nil	12	49	32	4	0
3	38	F	Present	Bilateral	8	Nil	Nil	18	55	35	0	0
4	40	M	Present	Bilateral	8	Nil	Nil	15	60	35	0	0
5	34	F	Absent	Bilateral	8	Nil	Nil	06	56	40	4	0
6	23	F	Absent	Left	10	Nil	Nil	09	59	42	4	0
7	28	F	Present	Right	10	Nil	Nil	15	47	35	5	0
8	28	F	Absent	Bilateral	06	Nil	Nil	12	48	32	0	0
9	29	F	Present	Bilateral	12	Nil	Nil	24	62	45	5	0
10	21	F	Present	Bilateral	20	Nil	Nil	20	53	31	4	0
11	37	M	Absent	Bilateral	10	Nil	Nil	16	55	35	0	0
12	42	F	Absent	Bilateral	08	Nil	Nil	12	57	35	4	0
13	18	F	Absent	Left	08	Nil	Nil	12	60	40	4	0
14	26	F	Absent	Bilateral	07	Nil	Nil	12	47	42	0	0
15	24	M	Absent	Bilateral	10	Nil	Nil	09	49	36	4	0
16	20	M	Absent	Bilateral	10	Nil	Nil	06	51	35	0	0
17	32	F	Absent	Bilateral	12	3	Nil	06	50	35	3	0
18	35	F	Present	Right	20	Nil	Nil	14	66	42	0	0
19	20	F	Absent	Bilateral	10	Nil	Nil	12	48	38	4	0

by narcotic medication. Temporary posterior open bite was observed in all the patients, which resolved in 24 h.

DISCUSSION

Brachmann[11] in 1964 was the first to report the use of ABI prolotherapy for the management of TMJ hypermobility. Ever since its introduction, it has been highly promoted as a simple safe noninvasive and cost-effective treatment modality but with highly unpredictable results. The complex anatomic nature of the TMJ results in a low accuracy when performed according to the clinical judgment and palpatory skills and hence demands the need for image guidance of the TMJ intra-articular blood injection. Ultrasonography has the potential to extend these palpatory skills by dynamic tissue visualization. The term sonographic palpation describes the use of the US probe to simultaneously observe the tissues and progression of the needle, while the patient reports sensitivity to pressure.[6]

US has been used as a guiding tool in maxillofacial surgery for biopsy, injection into salivary glands and salivary stone retrievals with successful results.[12] US guidance for arthrocentesis was suggested by Dayisoylu *et al*.[13] However, it has never been used for guiding intra-articular blood injection in the management of chronic TMJ dislocation. ABI can be performed by relatively less experienced surgeons under US guidance as the movement of needle no longer depends on palpatory skills, thus reducing reduces technique sensitivity and postoperative complications.

The pathophysiology of intra-articular blood injections to the TMJ is similar to the bleeding in joints elsewhere in the body such as the knee or the elbow. Matsumoto *et al*.[14] showed fibrous tissue formation between the posterior slope of the articular eminence and disk surface when observed through arthroscope after ABI 3-month postoperatively. Exposure of cartilage to blood results in disturbance of cartilage matrix turnover and a decrease of chondrocyte metabolism causing localized contraction.[15] Recently, Candrl *et al*. showed only fibrin accumulations in the tissue samples, with no evidence of degeneration in the joint cartilage histologically after ABI.[16]

Machon *et al*. reported the successful treatment of ABI in 20 patients among 25 (80%) at the end of 1 year.[15] Daif found 80% success with ABI in SJS and PT, whereas 60% in ABI in SJS only.[3] Bayoumi *et al*. reported 80% success rate when treated by arthrocentesis followed by ABI.[17] Hegab found that the group receiving both ABI and intermaxillary fixation for 4 weeks got no recurrences at the end of 12 months.[18] They explained relatively low success rate of ABI by stating "In ABI the needle is advanced blindly, with a risk that the autologous blood will go in the wrong place. Insertion of a needle can damage the surrounding tissues and cause bleeding in and around the joint." In the present study, a high success rate (95%) was witnessed when ABI was performed in SJS

and PT. This can be attributed to the guidance by US, which eliminates this disadvantage as the progression of needle can be actively visualized during injection into the joint cavity. Candirli *et al.* concluded that ABI had limited success in patients with frequent dislocations and unsuccessful results might be related to associated TMJ disorders (disc displacement or arthritis).[19] We found no such correlation among our patients. One patient had dislocation episodes at the end of 2 weeks, but he was not among the ones with high frequency of dislocation episodes and neither suffered from any other TMJ disorder. It was in fact due to sudden excessive mouth opening during the 2nd week when elastic bandage was advised for nocturnal wear.

Pain and mild bleeding as a result of needle trauma follow the injection of ABI in TMJ. Many patients have a pain flare at the end of 72 h typically self-limited and respond well to acetaminophen. Other nonsteroidal anti-inflammatory drugs were not prescribed postoperatively because they significantly inhibit some of the early chemical reactions in the inflammatory phase, particularly the production of prostaglandin E2.[20] On rare occasions, the occurrence of strong, postinjection pain may require treatment with narcotic medication. Introduction of injection fluid into the articular space routinely distracts the condyle and mandible inferiorly and produces a temporary posterior open bite. This change in occlusion in combination with the effect of local anesthetic incurs a risk that the patient may unwittingly bite the tongue or buccal mucosa for which precautionary care was advised in our patients.

The standardization of a US protocol for the TMJ is difficult due to complicated anatomy and patient variations. The authors recommend that this could be potentially acquired by the use of flexible intraoral US probes which may provide a detail and clear view of the superior joint compartment as they are being used in the field of gastrointestinal and pulmonary medicine.[21] These US probes can be placed in the buccal vestibule of the oral cavity with relative ease so that a more accurate image of the condylar head and glenoid fossa in a sagittal section can be obtained. The free-hand technique used for autologous blood delivery may have affected the results of the study due to the accidental movement of the hand, while injection with an automated delivery system can be devised.

This study is the first to report the use of US guidance for ABI for patients with chronic recurrent TMJ dislocations. However, to establish a sound protocol for US-guided ABI, randomized controlled trials with larger sample size are recommended.

CONCLUSION

US-guided ABI for patients with chronic recurrent TMJ dislocations serves as an alternative, minimally invasive, highly effective, and accurate modality of treatment since it includes exposure without radiation, real-time visualization of soft tissues, visualization of the needle tip advancement, and local anesthetic spread relevant to the surrounding structures which can be performed on an outpatient basis.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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