Original Article

Effects of Distal Mandibular Skeletal Injury on Temporomandibular Joint Soft Tissue without Bony Injury to the Joint: An Arthroscopic Screening Survey

Darpan Bhargava[1], Yogesh Sharma[1], Sivakumar Beena[1], Ganesh Koneru[1], Ankit Pandey[1]

[1]TMJ Consultancy Services, Bhopal, Madhya Pradesh, India

Abstract

Introduction: Trauma to the temporomandibular joint (TMJ) may be associated with injury to its associated soft tissues along with the bony condyle. However, it is often neglected that even in the absence of fracture of the mandibular condyle, there may be damage to the associated soft tissues of the joint. The routine radiographic study does not reveal the soft-tissue injury around the joint and its extent. Such injuries may progress to temporomandibular joint disorders (TMDs) in the future. **Materials and Methods:** A prospective study was conducted among 50 patients diagnosed with anterior mandibular fractures without condylar fracture. The patients were assessed for soft-tissue injury around the TMJ using an arthroscopic examination by a single qualified operator. Patients were evaluated clinically and arthroscopic examination was performed to examine the TMJ soft tissues at the time of surgery for facial fracture reduction under general anesthesia. **Results:** Among the 50 patients, *n* = 37 (74%) patients had severe injury to the soft tissues surrounding the TMJ. Majority of the patients had arthroscopic evidence of soft-tissue injury around the joint. **Conclusion:** From this study, we observe that patients with mandibular fracture without condylar involvement should be evaluated for TMJ soft-tissue injuries and subjected to long-term follow-up to prevent TMDs in the late postoperative period.

Keywords: Arthroscopy, disc displacement, incidence, jaw joint disorder, mandibular fracture, soft-tissue injury, temporomandibular joint

Introduction

Mandibular fracture is a commonly encountered facial fracture in a maxillofacial trauma unit. It may be isolated or associated with concomitant fractures of adjacent bones. The mandibular condyle may or may not be involved in the fracture process. Trauma to the condylar region is a common cause for the temporomandibular joint (TMJ) soft tissue injuries. Such injuries may result in persistent pain and dysfunction. due to varying mechanical changes within the joint such as fracture, hemarthrosis, joint effusion, internal derangement, hyperemia of the capsule, synovial ecchymosis, ankylosis, and joint dislocation.[1,2] Trauma to the joint may be due to direct or indirect injury. Various methods used to analyze the changes in the soft tissues of the temporomandibular joint include magnetic resonance imaging (MRI), arthrography, arthroscopic examination, ultrasonography, and synovial fluid analysis.[3] In the absence of condylar fracture (bony injury), the soft-tissue injury around the joint may contribute to the joint dysfunction.

It is evident from the literature that bony injury to the TMJ can cause pain and dysfunction.[1,2] Literature highlights that the soft-tissue injury surrounding a fractured condyle may complicate to such dysfunctions, but there remains no adequate support in the evidence of soft tissue injury to the temporomandibular joint in the absence of condylar bony injury. This could be attributed to the fact that some patients'

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Address for correspondence: Dr. Darpan Bhargava, H-3/2, B.D.A Colony, Nayapura, Lalghati, Airport Road, Bhopal - 462 001, Madhya Pradesh, India.
E-mail: emaildarpan@gmail.com

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develop symptoms and show clinical signs due to soft-tissue injury, but others do not. Based on the etiology, the severity of soft-tissue injury around the joint may vary in high- and low-velocity injuries as the force may directly or indirectly alter the joint structure.

The aim of the present study is to assess the effects of distal mandibular skeletal injury on TMJ soft tissue without bony injury to the joint [Figure 1] using an arthroscopic examination of the joint and periarticular structures.

Materials and Methods

A prospective clinical study was conducted among 50 patients diagnosed with anterior mandibular fracture without bony injury to the condyle. The study was performed in compliance with the Declaration of Helsinki on medical protocol and approved by the institutional ethical committee, institutional review board number: OMFS/07/2924. The patients included in this study were 18 years or older and with a fracture in the symphysis/parasymphysis region. Exclusion criteria were condylar fracture, presence of infection in the fracture site, history of previous facial trauma/orthognathic surgery/previous surgery to the TMJ region/temporomandibular joint disorders (TMDs)/systemic disease affecting bones and joints. Written informed consent was obtained from all the patients after explaining the study and need for an additional diagnostic arthroscopic examination during the surgery. Patients who were not willing for the arthroscopic procedure were not included without any negative consequences affecting their treatment. Routine clinical and radiographic presurgical workup was done. Clinical examination revealed malocclusion, restricted mouth opening, and masticatory difficulties. Twelve patients complained of preauricular pain. However, in patients with acute trauma it was difficult to differentiate the symptoms between anterior mandibular injury and those related to TMJ.

The etiology of the fracture was also documented to classify them into categories as high-velocity injury: road traffic accidents (RTAs) and fall from height and low-velocity injury: blow, sports injuries, and fall from standing position to correlate the severity of the soft tissue injuries to the joint. All the patients involved in this study were treated by a single qualified operator who performed open reduction and internal fixation (ORIF) of the fracture under general anesthesia using titanium (Ti) miniplate implant system. The facial fractures were reduced and fixed in their anatomic location based on standard principles of maxillofacial traumatology. The arthroscopic examination of the TMJ was performed by a single qualified operator who was a specialist in TMJ arthroscopy prior to ORIF intraoperatively. The diagnostic arthroscopy was done to screen the region around the joint using a 5.5 cm, 30° angle arthroscope of diameter 2.4 mm. Introduction of the arthroscope was performed as per the single puncture protocol by McCain *et al*.[4] The research assistant aided in manipulating the mandibular movements during the insertion of the trocar. The evident changes during diagnostic arthroscopic examination was recorded for all the patients.

Figure 1: A reconstructed three-dimensional computed tomographic scan of the face showing fracture in the right parasymphysis and body region without bony injury to bilateral mandibular condyle region

Antibiotics and analgesics were prescribed with standard postoperative instructions. Patients were instructed to report for review on the 7th postoperative day as well as the 3rd and 6th postoperative months for evaluation. Patients who failed to report for follow-up were excluded from the study without any negative consequences.

Results

Among the 50 patients, *n* = 40 (80%) were males and *n* = 10 (20%) were females. The most common cause of trauma among the study population was RTA caused by motor vehicle collision followed by interpersonal violence, sports injuries, and self-fall. The study population was subclassified as high velocity, *n* = 39 (78%), and low-velocity injury, *n* = 11 (22%), based on their etiology [Table 1 and Graph 1].

Majority of the patients, *n* = 37 (74%), of which *n* = 31 (62%) belonged to high-velocity and *n* = 6 (12%) belonged to low-velocity injury category, had severe distortion in the anatomy of soft tissues around a single or both joints with the evidence of tear in the external capsular ligaments laterally and distortion of the internal capsular anatomy [Figures 2-4]. The remaining *n* = 13 (26%) had mild disruption in the periarticular soft tissue. The medial synovial drape was intact in all the study patients [Table 1].

On the 7th postoperative day, patients had improved mandibular function following ORIF for the anterior mandibular fracture. In the 3rd postoperative month, *n* = 16 (32%), of which *n* = 13 (26%) belong to high-velocity injury and *n* = 3 (6%) low-velocity injury group, patients reported with pain in the TMJ region during functional movements. Clicking sound was evident in *n* = 2 (4%) with tenderness. Two patients (4%) had a slight deviation on mouth opening with associated pain [Table 2].

Table 1: Number of patients with and without injuries to the surrounding tissues of temporomandibular joint

Injury category	Number of patients among the study population		Total, *n* (%)
	Severe soft-tissue injury, *n* (%)	Mild soft-tissue injury, *n* (%)	
High-velocity injury	31 (62)	8 (16)	39 (78)
Low-velocity injury	6 (12)	5 (10)	11 (22)
Total	37 (74)	13 (26)	50 (100)

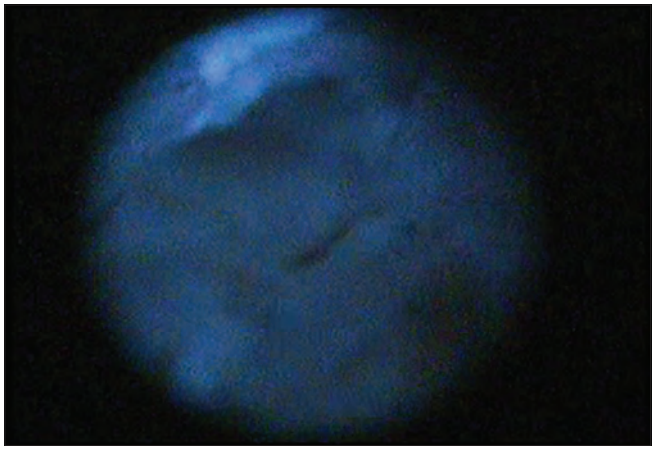


Figure 2: Arthroscopic image of a distorted internal anatomy of the periarticular tissue

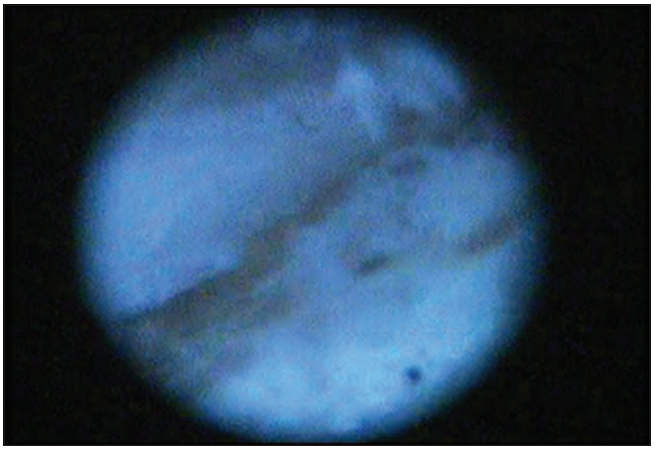
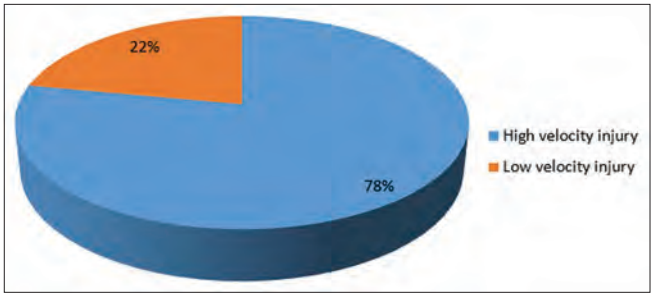


Figure 3: Arthroscopic image of tear in the lateral capsular ligament

Figure 4: Arthroscopic image of torn capsular ligament in the anterior recess



Graph 1: Classification of the study population ($n = 50$) based on high/low-velocity injury

On 6th postoperative month evaluation, $n = 7$ (14%) patients developed clicking sound who have previously reported with a complaint of pain in the preauricular region in the 3rd postoperative month. In addition, $n = 5$ (10%) patients developed pain in the 6th postoperative period with tenderness on mouth opening and mastication. Two patients (4%) developed internal derangement [Table 2]. We used the grading system to assess the periarticular soft-tissue injury by Tripathi *et al*. for arthroscopic findings.[2] All the patients from the present study population were categorized as to Grade III as there was evidence of disc displacement and periarticular soft-tissue injuries [Table 3].

Discussion

As observed from the present study, whenever there is an impact to the chin causing anterior mandibular fracture without the condylar involvement, there is an injury to the soft tissue surrounding the TMJ. The soft-tissue injury severity was more in patients who had RTA as compared to self-fall and sports injury. Males were commonly affected which could be attributed to the fact that they are engaged more in driving and sports activity. Arthroscopic evaluation revealed various soft-tissue injuries such as disc displacement, capsular ligament tear, and damage to the diskal and retrodiskal tissues. The soft-tissue injury was assessed using the grading used to assess the same in MRI by Tripathi *et al*. Postoperatively, patients developed various symptoms such as pain/tenderness in the TMJ region on function, deviation on mouth opening, clicking noise, and internal derangement. They were symptomatically managed during subsequent follow-ups. The limitation of this present study is the lack of soft-tissue imaging documentation in the

Table 2: Symptoms developed by the patients in the postoperative phase

Injury category	Pain			Clicking noise in the joint		
	7th day, *n* (%)	3rd month, *n* (%)	6th month, *n* (%)	7th day, *n* (%)	3rd month, *n* (%)	6th month, *n* (%)
High-velocity group	0	13 (26)	3 (6)	0	2 (4)	6 (12)
Low-velocity group	0	3 (6)	2 (4)	0	0	1 (2)
Total, *n* (%)	0	16 (32)	5 (10)	0 (0)	2 (4)	7 (14)

Table 3: Periarticular soft-tissue injuries surrounding the temporomandibular joint[5]

Grade	Feature
I	Hemarthrosis only
II	Hemarthrosis and disc displacement
III	Hemarthrosis, disc displacement, and capsular tear
IV	Disc perforation in association with Grade I, II, or III

postoperative period as the only screening orthopantomogram was done which showed normal condylar morphology among the study population.

There are three categories of traumatic forces causing condylar injury: (1) when an energy is imparted on a static individual by a moving object, (2) force of a moving individual striking a static object, and (3) energy developed by a combination of 1 and 2.[5] Injury to the lower third of the face can cause a fracture along the mandibular bone. The direction of traumatic force and the point of impact determine the fracture pattern. When such forces are encountered, the condyles fracture and dissipate the energy, thereby protecting the skull and brain from penetrating injuries.[6] Morphologic variance of the condyle and severe force to the chin may play a vital role in the injury to the soft tissues surrounding the mandibular condyle. Thus, it is believed that condyle absorbs all the transmitted force from the ipsilateral or contralateral chin and provides a cushioning effect by not transmitting the energy to the cranium.

He *et al.*[7] and Rajantie *et al*.[8] emphasized that the effects of mandibular fracture without injury to the condyle can have effects on the periarticular soft tissues. Macrotrauma to the TMJ can have detrimental changes such as cartilage degeneration, biochemical, and intra-articular progressive degenerative alterations.[9,10] Goss and Bosanquet observed that only one patient showed normal joints without any damage following a mandibular fracture. They also found that the damage to the soft tissue was more in the nonfractured condylar side in several patients.[11] Tabrizi *et al*. observed that few patients developed TMDs later when there is an absence of bony injury to the condyle. They evaluated their patients for joint disorders clinically during the follow-up period, and no soft-tissue imaging was performed.[12]

He *et al.* in their study observed postoperatively that out of the 12 joints which they examined for soft-tissue injury in the absence of bony injury to the Mandibular Condyle (MC), fibrous ankylosis was evident in 5 joints and intra-articular adhesions in 2 joints apart from internal derangement in the postoperative period. All the joints had displaced discs in MRI examination. Few patients did not show signs and symptoms of TMDs and had satisfactory mouth opening. They also observed that the condyle was intact in the computed tomography (CT) scan in the immediate postoperative period but was later destroyed in follow-up CT scan in a few patients.[7] The results obtained in the present study were similar to the above mentioned study where majority of the patients had injury to the periarticular soft tissues. Such trauma can cause joint dysfunction to some extent in the patient population in future which can be evaluated by close follow up of such patients.

Further studies need to be conducted among a larger patient population to establish the need for treatment of soft-tissue injuries around the periarticular region without bony involvement to develop an appropriate management protocol for such cases. The assessment of the degree of joint dysfunction and TMDs in the immediate and late postoperative period and a long-term follow-up should be done to observe the theoretical possibility of ankylosis in such patients.

Conclusion

From this study, it can be concluded that mandibular fracture without bony injury to the condyle can have a significant effect on the joint soft tissues causing TMDs in the postoperative period. Appropriate follow-up is mandatory in such patients to prevent possible complications.

Ethical approval

Ethical approval was obtained. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from the patients involved in this study.

Declaration

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Conflicts of interest

There are no conflicts of interest.

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