Original Article

Role of fixation in posttraumatic nerve injury recovery in displaced mandibular angle fracture

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ABSTRACT

Objective: The objective of this study was to assess the effectiveness of different types of fixation in the enhancement of posttraumatic inferior alveolar nerve (IAN) recovery in displaced mandibular angle fracture and to establish. **Patients and Methods:** Thirty patients of displaced mandibular angle fracture were treated with preangulated plate and three-dimensional (3D) matrix plate in two groups and were observed during follow-up at 04,06 and 12 weeks along with other parameters. **Results:** Fifteen patients were treated with preangulated plate and 15 patients with 3D matrix miniplate. There was early nerve recovery in Group A than Group B, with residual paresthesia 20% in Group A and 26.6% in Group B at the end of 12-week follow-up. **Conclusion:** The displaced mandibular angle fracture with posttraumatic IAN paresthesia treated with preangulated plate has shown evidence of early nerve recovery than those fractures were treated with matrix miniplate. The fracture fragments displaced more than 9 mm have shown poor nerve recovery in both groups.

Key words: Displaced mandibular fracture, inferior alveolar nerve, injury, preangulated plate, three-dimensional matrix plate

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Introduction

Mandibular fractures are common among facial bone fractures. Its anatomical structure and prominence makes prone to sustain injury. Among mandibular fractures, angle region fracture is the most common fracture in developing countries, accounting 30% of all fractures. Mandibular angle fracture line involves junction of ramus and body of the mandible to the third molar region and traverses through the inferior alveolar canal to reach the inferior border. Occasionally, this fracture extends posteriorly going through the region of gonial angle. The traditional biomechanical model comprising tension at the superior border and compression at the lower border has been challenged, and it has been found that these tension compression zones reverse as the load position moves posteriorly. Fracture involving inferior alveolar canal-associated nerve paresthesia may be transient or permanent type. Thurmuller *et al*. reviewed the literature on nerve injuries in facial trauma and reported the overall incidence of inferior alveolar nerve (IAN) injury in mandibular fractures with associated paresthesia to be 5.7–58.5% after injury without treatment and fractures in the mandibular body and angle region to be 46–58.5%.[1] The incidence of IAN injury in treated mandibular fractures ranged from 0.4% to 91.3%. The reported postoperative incidence of IAN injury in fractures of the nerve-bearing area of the mandible (angle,

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body) was 76.1–91.3%. Various factors such as fracture displacement, type of fixation, site, and type of fracture have been reported to influence the incidence of IAN injury in mandibular fractures. The actual amount of fracture displacement due to trauma is not accurately estimated, and radiographs only demonstrated the posttrauma tissue recoil bony fragments position. Estimation of the exact nature of injury is not possible. This is not clear why some minimally displaced fractures resulted in permanent numbness. In blunt trauma involving the thorax, it is well known that major bony and visceral displacements occur in high-velocity impact, with recoil back to their original position soon after, nevertheless, resulting in injury. There is not much published literature supporting that greater fracture displacement can cause more nerve injury or vice versa.

Patients and Methods

In this study, thirty patients of displaced mandibular angle fracture which are traversed by mandibular canal were included in the study. The University Ethical Board clearance was taken. Patients who were reported at the Oral and Maxillofacial (OMF) Unit of trauma center and the outpatient department of OMF Surgery Department of King George's Medical University were included in the study after their informed consent. In addition to demographic information (i.e. gender age, cause), the following data of all the patients were also collected: Location of fracture - left or right, presence of tooth in the fracture line, displacement of the inferior alveolar canal, and any major postsurgical complication; routine antibiotics therapy and use of elastic for slight malocclusion were not considered in complication.

IAN injury assessment[2] was monitored routinely at admission and postoperative at different intervals. Postoperative complications requiring another surgery were excluded from the study.

Clearance to conduct the study was obtained from the University Ethical Committee. Written informed consent to participate in the study was obtained from each patient before enrolling in the study.

Inclusion criteria

- Patients with at least one fracture passing through the inferior alveolar canal on orthopantomogram (OPG)
- Displacement of the fractured fragments was measured on OPG and was classified as 0–3 mm, 3–5 mm, and >5 mm displacement between the fracture fragments.

Exclusion criteria

- Patients not willing to participate in the study
- Pathological fracture, fractures with major tissue loss
- Previous surgery (orthognathic surgery, implant surgery, surgery for mandibular pathology involving mandibular canal region and mandibular impacted third molar surgery resulting numbness)
- Panfacial trauma.

These thirty patients were divided into two groups, 15 patients in each group. In Group A, the patients were treated using 2-mm preangulated plate fixation device. In Group B, the patients were treated using 2-mm three-dimensional (3D) plate. All the patients were operated under general anesthesia with standard operating preparation. An intraoral approach was used to exposed fractures. Fracture fragments were reduced and intermaxillary fixation was done to check occlusion. Group A patients were treated with six-hole preangulated plate as was applied along external oblique ridge transbucally. In Group B, patients underwent osteosynthesis using 3D titanium strut plate transbucally. The 3/0 absorbable suture was used to close the mucosal wound. Postoperatively, pain, swelling, and mobility between fracture fragments, nerve paresthesia, and recovery were assessed between two groups at various periods of follow-up. Radiographic assessment was done using posteroanterior view of the mandible and OPG.

Results

A total of thirty patients of displaced angle fracture treated with different types of fixation were studied. There was significantly more prevalence of fracture in male patients with a mean age of ≥25 years. Road traffic accident was the major cause (74%) of fracture of the mandible and interpersonal violence and fall from height was less, incidence-wise. The mean duration of time lapse between injury and definitive treatment in both groups was 6–8 days. The failure to recognize or detect nerve paresthesia initially is due to poor cooperation of patients due to facial edema, lacerations and associated injury, or unconsciousness. Nerve sensory function was evaluated by a light touch with cotton wool and two-point discrimination on the skin of chin and lip. Postoperatively, there was significant in pain on a visual analog scale between both groups at different intervals. A decreasing trend was found with the time interval in both groups.

At 6-week follow-up, the patients in both groups were pain-free. There was a gradual change in molar bite force from 7th day onward at different intervals in both groups; however, in Group A, this change was less than Group B. Preoperatively the mean displacement in Group A was 7.86 ± 6.75 mm and in Group B was 8.43 ± 6.65 mm preoperatively. The mean displacement in Group A was 0.20 ± 0.41 mm and in Group B was 0.66 ± 0.61 mm. The mean change was 7.66 ± 4.48 mm and 7.76 ± 6.54 mm, respectively. There was a significant change observed postoperatively in both groups; t and P values were statistically significant, 2.43 and 0.02, respectively. Paresthesia was present in 46.6% cases of Group A and 40% cases of Group B preoperatively [Figure 1].

At 7th day postoperatively, 33.3% cases in Group A and 40% cases in Group B had paresthesia. At the end of 4 weeks, 20% cases in Group A and 26% cases in Group B had paresthesia while at the end of 12 weeks, 20% cases in Group A and 26.6% cases in Group B had paresthesia. There was no statistical significance ($P < 0.05$) in anesthesia/paresthesia between both the groups at different time intervals. However, the presence of paresthesia was lower in Group A than in Group B. One patient in Group A and two patients in Group B had persistent paresthesia postoperatively at 12 weeks. There was a significant correlation between the degree of displacement and paresthesia. Paresthesia was present 28.5% cases when displacement was 1–3 mm, 62% cases when displacement was 3–9 mm, and 71% cases when displacement between fragments was >9 mm. There was a complete recovery in both Groups A and B when displacement was <5 mm and persistent paresthesia 33% in Group A and 66% in Group B when displacement was >9 mm after 12-week follow-up [Figure 2].

Discussion

The mandibular angle fracture usually resulted in pain, swelling, bleeding, and disturbed occlusion due to the displacement of fractured fragments. Displaced fractures generally resulted in paresthesia, which causes problems such fluid drooling or food escape or accidental lip biting and occasionally shaving and applying makeup even kissing become difficult.[3,4] Angle fracture can be displaced by a number of ways as an open book, vertical overlap, and laterally. This can be explained on the basis that etiology of fracture shifting toward assault or interpersonal violence with a blow to side of the face. There is no accurate method to access the IAN injury, but radiographically fractured fragments separation/gap and misalignment of inferior alveolar canal only suggest the IAN injury. This nerve injury can also be caused by trauma or during treatment also.[5] Manipulation of fracture fragments during reduction and stabilization or extraction of the third molar and even screws placement may result in inferior nerve injury. Persistent mobility at fracture site even in minimally displaced fracture can cause further nerve injury. In this study, group A patients had pretreatment sensory disturbance 46.6% paresthesia preoperatively, and postoperatively, 33% and 20% at 1 week, 4 weeks, and at the end of 12 weeks respectively. While in Group B (matrix plate), 40% patients had paresthesia preoperatively, and postoperatively, 26% and 26.6% at 4 weeks and the end of 12 weeks, respectively.[6,7] Postoperative difference in nerve injury recovery may be explained on the basis of fixation, that provides more firm fixation, which helps in early nerve recovery in Group A than Group B. Similar observation was also reported by Thurmuller *et al*. (46–58.5%),[1] Lizuka *et al*. (50.7%).[8] These figures confirm the risk of IAN injury with fracture gap.[9] Manipulation and reduction of fracture fragments can further result in starching or injury to the nerve. Even drilling procedure can cause thermal or mechanical injury to nerve. Nagadia *et al*. found by computed tomography (CT) imaging that the mean distance from the outer buccal cortex to the inferior alveolar canal in Chinese mandible was 6.97 mm (min 4.8 mm); the use of >6 mm of monocortical screws can cause injury to nerve in this region. Levine *et al*. reported that the distance of buccal cortical margin to the mandibular canal was 4.9 mm using CT imaging. Demyelinating nerve lesion generally recovers during the first 4 months of injury; however, after sustained axonal nerve injury, the nerve conduction velocity can also slow down permanently due to the Schwann cell regeneration having shorter internodal interval than before injury and it may never reach baseline as happened probably in our few cases.[9]

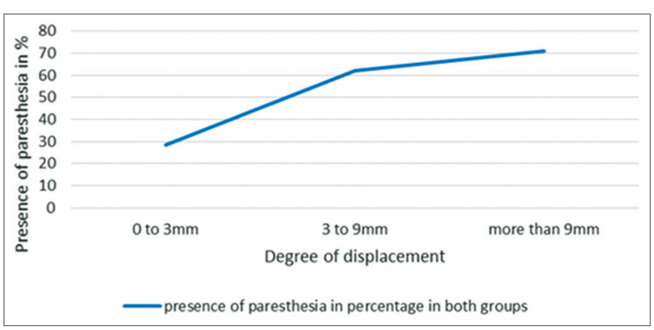

Figure 1: Relation of paresthesia with degree of displacement of fractured fragments in both groups

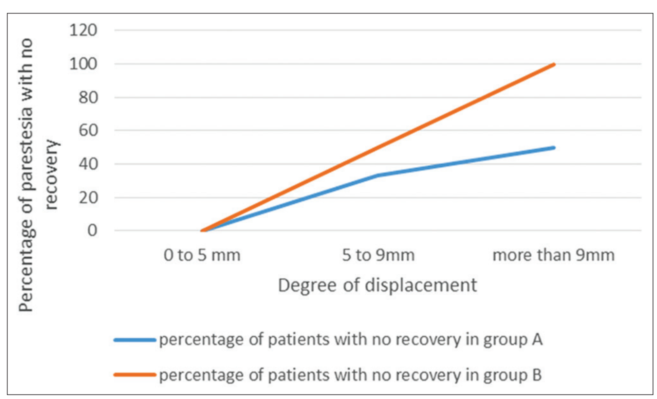

Figure 2: Comparison of the persistence of paresthesia in both groups after fixation, showing greater percentage of recovery in Group A

Due to wide separation of fractured fragments with persistent mobility at fractured may causes, repeated nerve injuries in the already stretched nerve. There is no direct evidence that suggested the relationship of fracture fragments displacement and time lapse in treatment resulted in paresthesia. Early reduction and fragments fixation of fracture fragments may offer early nerve chances of nerve recovery margins.

Al-Jandan *et al*. reported[10] cone-beam CT observation that horizontal distances at the canine, first premolar, and second molar and reported that using 6 mm screw can cause 56% IAN injury and 7 mm can cause 78% injury. Hence, the routine use of 5–7 mm screws would have a high risk of injury to the root apex and the inferior alveolar canal if miniplate was placed along Champy's line of osteosynthesis.[11,12] In this study when fractured fragment displacements were >5 mm, then rate of recovery was poor as 33% in Group A and 66% in Group B, with persistent paresthesia at the end of 12-week follow-up. This may be explained on the basis that prolonged stretching of fragments may cause more nerve damage. While in <5 mm displaced group, patients had complete nerve recovery; Robinson[5,13] reported that most of the improvements of nerve injury occur in initial 4 weeks, but long-term 12-month follow-up will definitely be helpful.[14] Another study by Queral *et al*.[15] reported that fracture displaced >5 mm had a 7-fold increased risk of IAN after treatment compared with patients with <5 mm fracture displaced. IAN completely recovered neurosensory efficiency in 4–24 weeks. Campbell *et al*. reported postoperatively 81% had poor sensation to thermal stimuli and 67% to von Frey tactile stimulation. Ardary[16] and Raveh *et al*. reported that the rate of postoperative sensory deficit has been lower varying from 0.9% to 34%. This variation may be explained on the basis as paresthesia diminished with the time and different follow-up of studies, and possibility studies had included fractures of noninferior canal region (parasymphysis and symphysis). Cabrini *et al*.[17] claimed that rigid fixation causes postoperative paresthesia more often than the other treatment methods.

This study suggests that more stable fixation helps in early nerve recovery in displaced angle fracture. The prevalence of IAN injury after fracture treatment varies from 0.4% to 91.3%.[2] Permanent IAN neurosensory deficits may complain as pain, paresthesia dysesthesia, hypoesthesia, or anesthesia involving the chin, lower lip, and gums. Early manual reduction, and temporary stabilization of fracture fragments will definitely prevent mobility of fragments and reduce bleeding, pain, and swelling causing injury to nerve.

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Conflicts of interest
There are no conflicts of interest.

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