

Unraveling the intricacies of acute temporomandibular joint dislocation in emergency department: a multidimensional exploration of reduction techniques and success rate by emergency physicians

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Abstract

Temporomandibular joint (TMJ) dislocation is a distressing condition that requires prompt management in the emergency setting. This retrospective study aimed to assess the success rate of TMJ reduction performed by emergency physicians (EPs) and evaluate the commonly used reduction techniques and sedative choices. The EPs achieved an overall success rate of 86.29% in reducing the dislocations. Among the successful reductions, 68.21% were accomplished in the first attempt, with only 7.29% requiring three or more attempts. Procedural sedation and analge-

sia were commonly employed, with midazolam (34.44%) and fentanyl (21.85%) being the most frequently used in successful cases. The classic intraoral technique (29.14%) was the preferred method for successful reductions. No significant differences were observed in drug utilization or reduction techniques between the groups of successful and failed reductions. The findings demonstrate the high competence of EPs in managing acute TMJ dislocations in the emergency department. The study provides valuable insights into the commonly employed reduction techniques and sedative choices, offering important guidance for emergency medical practice.

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Introduction

Temporomandibular joint (TMJ) dislocation is a rare but distressing condition that can result in debilitating pain with compromised jaw function. As a critical anatomical hinge, the stability of the TMJ is essential for proper chewing, vocalization, and facial movements. In the emergency medicine (EM) setting, the timely and effective reduction of TMJ dislocation is of extreme importance due to the potential for airway obstruction and the inability to clear secretions.¹

TMJ dislocation exhibits a female predilection, with an estimated annual incidence of 25 cases per 100,000 population and a lifetime prevalence varying from 5% to 8% which also includes the pediatric population.²⁻⁵ It commonly occurs during activities involving extreme mouth opening, such as yawning, eating, laughing, vomiting, dental treatment, and as well as due to traumatic causes. Additionally, dislocations can be triggered by dystonic reactions secondary to drugs or seizures, underscoring the diverse etiology.⁶ These dislocations can present as acute (less than 2 weeks) or chronic (more than 2 weeks), and they may be unilateral or bilateral, occurring in diverse types - anterior, posterior, superior, or lateral. Among these, anterior dislocations, despite their rarity, are the most prevalent type.⁷ Traumatic events, like road traffic accidents, assault, and falls, are often associated with other types of TMJ dislocations, sometimes leading to concurrent facial fractures.⁸

In recent years, emergency medicine in India has made significant strides towards improving the management of traumatic and non-traumatic injuries. However, despite advancements in the field, managing TMJ dislocation remains a challenging and multifaceted procedure that demands a comprehensive understanding of various reduction techniques and their corresponding success rates.

TMJ reduction techniques are broadly categorized as intraoral and extraoral, using a conservative approach. In intraoral methods, clinicians place their thumbs or fingers inside the patient's mouth for reduction. The Classic method, which is the most commonly employed technique by emergency physicians (EPs), involves

grasping the mandible with both hands by positioning the thumbs inside the mouth on the ridge of the mandible adjacent to the molars and wrapping the fingers around the outside of the jaw.² The Wrist Pivot and Supine methods are other common methods used during intraoral reduction. For extraoral reduction techniques, pressure is applied to the mandibular angle without inserting any fingers into the mouth. The Gag, Syringe, and External Approach methods fall into this category.⁶ Failure of reduction may be due to pain, muscle spasms, and improper technique employed. To achieve a successful reduction, it is essential to employ appropriate methods of reduction with or without the use of procedural sedation and analgesia, ensuring patient comfort and safety during the procedure.⁹

Despite the clinical significance of TMJ dislocation, there remains a paucity of strong evidence of literature specifically focusing on reduction techniques and optimal use of sedatives or analgesics in the context of emergency medicine.¹⁰ Previous studies have primarily centered on case reports and small-scale investigations, only providing insights into the epidemiology and etiology of TMJ dislocation. Consequently, EPs are often confronted with uncertainty in their decision-making process when selecting the optimal reduction technique or sedation and analgesia for each patient presenting to the emergency department (ED).

This research article seeks to address a critical knowledge gap by embarking on a comprehensive exploration of the various reduction techniques with the use of an array of procedural sedation and anesthesia employed by EPs in managing TMJ dislocation in the context of EM settings.

Materials and Methods

The study was structured as a retrospective cross-sectional study. Data was collected from patients who arrived at ED between 1st January 2005 and 1st June 2023. Our ED has an average annual visit of around 25,000 cases.

Patients who presented to our ED with acute TMJ dislocation, which was clinically diagnosed and confirmed using radiological imaging such as orthopantomogram or computed tomography of the face with 3D reconstruction were selected for the study.

Inclusion and exclusion criteria

The study population includes patients with acute TMJ dislocation who underwent initial reduction by EPs.

We excluded for the study: i) pregnant patients; ii) patients with accompanying oro-facial fractures; iii) patients whose initial reduction was performed by OMF surgeons; iv) those patients who required surgical intervention due to failure of reduction.

Study protocol

Upon arrival at the ED, patients were initially stabilized following advanced trauma life support principles. Patients diagnosed with TMJ dislocation underwent an initial reduction procedure performed by EPs. Initial reduction attempts were made without sedation if the patient was cooperative. In cases where the patient remained unable to relax and cooperate, intravenous (IV) procedural sedation and analgesia were administered. Baseline vital signs were recorded initially. The systemic sedation options included: Midazolam at 0.1 mg/kg IV, with the option of a repeat dose of 0.05 mg/kg after 3-5 minutes. Propofol at 0.5-1 mg/kg (0.25-0.5 mg/kg in elderly patients) IV with a repeat dose of 0.5 mg/kg. Fentanyl at 0.5-1 mcg/kg (0.25 mcg/kg in elderly patients)

IV, with a repeat dose of 0.25-0.5 mg/kg. Patients were closely monitored every 5 minutes until they fully recovered.

For patients considered high risk for procedural sedation, local analgesic (LA) techniques like local infiltration or nerve block were employed. In the case of LA infiltration in the periauricular region, 2% lignocaine without adrenaline was the chosen anesthetic. The site for injection, determined using a landmark technique, was located below the zygoma, approximately 2.5 cm anterior to the tragus. A needle was inserted perpendicularly, advanced medially by about 0.5 cm into the joint space, and aspirated to rule out intravascular placement. Subsequently, 1 mL of 2% lignocaine was slowly injected, and the site was gently massaged to accelerate anesthesia onset. For deep temporal nerve blocks, 1-2 mL of 2% lignocaine with 1:100,000 adrenaline was utilized. The needle entry point, based solely on anatomical landmarks, was positioned one finger's width anterior to the TMJ, at the superior border of the zygomatic arch. The needle was directed inferiorly at a 30-degree angle from the temporal bone, advanced until reaching the temporal bone, and aspirated to rule out intravascular injection before the local anesthetic was deposited. Patients were monitored every 5 minutes until they fully recovered from the local anesthetic. In cases where additional sedation and anesthesia were required, a combination of systemic and local anesthesia was administered. Ultrasound was not used for any patients, and all procedures relied on landmark techniques.

During the reduction procedure, patients were positioned upright or slightly reclined with their heads firmly against a support. The EPs' attempts at reducing TMJ dislocation were categorized as one, two, or three or more attempts. The decision regarding the maximum number of attempts and the early involvement of an Oral and Maxillofacial (OMF) surgeon depended on the EP's clinical judgment and the ED's workload at the time of patient presentation. If the EP successfully reduced the TMJ dislocation, the patient was referred to OMF for further evaluation. Conversely, if the EP was unable to achieve reduction, emergency consultation with an OMF surgeon was initiated.

Outcome

The primary outcome was to assess the success rate of TMJ reduction performed by EPs. Success was defined as the successful reduction by EPs and failure of reduction was defined as cases where EPs were unable to reduce the dislocation and required consultation with an OMF surgeon for reduction. The secondary outcome measure involved comparing the success and failure rates of reduction performed by EPs.

Ethical consideration

The study received approval from the SNMC Ethical Committee Board which adhered to the principles outlined in the Declaration of Helsinki concerning ethical principles in medical research.

Statistical analysis

Data analysis was conducted using the software SPSS version 23.0. Descriptive statistics were calculated, including frequencies, percentages, means, standard deviations, and medians. Inferential statistics were performed for comparison between successful and failed reduction cases, using the Mann-Whitney U test. The association between categorical variables was assessed using the chi-square test. The level of significance for all statistical analyses was set at 5%.

Results

During the study period, a total of 394 cases were identified as having acute TMJ dislocation. Among these, 219 cases were excluded from the study due to various reasons, including missing data (n=92), nonanterior dislocation (n=10), initial reduction performed by an OMF surgeon (n=62), and patients who needed direct surgical intervention by the OMF surgeon (n=55). After applying the exclusion criteria, a total of 175 cases of TMJ dislocation remained eligible for analysis (Figure 1).

The majority of cases were in the age group of 20-39 years (36.57%), followed by 40-59 years (32.00%). Among the cases, 57.71% were females who majority (78.86%) resided in urban settings. Recurrent TMJ dislocation cases accounted for 38.86% of the analyzed cases with 57.71% being bilateral (Table 1).

The etiology of TMJ dislocation was diverse, with non-traumatic causes attributed to common activities such as yawning (14.86%), eating (12.57%), and vomiting (13.71%). Among traumatic causes, road traffic accidents (RTA) were predominant (20.57%), followed by falls (9.71%). A small proportion of cases (1.73%) had an unknown cause, warranting further investigation (Table 2).

The EPs successfully reduced TMJ dislocation in 151 cases with an overall success rate of 86.29%, among these 68.21% were accomplished in the first attempt, and only 7.29% required three or more attempts. Regarding the usage of procedural sedation and anesthesia, the most commonly used among the success group was midazolam (34.44%), followed by fentanyl (21.85%). In the failed reduction group, midazolam was again the most commonly used sedative (29.17%), with fentanyl (20.83%) as the second. Two elderly patients, both over 60 years of age, experienced transient hypoxia shortly after receiving midazolam, which was identified within 10 minutes of injection. The prompt intervention involved administering oxygen via a simple face mask at a rate of 8 liters per minute for 15 minutes. Following complete recovery from the sedative effects, these patients were continuously monitored for an additional 30 minutes in the ED. None of the patients received a combination of sedatives; also none of the patients had local LA toxicity. When considering the methods of reduction the most common technique used in successful reductions was

Table 1. Demographic profile of temporomandibular joint dislocation.

Demographic variables	n	n%
Age		
0-19 years	17	9.71
20-39 years	64	36.57
40-59 years	56	32.00
>60 years	38	21.72
Sex		
Male	74	42.29
Female	101	57.71
Residence		
Urban	138	78.86
Rural	37	21.14
Time		
8am-2pm	57	32.57
2pm-8pm	75	42.86
8pm-8am	43	24.57
Occurrence		
First	108	61.71
Recurrent	67	38.29
Side		
Unilateral	74	42.29
Bilateral	101	57.71

Table 2. Etiology of temporomandibular joint dislocation.

Etiology	n	n%
Nontraumatic		
Yawning	26	14.86
Laughing	17	9.71
Eating	22	12.57
Vomiting	24	13.71
Dental procedure	5	2.86
Seizure	10	5.71
Traumatic		
Road traffic accidents	36	20.57
Falls	17	9.71
Assault	7	4.00
Sports	8	4.57
Unknown cause	3	1.73

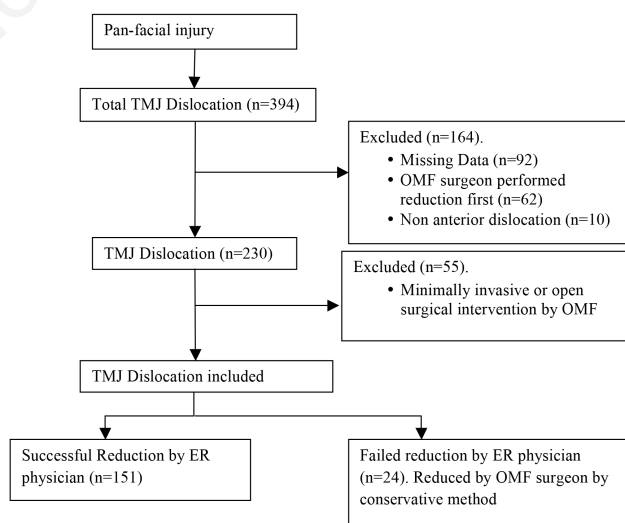


Figure 1. Patient flow chart

Bimanual/Classic (29.14%), followed by Wrist pivot (20.53%). In failed reductions, the most common technique was again the Wrist pivot (33.33%), followed by Bimanual/Classic (25.00%). No significant differences in drug utilization or reduction techniques were found between the two groups of successful and failed reductions (Table 3).

Discussion

EPs achieved a high success rate (86.29%) in reducing TMJ dislocation, primarily in the first attempt using midazolam and the classic intraoral technique, showcasing their expertise in managing this condition effectively. The choice of sedation and reduction technique did not significantly differ between the success and failure groups. This study represents the first investigation in India to explore the success rate of TMJ dislocation reduction performed by EPs.

Several studies conducted in different countries have explored the efficacy of various reduction methods for TMJ dislocation. In a randomized controlled trial conducted in Iran, the success rates were reported to be 86.7% for the conventional method, 96.7% for the wrist pivot method, and 66.7% for the extraoral method.¹¹ It also found that the extraoral method posed greater challenges for both physicians and patients compared to the other two techniques. Interestingly, similar to our study, their research did not identify a significant difference in the success rate between the extraoral and

conventional methods ($p=0.06$). It is noteworthy that procedural sedation and analgesia were not utilized in their patient cohort. Another similar study reported success rates of 86.2% for the classic method and 55.2% for the extraoral method.¹² In a Nigerian observational study, successful intraoral reduction was achieved in 59.1% of cases.¹³ In an ED-centered study, the extraoral syringe technique achieved an impressive 97% success rate with the majority of cases being successfully reduced in less than a minute.¹⁴

The use of procedural sedation and analgesia to achieve successful reduction was observed in many studies, although the specific type was not always mentioned. A Swiss study reported that in only 38.7% of cases, one or a combination of analgesedation was used for successful reduction.¹⁵ Some case reports suggested higher success rate with propofol or local anesthetics like mase-teric nerve blocks or temporal nerve blocks.^{16,17}

While there are some international guidelines like the European Society of Temporomandibular Joint Surgeons (EST-MJS), there are currently none that are widely accepted internationally.^{18,19} Recent literature suggests a reduction in a supine position for acute non-traumatic TMJ dislocations.^{20,21} On the contrary, the German S3 Guidelines recommend attempting manual reduction in a sitting position with the patient's head stabilized on a headrest.^{22,23} This diversity in approaches highlights the need for further research and standardization in TMJ dislocation reduction techniques to ensure optimal outcomes in ED settings.

Several of the aforementioned studies included cases of chronic TMJ dislocation as well, which might have contributed to lower

Table 3. Comparison of successful and failed reduction of TMJ dislocation by Emergency physician.

	Successful reduction			Total attempt	Failed reduction		p
	1 Attempt	2 Attempt	≥3 Attempt		N(n%)	24(13.71)	
Procedural sedation and anaesthesia used							
IV analgesics and sedatives							
Midazolam	37(24.50)	12(7.95)	3(1.99)	52 (34.44)	7 (29.17)		0.617
Fentanyl	21(13.91)	8(5.30)	4(2.65)	33 (21.85)	5 (20.83)		0.912
Propofol	17(11.26)	9(5.96)	1(0.66)	27 (17.88)	1 (4.17)		0.091
Local anaesthesia							
2% Lignocaine in periauricular region	11(7.28)						
	4(2.65)						
	2(1.32)	4 (16.67)	0.447				
Deep temporal nerve block							
	9(5.96)						
	2(1.32)						
	1(0.66)	2 (8.33)	0.952				
Conjugation of both IV and local anaesthesia	6(3.97)	2(1.32)	0(0.00)	8 (5.30)	4 (16.67)		0.040
NO drug used	2(1.32)	0(0.00)	0(0.00)	2 (1.32)	1 (4.17)		0.317
Methods of reduction							
Intraoral							
Classic	33(21.85)	8(5.30)	3(1.99)	44 (29.14)	6 (25.00)		0.681
Wrist pivot	22(14.57)	7(4.64)	2(1.32)	31 (20.53)	8 (33.33)		0.161
Supine	15(9.93)	9(5.96)	3(1.99)	27 (17.88)	4 (16.67)		0.888
Extraoral							
Gag	8(5.30)	4(2.65)	3(1.99)	15 (9.93)	2 (8.33)		0.802
Syringe	16(10.60)	8(5.30)	2(1.32)	26 (17.22)	1 (4.17)		0.101
External approach	7(4.64)	1(0.66)	0(0.00)	8 (5.30)	3 (12.50)		0.177

LA, local anaesthesia.

success rates in their findings. In contrast, our study specifically focused on acute TMJ dislocation. Additionally, the success rate of reduction appears to be influenced by the experience and proficiency of the physician performing the procedure. In the above-cited studies, the reduction was carried out by otorhinolaryngologists or OMF surgeons, while in ours EPs were primarily responsible for the initial reduction. At our institute, an emergency resident, along with an emergency medicine attending, typically covers shifts. In most cases, the resident attempted the initial reduction, and if faced with difficulty, the attending performed the reduction. Such variation in the skill levels of attending physicians and residents may account for the observed variations in success rates which were not individually investigated in our study, and this could be an area for further research.

A Swiss epidemiological study reported the mean age of patients with TMJ dislocation was 42.06 years, with no gender predominance.¹⁵ But, a Nigerian study demonstrated a slight male preponderance (52%) and a male-to-female ratio of 1.1:1, with a mean age of 35.52 ± 17.36 years and a range of 15 to 80 years.²⁴ Our study found a slightly higher prevalence among females, likely due to increased mobility and social engagement in urban India. Women's empowerment and equal opportunities have led to shifts in traditional work norms, enabling independent doctor consultations without seeking male permission.²⁵ Furthermore, joint capsule or ligament laxity may contribute to TMJ dislocation, especially in elderly individuals.²⁶

In various studies, including ours, yawning emerged as the most common cause of TMJ dislocation, which can be attributed to the morphological features of the TMJ, such as a flat mandibular condyle in a significant portion of the population.^{27,28} Trauma resulting from RTA, falls, and sports-related injuries was described as the second most common cause in 6% to 60% of cases, consistent with our findings.^{5,29} The higher incidence of RTAs in developing countries like India may be attributed to an increase in the motorcyclist population, particularly post-pandemic with limited access to public transportation, where the majority of motorcycles lack safety features, leading to a surge in RTAs. Moreover, the easy availability of rental bikes and low maintenance costs further contribute to their popularity as a mode of transportation. The lack of safety equipment for motorcyclists, like full-cover helmets and protective gear, exacerbates the risks associated with accidents. Falls, especially from trees like coconut and areca nut trees prevalent in India's agricultural landscape, were the second most common traumatic cause of TMJ dislocation in our study, along with slips on stairs and in bathrooms, particularly among the geriatric population, which is more susceptible to fractures.

Our study has a few limitations that need to be acknowledged. Firstly the sample size is relatively small, and being retrospective it can introduce some inherent biases. Additionally, we did not consider the time elapsed between the onset of dislocation and reduction by EPs, which also could have influenced the outcomes. As our study was conducted in a tertiary care institute with one ER expert always present to supervise, the generalizability of our findings to other healthcare settings worldwide may be limited. Despite these limitations, our study provides valuable insights into the success rate of TMJ dislocation reduction by Emergency Physicians, which can pave the way for future research and improvements in patient care protocols.

Conclusions

This study reveals a relatively high success rate in the reduction of TMJ dislocation by EPs. The Classic intraoral technique along with the use of midazolam played a significant role. This study adds valuable insights to the field of EM by contributing to the multidimensional exploration of reduction techniques and success rates, ultimately advancing our understanding of optimal management strategies for TMJ dislocations in the emergency setting.

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