

Case Report

Rapid, conservative, multidisciplinary miniscrew-assisted approach for treatment of mandibular fractures following plane crash

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ABSTRACT

Mandibular fractures are among the most common facial injuries. This case report demonstrates the efficacy of simultaneous usage of miniscrews and direct bonding techniques without open reduction in an extensive traumatized patient. A 25-year-old girl with multiple injuries in the head and facial region 1 month after a plane crash accident was referred to manage the mandibular fractures. Due to the presence of multiple injuries, a conservative treatment of symphyseal fracture was performed. In order to keep the fractured fragments of the mandible close together, the anterior teeth of the lower arch were tied by means of the orthodontic wire. Ten miniscrews were used to improve the anchorage units and also, settling the occlusion by means of light intermaxillary elastics. Following the active treatment, clinical and radiographic analysis showed satisfactory healing without any periodontal involvement of the teeth in the fracture line.

Key Words: Mandibular fracture, miniscrew, orthodontics, trauma

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INTRODUCTION

Sudden deceleration is the most common etiology of aircraft crashes injuries. Human tolerance to deceleration depends upon a number of factors including the duration, magnitude and direction of the internal forces.^[1,2] Age, gender, level of physical fitness and many other personal variables are important components, which usually define the nature of the individual's reaction to this phenomenon. It is well-known that long bones are most susceptible to bending injuries while short bones can withstand stress, but are most affected by crushing. Different kinds of injuries are usually categorized into cranial, spinal, thoracic, abdominal and limb injuries. Among

these categories, cranial injuries are the most common and a major cause of death. Spinal fractures also are present in many cases.^[1]

In general, early surgery for jaw fractures is the optimal treatment when occlusion is a major concern.^[3] Considering other catastrophic and life-threatening medical problems of such patients, the clinicians usually are not allowed to initiate any kind of definitive treatment modalities of maxillomandibular fractures before the time that other major medical problems become under control.^[4] However, early detection and reduction of such fractures may result in improved outcomes. Computerized tomography (CT) scan of the head is often required to identify bony injuries of the skull and detect fracture sites before fixation.^[5] It may also help the clinicians to assess the probability of bleeding in maxillofacial sinuses following skull fractures.

Therefore, if a late treatment of maxillomandibular fractures is initiated, two-phase treatment protocols including surgical re-reduction and fixation of the fractured bones with new osteotomies lines and comprehensive orthodontic therapy usually become

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necessary.^[6] From the clinical standpoint, the ability to keep the fractured bony segments in a correct location is an essential ingredient of successful management of post-traumatized patients, whether the treatment is initiated early or late. Malunion, non-union and infections are of the greatest concern in assessing and evaluating the treatment in fractures of mandible.^[7,8]

Intermaxillary fixation (IMF) with or without osteosynthesis, open reduction, internal fixation, resorbable plates, lag screws, poly lactide miniplates, miniscrews, bioresorbable or conventional metal osteofixation devices are examples of different methods used to treat fractures in mandible.^[9-13] IMF with archbars or looped wires following open reduction had been widely used to treat fractures in the mandible. Manipulation of these appliances takes time and might have negative effects on nutrition, hygiene of patients and also, limit the normal functional movements, which are needed especially in condylar fractures to prevent temporomandibular joint ankylosis.^[14] Recently, the use of IMF screws instead of wire fixations has been proposed as a quick and easy method, particularly for patients with mutilated dentitions.^[15] Applications of the IMF screw; however, has its own potential complications including screw loosening, soft-tissue injuries and tooth root damages and does not remove the need for open reduction of the fractured bony segments.^[16,17] Considering these limitations, it seems that a mixture of direct bonding techniques with miniscrew-assisted orthodontic appliances may simplify the IMF procedures and overcome the necessity of surgical reductions in traumatized patients. This report presents a case of a conservative multidisciplinary treatment of a young patient with maxillofacial trauma who sustained serious injuries in a plane crash.

CASE REPORT

Diagnosis

Iran Air Flight 277 was a domestic passenger flight that crashed on January 9, 2011 during the final approach in poor weather conditions (snow and low visibility) to Urmia Airport, West Azarbaijan province, in Northwestern Iran. The accident occurred at around 19:45 local time, near a lake. The aircraft broke into multiple pieces; although, there was no fire or explosion. A total of 93 passengers and 12 crew members were on board. 77 people were killed and 26 were injured. Rescue efforts were complicated by heavy snow in the area (http://en.wikipedia.org/wik/Iran_Air_Flight_277).

A 25-year-old female crash victim with multiple head injuries (skull fracture and two fractures in mandible), leg injuries (broken left leg), abdominal injuries (ruptured liver), spinal fractures, head contusion in left temporal lobe (CT scan revealed edema and hematoma) and other injuries was referred to Urmia Imam Khomeini Education and Treatment Center and was incubated for 2 weeks until her hemodynamic, low blood pressure and pneumonia got under control.

All emergency procedures such as abdominal surgery for suturing liver and orthopedic treatment were applied. Thoracolumbar external splint for spinal fractures was used. One month after the accident, patient was referred to oral and maxillofacial surgery clinic to manage the maxillofacial traumatic injuries. Clinical examinations revealed the injuries included multiple complicated and uncomplicated teeth fractures on the upper left and lower right segments with the loss of coronal tooth structure. Clinical and radiographic maxillofacial examination revealed two bony fractures, one complete fracture at the symphysis and another greenstick fracture at the anterior border of the left ramus in mandible [Figure 1]. Pre-treatment facial photographs indicated that she had an asymmetrical face from the front view, straight profile with competent lips at rest and inadequate gingival tissue on full smile [Figure 2]. The maxillary and mandibular dental midlines were not coincident with the soft tissue facial midline. The dental casts and intraoral examination revealed that she had a bilateral class I molar and canine relationship in centric occlusion, mild upper and moderate lower crowding, 3 mm open bite, no overjet and no Bolton discrepancy. There was no transverse discrepancy. There was no reliable information on the occlusion of patient before accident; however, by reviewing her previous non-academic photographs it seems that she have had a class I skeletal and dental malocclusion. In addition, due to excessive edema and inflammation present at the start of treatment, the range of mandibular movement in eccentric and opening was seriously restricted. The maximum comfortable mouth opening was about 10 mm and 13 mm in the presence of pain. Lateral movements were restricted to about 6 mm at the right and 4 mm at the left side. Protrusive movement was also limited to about 5 mm.

Treatment objectives

The treatment objectives, based on the clinical examination and the radiographic analysis were:

1. To keep the fractured bone in close contact and activating the proper bone remodeling at the line



Figure 1: Computerized tomography scans views of the patient shows mandibular fractures; one complete fracture at the symphysis and another greenstick fracture at the anterior border of the ramus



Figure 2: Pre-treatment intraoral and facial photographs, open-bite occlusion with complicated and uncomplicated crown fractures

of the fracture at the symphysis without any open reduction.

2. To align upper and lower arch.
3. To maintain mandibular function during mastication and regain normal range of motion.
4. To provide an esthetic smile.

Miniscrews insertions and treatment steps

To manage dental problems, pulp vitality and thermal tests of fractured teeth were checked and their corresponding responses were precisely recorded. The periodontal status of all fractured teeth was pre-operatively measured. Radiographs were obtained to rule out root fracture and

confirm the diagnosis during clinical examinations. Fortunately, due to pulp conditions, there was no need for immediate pulp therapy of most of the coronal fractures; therefore, a conservative treatment regimen was undertaken including light-cure composite resin build-ups.

Due to the skull fracture and critical situation of the patient, the decision was made to avoid any invasive surgical procedures. Ten self-tapping Dentaurem miniscrews (1.6 mm diameter, 8 mm length) were placed in upper and lower jaws, just above the mucogingival line [Figures 3 and 4]. The miniscrews were placed under local anesthesia and

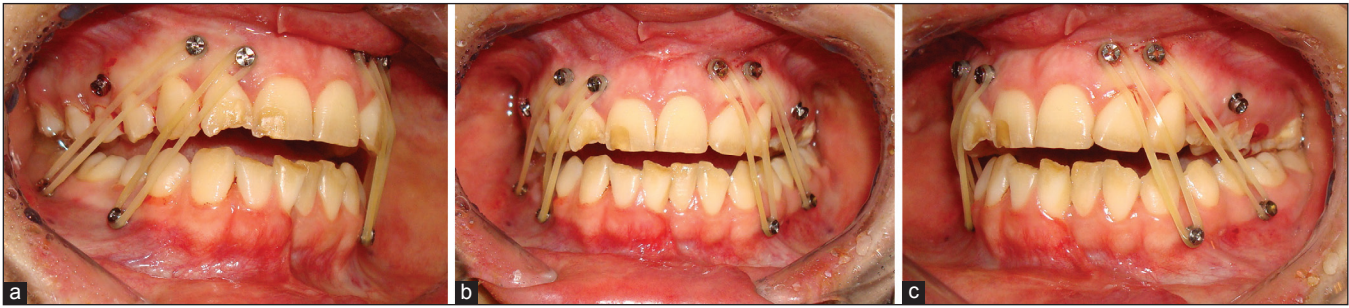


Figure 3: Intraoral photographs of the patient after miniscrew insertion

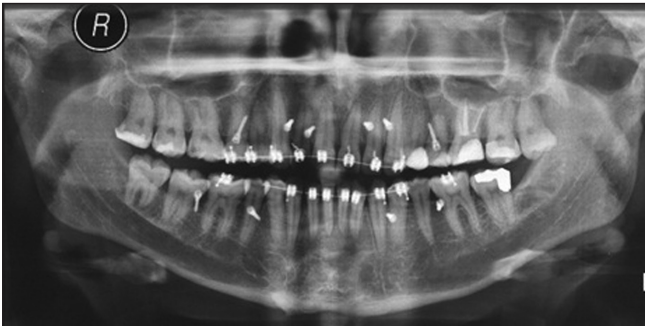


Figure 4: Panoramic view of the miniscrews after initiation of the active treatment

in accordance with the manufacturer's protocol. All miniscrews had a good primary stability, which was assessed intraorally with a tweezer. No healing period was considered and miniscrews were loaded immediately after insertion. Orthodontic brackets (Roth system 0.022 inch) were placed on available teeth surfaces before definite restorative treatment of fractured teeth, to improve the alignment of both arches. Mandibular incisors were ligated together to keep the dentoalveolar close together at the symphysis fracture line. Miniscrews were placed at the lower arch to make a greater anchorage unit for fixation. Fulltime Intraoral elastics (1/4 and 1/8 Medium) from miniscrews and brackets were used to adjust the proper occlusion [Figure 5].

Approximately, 2 months after removal of the multibracket appliance, the miniscrews were removed. After the removal of the fixed appliance, maxillary and mandibular teeth were stabilized by removable Hawley retainers. During the active orthodontic treatment, patient was seen every 4 weeks while home care was emphasized.

Treatment progress

After 8 months, the appliances were removed and definite restorative treatments of remained crown fractures were performed. Correction of the

malocclusion was accomplished with dentoalveolar changes only. In 5 months, class I molar relationship in addition to normal overjet and overbite was obtained, the frontal crowding of both arches was resolved and posterior occlusion had good overall intercuspation. Different types of elastics (triangular or vertical) were used to overcome the open bite tendency of dentition. In addition, smile arc of the upper anterior teeth was enhanced. The lower dental midline was deviated to the left. It was however, decided not fully correct the deviation because of the possibility of the side-effects on the proximity of the two bony segments. The mandibular range of motion was significantly improved to the normal limits. The maximum comfortable mouth opening was about 37 mm at the end of the active treatment, similar to maximum opening in the absence of pain and remained the same during the retention period.

The remarkable skin scar on the forehead disappeared using Cicalfate (Avene) [Figures 6 and 7]. Liver rupture spinal and leg injuries were all successfully treated. The patient's dementia helped her to cope with the state of shock very well. The treatment protocol was fast, safe and easy for patient while her periodontal situation of lower anterior teeth remained healthy [Figure 8]. She was very happy and excited with her treatment following her miraculous survival. She is back to work, but still refuses to get on an airplane.

DISCUSSION

To treat fractures in mandible, IMF with archbars has been generally used. However manipulation of these appliances is painful, takes time and can endanger periodontal health of the remaining teeth.^[14] Direct bonding of orthodontic appliances and using miniscrews simplify the IMF concept and overcome these problems while treatment results, ease of chewing and hygiene



Figure 5: Facial and intraoral photographs of the patient after bonding of upper and lower dentition



Figure 6: Facial and intraoral photographs of the case at the end of the fixed orthodontic treatment



Figure 7: Frontal view of the face before, during, after treatment (from left to right, respectively)

is more favorable.^[16] IMF using IMF bone screw or arch bars provides good reduction and often adequate immobilization of mandibular fractures. However, patients are required to carry wire cutters with them at all times so that they can cut wire or elastics that are placed between the IMF screws or arch bars in case of vomiting that may compromise the airway.^[18]

In order to manage the symphysis fractures, many treatment modalities have been reported in the literature.^[19] The applied technique in this case is to some extent similar to the reported approach of tension band wiring that uses a wire between screws to allow some displacement of the bony segments with muscular force and eliminate the need for precise reduction.^[20] In this case, the tension force was applied by ligating the lower incisors together to keep the bony segments close to each other. The miniscrews were preferred not to be placed exactly near the fracture line in symphysis to prevent any further infection possibilities.^[17,21] The main drawback of this approach is the risk of the movements of the fractured bone segments, so it is recommended to use this clinical approach in hairline fractures with little pre-surgical displacement. This procedure takes advantages of both miniscrew and direct bonding procedures is conservative with regard to soft tissue and eliminates the need for open reduction, which is usually done before fixation. Hence, this method can be used earlier than any alternative methods, which that involve surgical procedures and is beneficial to patients with multiple head and face fractures.^[22] The open bite created following mandibular ramal fracture and symphyseal fracture, was managed with continuous usage of intermaxillary elastics



Figure 8: Periapical radiograph of the lower anterior segment; complete remodeling of the fracture line and slight widening of the periodontal ligament space

from miniscrews and dental brackets with the aim of keeping the new-formed bony callus close to each other in proper position and simplifying the remodeling process of fractured bony fragments. These triangular and box elastics were worn 24 h including eating for the first 2 months and in addition to ligature ties, prevent further movement of the fractured segments. However, facing the usual closed reduction procedures in mandibular fractures, these elastics are usually used temporary (24-72 h) to create suitable reduction of the fractured segments and once adequate reduction is achieved, the surgeons mostly go with the IMF.^[23] This IMF frequently kept for about 1 month to guide the proper healing procedures and has its own disadvantages regarding the nutrition and restriction of the mandibular movements.^[23] The success following the technique presented in this case is significantly based on the extent of the deformity and timing of the treatment intervention.

Another issue in this case was the vitality and periodontal health status of the lower anterior teeth, which was near the line of fractures. It has been reported that if the vitality of the teeth were lost in the pre-surgical stage, the extraction of the teeth would be a logical decision to prevent infection in the fractured bony segments.^[24] However, maintaining the vital teeth in this region might simplify the correct repositioning of the fractured fragments and provides stabilizing effect.^[25,26] Hence, in this case, the periodontal status of these teeth were precisely monitored. The 6 months follow-up periapical radiograph of the anterior segment shows complete healing of the fracture line with the absence of symptomatic periodontal problem. However, some widening of the periodontal ligament space is still present.

CONCLUSION

In brief, the technique described in the present clinical case report may be a useful option to assist IMF in traumatized cases. Taking advantage of immobilization of bony segments by means of ligating the teeth together may remove the need for open reduction and fixation, if this procedure could be done in early callus formation phase although the extent of the deformity and timing of intervention are crucial factors to achieve acceptable results by this technique.

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