Isolated Bilateral Mandibular Angle Fractures: An Extensive Literature Review of the Rare Clinical Phenomenon with Presentation of a Classical Clinical Model

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Abstract

Bilateral angle fractures are a rare clinical phenomenon in contrast to the incidence of unilateral angle fractures. However, the rarity has garnered less attention in spite of the uniqueness of fracture pattern and distinctive biomechanics. This article is a detailed review on the etiology, clinical presentation, and management of bilateral angle fractures with the presentation of an interesting case. The bilateral angle fracture reported is a untreated, malunited fracture representing an ideal clinical model to study its biomechanics. The clinical features were anterior open bite, increased facial height, and temporomandibular joint tenderness. The management included osteotomy at the malunion and miniplate osteosynthesis. Bilateral angle fracture presents mandible in three independent fragments (left angle, right angle, and intermediate corpus), each with strong muscles acting in different vectors. This makes the fracture vulnerable to severe displacing forces and unfavorable to achieve the optimal reduction, stability, and healing. This necessitates comprehension of the biomechanical forces involved to avoid malunion following fixation. The article details the complex biomechanics of mandibular angle and its clinical implications in the rare event of bilateral angle fractures. It describes the necessity for a systematic approach and ideal osteosynthesis principles to achieve maximal treatment outcomes and minimal complications.

Keywords

- bilateral angle fracture
- impacted third molar in angle fracture
- angle biomechanics
- malunion

Purpose

Bilateral fractures of the mandibular angle are described as a “rare traumatic event.”¹ However, the rarity is often obscured by the enormous literature on unilateral angle fractures.^{2–7} Bilateral angle fractures may be observed concomitantly with pan facial fractures, where the impacting force is severe, but its isolated occurrence is unusual. The etiology and biomechanics of such fractures is unique and deserves scrutiny.

The angle is one of the common sites of mandibular fracture. The biomechanics of unilateral angle fractures which are a frequent finding has been studied extensively and attributed to three main factors: (1) the change in curvature of the mandible at the angle region leading to concentration of stresses,^{2,8} (2) the presence of third molars which compromise the structural integrity of the mandible,^{9–19} and (3) the splinting action of the muscles behind the third molar region, which make the area along the third molar socket relatively weak.

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The angle is a zone of dynamic yet balanced muscular activity.²⁰ Equilibrium of these muscles is lost when a fracture occurs at the angle, especially in the unfavorable type, where the muscles displace the fracture segments and affect the bone morphology, function, and occlusion. In bilateral angle fractures, the complexity is manifold because the mandible is split into three fragments: two proximal fragments—the right and left angles influenced by the pterygomasseteric sling and the temporalis producing a superior vector—and the distal corpus (intermediate segment) acted upon by the mylohyoid and suprahyoid muscles with an inferior vector. This produces two large quanta of opposing forces with the angle as the fulcrum, leading to a characteristic open bite (► **Fig. 1a**).²¹ The dynamic environment predisposes the angle to high incidence of nonunion or malunion in the event of inadequate reduction and suboptimal fixation.^{22–26}

A thorough analysis of literature and involved biomechanics is thus required to rationalize the treatment principles of this uncommon clinical entity for obtaining stable and functional outcomes. The representative case report, which is discussed later, illustrates the earlier-discussed complexities and may add critical clinical information on management concepts.

Review of Literature

The incidence of bilateral angle fractures is negligible when compared with the occurrence of unilateral angle fractures. In an analytical series comprising of 2,195 mandibular fractures, Cillo and Ellis reported a frequency of only 2.1% of bilateral angle fractures over a period of 20 years.¹ Paza et al reported a trifling 1 case out of the 116 angle fractures in 5 years²⁷ while Boffano and Rocchia observed 8 cases in 8 years.²⁸ An interesting case of bilateral angle fracture following severe bouts of vomiting in a patient treated with droperidol to manage postoperative pain following bilateral sagittal split osteotomy (BSSO) has been reported by Freymond et al who attributed it to severe contracture of the pterygomasseteric sling.²⁹

The mandible is analogous to a long bone bent into a horseshoe shape with its greatest strength at the center—the

symphysis. The weakest regions are the condyles in the dentulous mandible and the body in the edentulous.^{30–32} However, biomechanical and finite element studies indicate that angles, in the presence of impacted or partially erupted third molars^{33–35} constitute more vulnerable sites and are predisposed to fracture. It is an interesting finding that superficially impacted teeth show more propensities than deep seated ones in causing these fractures.^{36,37} A centrally directed force on the mandible, depending on its magnitude and vector orientation usually results in counter coup bilateral fractures of the condyles or parasymphysis; but rarely bilateral angles.³⁸ This infrequent occurrence has created lacunae in its management ideology.

Unilateral angle fractures have been managed by a multitude of treatment options from nonrigid to rigid fixation ranging from large bone plates and compression plates at the lower border to miniplates positioned at the inferior or superior borders and lag screws.^{39–42} The fixation of unilateral mandibular angles has been extensively studied by Ellis, who has compared eight different modalities of fixation with varying results.⁴³ The use of one miniplate on the superior border has proved to be the best method with the least complications.⁴⁴ This observation was confirmed by Haug et al in a similar study, who performed in vitro comparisons of fixation methods for mandibular angle.⁴³

It is noteworthy that there is minimal literature regarding management concepts of bilateral angle where the surgical challenges concerning reduction and fixation are manifold. In a recent study,¹ Ellis has assessed the management of bilateral fractures of the mandibular angle and concluded that the bilateral fractures are more unstable than the unilateral variety with the degree of displacement playing an important role in postfixation stability. They advocated the use of two miniplates on the more displaced side and one at the superior border on the less displaced side.

Removal of third molars in the fracture line has always been contentious; but the general consensus as revealed by studies of Rubin et al⁴⁵ and Wagner et al,⁴⁶ indicate that the tooth needs to be removed when longitudinally fractured, mobile, infected or associated with a pathology.

Fig. 1 (a) Bilateral angle fracture: (a) temporalis, (b) masseter, (c) medial pterygoid. (b) Bilateral parasymphyseal fracture: (d) geniohyoid, (e) digastric, anterior belly, (f) mylohyoid, (g) digastric, posterior belly.

Fig. 2 Intraoral photographs illustrating pre- and postoperative dental relationship. (a) Preoperative frontal. (b) Preoperative right lateral. (c) Preoperative left lateral. (d) Postoperative frontal. (e) Postoperative right lateral. (f) Postoperative left lateral.

The mandibular angle is a frequent site of malunion^{22–25} due to the biodynamics involved. The greater number of malunion associated with closed reduction of 99 unilateral angle fractures observed by Passeri et al over a period of 3 years validates the need for rigid fixation.²⁶ Fractures of the mandibular angles and condyles also produce the highest incidence of posttraumatic dysocclusion which needed secondary correction by osteotomies.⁴⁷

Case Report

A 29-year-old male patient reported to the Department of Oral and Maxillofacial Surgery, SRM Dental College, with complaints of elongated face and inability to close mouth and chew properly with associated temporomandibular joint (TMJ) pain following a road traffic accident 2 months earlier. History revealed that the patient had sustained an injury with direct impact on the chin. The fracture was left untreated for 2 months due to misdiagnosis and poor medical care.

On examination, the patient demonstrated restricted mouth opening (10 mm), anterior open bite with contact only in the second molar region (►Fig. 2a–c), increased lower third facial height (47 mm) (►Fig. 3a) and tenderness in the TMJ region, bilaterally. No paresthesia was elicited along the inferior alveolar nerve distribution and no mobility of bone fragments was detected clinically. Orthopantomogram (OPG) and computed tomography scan revealed malunion in the angle region bilaterally. The fracture lines were traceable on the OPG through the impacted third molar sockets on both sides demonstrating a horizontally unfavorable pattern (►Fig. 4a).

Under general anesthesia (GA), the fracture sites were approached through intraoral incisions. Bony union was observed between the fractured fragments on both the sides (►Fig. 5a). The impacted teeth associated with the fractures were surgically removed (►Fig. 5b). The refracture of malunioned angles were achieved by osteotomizing along the fracture line using a surgical drill (►Fig. 5c). The cortices

were sectioned using the drill and the final refracture and mobilization of the malunioned fragments were performed using osteotomes to avoid damage to the inferior alveolar neurovascular bundle. The fracture ends were debrided to eliminate any fibrous adhesions that might hamper future fracture union. The mobilized segments were reduced into an optimal anatomical relationship while simultaneously achieving ideal dental occlusion with the use of a prefabricated splint (►Fig. 5d). The intermaxillary fixation (IMF) was performed with splint in position and fractures were fixed with miniplates (2-mm system) on the superior border in accordance with the osteosynthesis lines of Champy (►Fig. 5e). The IMF was released and postfixation occlusion was checked passively. The intraoral wounds were closed with 3–0 Vicryl sutures (Vicryl, Ethicon, Johnson & Johnson, Aurangabad, India). The patient was followed up on a monthly basis to check for stability of the dental occlusion and fracture healing (►Figs. 2d–f and 4b–d). The postsurgical

Fig. 3 Extraoral frontal photograph of the patient demonstrating. (a) Preoperative lower facial height (47 mm). (b) Postoperative lower facial height (37 mm).

Fig. 4 Figure showing pre- and postoperative OPGs. (a) Preoperative. (b) Immediate postoperative. (c) Postoperative after 6 weeks. (d) Postoperative after 12 weeks.

sequel was uneventful with no complications, including neurological deficits. An evaluation of postsurgical outcome was performed after 2.5 months of surgery, which included a reassessment of facial esthetics, occlusion, and mouth opening. The patient demonstrated excellent and stable results with balanced facial esthetics, good masticatory efficiency, and complete resolution of the TMJ pain.

Discussion

The case presented in this article is a classical clinical model, which demonstrates the unique combination of a centrally directed force and presence of superficially impacted third molars as a possible risk for the occurrence of bilateral angle fractures. It also highlights the sequel of the uninhibited action of muscular forces in the angle region, when not

treated. The opposing forces generated by the muscles acting on the angles result in an anterior open bite, which is functionally and cosmetically unacceptable and renders more complexity in the fracture management. This is reiterated by a case report, which describes the successful management of recalcitrant traumatic open bite following bilateral angle fractures by injecting botulinum toxin A into the anterior belly of digastric,⁴⁸ which negated the powerful downward displacing forces of the suprahyoid muscles.

This condition is analogous to the bilateral fractures of the parasymphysis in presenting the mandible in three independent fragments. However, the biomechanics involving bilateral angle is more complex. The bilateral parasymphysis fractures show a single vector of displacement (downward) through the action of the suprahyoid muscle group with the mylohyoid negating the minimal forces of the mandibular

Fig. 5 Picture demonstrating surgical sequence. (a) Exposure of malunited fracture. (b) Surgical removal of impacted molar. (c) Refracture of the malunion. (d) Use of splint for reduction. (e) Fracture fixation using a miniplate.

elevators (►Fig. 1a, b). The bilateral angle fractures on the other hand show opposing vectors of action at the angle (upward and downward), which produce a more severe displacement. Moreover, the downward pull of the suprahyoid muscles in the angle fractures is stronger than with the fractures of the parasymphysis because the corpus of the mandible acts as a longer lever arm giving more mechanical advantage for the muscular action. The overwhelming multidirectional action of the muscles in this region increases the chances of micromovements along the fracture line even postfixation and may destabilize the achieved outcome.

Mandibular angles show high prevalence of malunions.^{22–26} Two major/critical determinants of ideal fracture union, which is dependent on stability are bone contact and the rigidity of the fixation. An unstable fracture fixation leads to infection, malunion, and implant deformation or loosening. Malunion is managed sequentially by refracture of the malunited bone, debridement, and decortication of fracture ends, achieving anatomical reduction and dental occlusion, and finally stabilizing the reduced fragments. In grossly malunited fractures, bone grafts may be necessary to bridge large gaps, which arise after osteotomy and refracture.

The patient in this case report, presented with bilaterally malunited angle fractures following untreated primary trauma directed at the chin. The fractured segments showed uniform displacement on both sides, which was static due to the malunion with a resultant anterior open bite. This case also evidenced the characteristic sequel to posttraumatic open bite such as TMJ pain and deranged facial esthetics. Lack of contact between the anterior teeth lays a tremendous load on the molars with masticatory muscle hyperactivity and fatigue. This gets transmitted to the TMJ leading to severe pain and dysfunction of the masticatory muscles, sternocleidomastoid, and trapezius muscles.^{35,46,49} The open bite also affected the facial esthetics by increasing the vertical dimension of the lower face.

The key points regarding the management of this case which deserves discussion are (1) surgical removal of the impacted third molars performed as the first step, (2) use of a prefabricated dental splint for optimal reduction, and (3) choice of one superior border miniplate as the fixation method. The impacted mandibular molars were surgically removed first, to facilitate osteotomy of the malunited bone through the socket and hindrance-free reduction of the fracture fragments. Subsequently anatomic reduction was achieved using a prefabricated dental splint. The splint served as a guide to achieve optimal dental occlusion,⁵⁰ to minimize micromovements (in transverse and sagittal directions) and provide cross-arch stability during plate fixation. It also enabled to ensure precise dental relationship on the lingual aspect, intraoperatively, which cannot otherwise be confirmed. A functionally stable internal fixation with one superior border five-hole miniplate was sufficient in this particular case as the displacing forces of the muscles were “inactive” due to the malunion.^{1,44,45,51,52} A miniplate without bar was chosen against one with the bar because of the reduced span of bridging and nonproximity of vital anatomical structures that needed to be bypassed.⁵²

The correction of the open bite not only relieved the TMJ symptoms within the immediate postoperative period, but also caused a dramatic improvement of facial esthetics. The posttraumatic vertical dimension of 47 mm was restituted to a more balanced vertical dimension of 37 mm (►Fig. 3a, b). The patient followed up for a period of 3 months demonstrated good fracture healing clinically as well as radiographically.

Conclusion

Bilateral angle fractures of mandible present a complex clinical situation with mandible in three different fragments with powerful displacing muscular forces acting in opposite directions. Therefore, fracture stabilization methods which conform to rational biomechanical principles are absolutely necessary to prevent complications such as nonunion and malunion. The successful use of a prefabricated splint and a functionally stable method of fixation in achieving ideal dental and skeletal relationships have been demonstrated in this clinical report.

As this is a solitary case, the suggestions and sequencing from this report may not be substantial in formulating a protocol but may be useful as clinical guidelines for improving postsurgical outcome.

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