sciendo
10.2478/bjdm-2021-0030

BALKAN JOURNAL OF DENTAL MEDICINE

BaSS

ISSN 2335-0245

Treatment of Gunshot-Related Mandibular Fracture with Splint-Guided Reduction: Case Report

SUMMARY

Background/Aim*: Gunshot injury-related mandibular fractures often have a complex pattern, characterized by comminution, bone loss, and soft-tissue avulsion. The management is difficult and varies between individual cases.* ***Case Report****: A 41-year-old male patient presented with marked swelling and ecchymosis in the left mandibular region. Intraorally, he had a deviated open bite on the left side. A unilateral comminuted mandibular fracture was diagnosed by panoramic radiograph and computed tomography. An acrylic dental splint-guided open reduction and internal fixation, including intermaxillary fixation through brackets and intermaxillary elastics, was planned. No complications were observed throughout the healing period, and healing at the fracture site was satisfactory. The occlusion returned to the preinjury position and was stable.* ***Conclusions****: This case report shows that successful functional and esthetic results can be achieved with a strict patient-specific treatment protocol for a comminuted mandibular fracture due to gunshot injury.*

Key words: Acrylic Dental Splint, Bracket, Gunshot Injury, Mandibular Fracture, Open Reduction, Internal Fixation

Demet Kaya[1], Ersoy Konaş[2], İlken Kocadereli[1], Mehmet Emin Mavili[2]

[1] Department of Orthodontics, Faculty of Dentistry, Hacettepe University, Ankara, Turkey
[2] Department of Plastic, Reconstructive and Esthetic Surgery, Faculty of Medicine, Hacettepe University, Ankara, Turkey

CASE REPORT (CR)

Balk J Dent Med, 2021;188-192

Introduction

Mandibular fractures are the most common types of fracture of maxillofacial fractures. They cause both functional and esthetic impairments[1,2] and have different etiologies based on the geographic region, cultural status, lifestyle differences, and socioeconomic status[3,4]. The most frequent etiologies include traffic accidents, violence, gunshots, falls, and work and sport accidents[5,6]. Of these factors, gunshot injury-related mandibular fractures are different from the other related etiologies and often have a complex pattern characterized by comminution, bone loss, and soft-tissue avulsion. The management of gunshot injury-related mandibular fractures varies between individual cases and often presents difficulty for the surgeon. There are risks of both death and infection. A strict patient-specific treatment protocol, including occlusion, should be established. If the occlusion is not treated, the treated fracture may be nonfunctional and have unesthetic results, and a redo surgery may be required. Reestablishment of preinjury occlusion provides accurate positioning of the jaw and anatomical reduction of the fracture[7].

The aim of this case report is to present the treatment of a 41-year-old male patient with a history of mandibular fracture related to a suicide attempt with a gunshot.

Case Report

A 41-year-old male patient with a history of mandibular fracture related to a suicide attempt with a gunshot was referred to the department of orthodontics for occlusal impairment. The patient consulted 8 days after the injury. He had a medical history of diabetes mellitus and psychotic depression. Extraorally, he had marked

swelling, ecchymosis, pain, and tactile sensation on the left side of his face, around the mandible. The projectile had entered under his right mandible and exited from the left cheek. Intraoral examination revealed a deviated open bite starting from the left anterior and extending to the posterior (Figure 1). The maximum mouth opening was 15 mm. Radiological examination showed a comminuted mandibular fracture on the left side and the anterior and posterior cortexes of the mandibular angle were slightly separated (Figure 2).

Figure 1. Extraoral and intraoral photographs taken 8 days after the injury

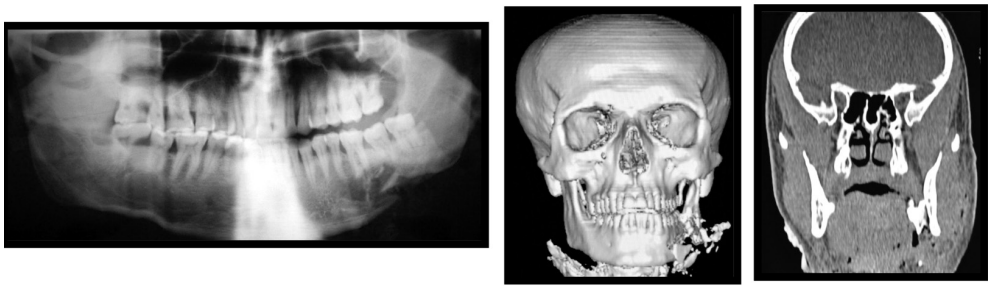

Figure 2. Panoramic radiograph and computed tomography images taken after the injury

An acrylic dental splint (ADS)-guided open reduction with both mini screw and intermaxillary fixation (IMF) using brackets and intermaxillary elastics was planned for the treatment. First, the teeth were rinsed with water and dried on airflow. All teeth from the upper and lower right second premolars to the upper and lower left second premolars were acid-etched with 37% orthophosphoric acid. After the teeth were rinsed and dried again, the primer was applied. Brackets (Roth prescribed, 0.018 inch) were bonded to the teeth with an orthodontic composite resin. A 0.016×0.022 inch-diameter stainless steel wire was bent appropriately to fit into the bracket slot passively and attached to the teeth with ligature wire. Crimpable surgical hooks were placed on the bent arch wires to attach intermaxillary elastics (Figure 3). Following the bonding procedure, dental impressions of both the upper and lower jaws were obtained using alginate impression material and plaster models were prepared. A traditional surgical model set up was performed according to an old photograph showing the preinjury occlusion (Figure 3). An ADS was fabricated so as to establish the preinjury occlusion. Before surgery, the compatibility of the ADS with the upper and lower teeth was confirmed.

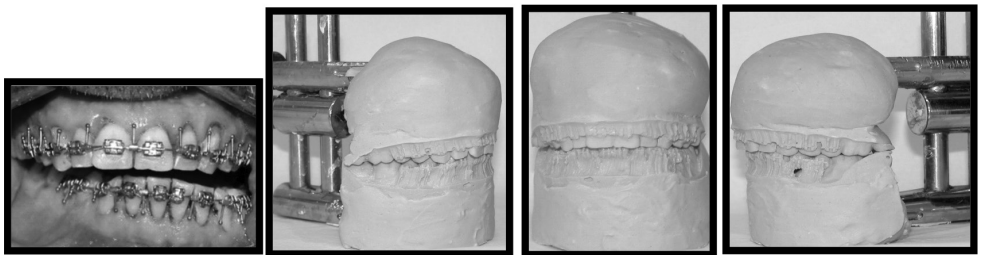

Figure 3. Bracket bonding and surgical model set up before surgery.

Following the presurgical preparation, the fracture segments were reduced with the aid of the ADS, and internal fixation was achieved with four bicortical screws (length 15 mm, diameter 2 mm) under general anesthesia. Two days post-surgery, the ADS was placed into the mouth and IMF was done over the brackets using intermaxillary elastics to guide the mandible. During the IMF period, the patient was set on a liquid diet and was examined weekly. Four weeks after surgery, the IMF device was released, and a few training elastics were retained to ensure the stability of the fracture and occlusion. Then, the elastic force was gradually reduced. He was advised a soft diet and to perform mouth opening-closing exercises.

The patient experienced minimal discomfort during the healing period. No complications were observed. The panoramic radiograph taken 3 months after the injury was normal (Figure 4), and the brackets and arch wires were removed. Healing at the fracture site was satisfactory. The occlusion returned to the preinjury position and was stable. The maximum mouth opening increased from 15 mm to 35 mm (Figure 5).

Figure 4. Panoramic radiograph taken 3 months after surgery

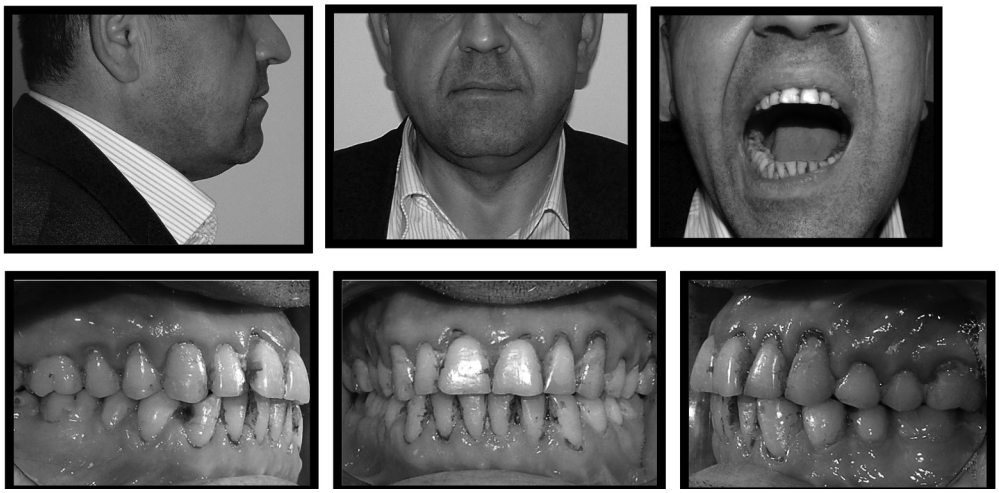

Figure 5. Extraoral and intraoral photographs taken 3 months after surgery

Discussion

Gunshot injury-related mandibular fractures are different from other simpler mandibular fractures. There are often numerous small pieces of comminuted bone and foreign bodies covered with non-vital soft tissue at the wound site. The severity of gunshot injuries to the mandible is dependent on the energy of the projectile (low or high), entrance angle of the projectile, proximity to the anatomic region, and anatomy of the injured region[8-10]. Gunshot injuries occur mostly in males[8,11]. The most common causes of these injuries are interpersonal civilian violence and suicide attempts[12]. The present case was also an attempted suicide with the patient's own handgun while on duty.

As with all fractures, gunshot injury-related mandibular fractures should be treated as soon as they are diagnosed; otherwise, the risk of infection increases as the treatment is postponed. However, immediate treatment of these fractures may not always be possible due to airway problems, hemorrhage, pain, and other issues. In our case, the consultation was made at the department of orthodontics on the eighth day after the injury due to the patient's general condition and high glucose value. Providing care for such patients is difficult for both surgeons and orthodontists as the treatment is challenging. First, it is necessary to analyze in detail how the event occurred so as to propose an appropriate treatment. After stabilizing the patient's vital signs, the treatment steps are removal of foreign bodies and dead tissues in the wound area, reduction of the fracture, and subsequent fixation. Previous studies have proposed different treatment approaches for gunshot injury-related mandibular fractures; these include external fixation, closed reduction with IMF, internal wire fixation, and open reduction and internal fixation with or without IMF[7,11,13-15]. External fixation and closed reduction with IMF have been previously recommended in some studies so as to avoid periosteal stripping and devascularization of the comminuted bony segments in selected patients[13,14].

With advances in technology and increased experience, open reduction and internal fixation have now been advocated in these cases[7,11,14,15]. This has significantly shortened the postoperative healing period[16]. Furthermore, patients treated with open reduction and internal fixation with adjunct IMF have been reported to have lesser complications than those treated with closed reduction with IMF[11,14]. For this case, our surgeons preferred open reduction and internal fixation with bicortical mini screws. The aim of using mini screws was to decrease the infection risk by using less instruments; furthermore, the procedure is technically easier, and the use of a plate would not provide control over the third fragment of the fracture.

Concerns regarding malocclusion after open/closed reduction prompted researchers to include occlusion in the treatment of these patients[7,13,15,17]. In particular for gunshot injury-related mandibular fractures, difficulties in reduction of multisegmented bones during fixation may result in improper fixation, leading to malocclusion and unesthetic results. Furthermore, malocclusion occurring after rigid fixation cannot respond to orthodontic adjustment, which results in additional surgical interventions required to reestablish preinjury occlusion. For the reestablishment of preinjury occlusion splints, orthodontic brackets, and a combination of these have been used in the literature[7,9,15,17]. Cohen *et al*.[17] suggested the use of a splint to reestablish preinjury occlusion and obtained excellent results. Unlike in this case report, they used an arch bar for IMF. In a study on cases with comminuted or complex maxillofacial fractures, Konas *et al.*[7] reported only one case with mild malocclusion after splint-assisted open reduction and internal fixation including IMF through the application of intermaxillary elastics over brackets, and a splint was the leading device overcoming problems related to intraoperative reduction. On the contrary, Peleg and Sawatari stated that 6 out of 30 patients with comminuted mandibular fractures had malocclusion after open reduction and internal fixation in combination with splint use and IMF, resulting in a slightly higher malocclusion rate[9]. This result was likely related to the severity of the fracture and a small sample size. In this case, the occlusion was restored with an ADS and IMF through the application of intermaxillary elastics over brackets. This method has the advantages of providing dental alignment and stabilization and preventing fractured segment from rotation and distraction. The occlusal surface prevents overeruption of teeth[17]. We used brackets for IMF instead of an arch bar, as the latter may damage the gingival and periodontal tissues and requires increased surgical time. On the other hand, IMF through the brackets is both challenging and time-consuming.

At the end of the treatment, we did not encounter any complications in the patient. In contrast to this result, several complications may arise from these injuries such as infection, malocclusion, malunion/nonunion, plate exposure, facial asymmetry, airway obstruction, nerve injury, and sequestration[9,11]. Such fractures require special management to minimize these complications.

Conclusions

Each case with gunshot-related mandibular fracture should be evaluated individually and a treatment plan should be patient-specific, depending on factors such as the general condition of the patient, severity of the fracture, skill of the doctor, and presence of appropriate equipment. An ADS-guided open reduction and internal fixation, including IMF with intermaxillary elastic application over the brackets, provides optimum stabilization and treatment results when the patient is an appropriate candidate.

Acknowledgement: The authors would you like to thank Hacettepe University Technopolis Technology Transfer Center for editing the article

References

1. Elarabi MS, Bataineh AB. Changing pattern and etiology of maxillofacial fractures during the civil uprising in Western Libya. Med Oral Patol Oral Cir Bucal, 2018;23:248-255.
2. Demirdöver C, Geyik A, Yazgan HS, Ozturk FA, Cakmak S, Vayvada H, et al. Epidemiologic analysis and evaluation of complications in 1266 cases with maxillofacial trauma. Turk J Plas Surg, 2018;26:6-11.
3. Boffano P, Kommers SC, Karagozoglu KH, Forouzanfar T. Aetiology of maxillofacial fractures: a review of published studies during the last 30 years. Br J Oral Maxillofac Surg, 2014;52:901-906.
4. Boffano P, Roccia F, Zavattero E, Dediol E, Uglešić V, Kovačič Ž et al. European Maxillofacial Trauma (EURMAT) project: a multicentre and prospective study. J Craniomaxillofac Surg, 2015;43:62-70.
5. Munante-Cardenas JL, Facchina Nunes PH, Passeri LA. Etiology, treatment, and complications of mandibular fractures. J Craniofac Surg, 2015;26:611-615.
6. Gadicherla S, Sasikumar P, Gill SS, Bhagania M, Kamath AT, Pentapati KC. Mandibular Fractures and Associated Factors at a Tertiary Care Hospital. Arch Trauma Res, 2016;5:e30574.
7. Konaş E, Tunçbilek G, Kayikçıoğlu A, Akcan CA, Kocadereli I, Mavili ME. Splint-assisted reduction of comminuted or complex maxillofacial fractures. J Craniofac Surg, 2011;22:1471-1475.
8. Bede SYH, Ismael WK, Al-Assaf D. Characteristics of mandibular injuries caused by bullets and improvised explosive devices: a comparative study. Int J Oral Maxillofac Surg, 2017;46:1271-1275.
9. Peleg M, Sawatari Y. Management of gunshot wounds to the mandible. J Craniofac Surg, 2010;21:1252-1256.

10. Bakardjiev A, Pechalova P. Maxillofacial fractures in Southern Bulgaria - a retrospective study of 1706 cases. J Craniomaxillofac Surg, 2007;35:147-150.
11. Rana M, Warraich R, Rashad A, von See C, Channar KA, Rana M, et al. Management of comminuted but continuous mandible defects after gunshot injuries. Injury, 2014;45:206-211.
12. Norris O, Mehra P, Salama A. Maxillofacial Gunshot Injuries at an Urban Level I Trauma Center—10-Year Analysis. J Oral Maxillofac Surg, 2015;73:1532-1539.
13. Wilkening MW, Patel PA, Gordon CB. External fixation in a low-velocity gunshot wound to the mandible. J Craniofac Surg, 2012;23:e418-419.
14. Ellis E, Muniz O, Anand K. Treatment considerations for comminuted mandibular fractures. J Oral Maxillofac Surg, 2003;61:861-870.
15. Siddiqui SU, Iqbal N, Baig MH, Mehdi H, Mahmood Haider S. Efficacy of open reduction and internal fixation in achieving bony union of comminuted mandibular fractures caused by civilian gunshot injuries. Surgeon ,2020;18:214-218.
16. Alpert B, Tiwana PS, Kushner GM. Management of comminuted fractures of the mandible. Oral Maxillofac Surg Clin North Am, 2009;21:185-192.
17. Cohen SR, Leonard DK, Markowitz BL, Manson PN. Acrylic splints for dental alignment in complex facial injuries. Ann Plast Surg, 1993;31:406-412.

Conflict of Interests: Nothing to declare.

Financial Disclosure Statement: Nothing to declare.

Human Rights Statement: All the procedures on humans were conducted in accordance with the Helsinki Declaration of 1975, as revised 2000. Consent was obtained from the patient/s and approved for the current study by national ethical committee.

Animal Rights Statement: None required.

Received on September 28, 2020.
Revised on November 28, 2020.
Accepted on Jun 20, 2021.

Correspondence:

Demet Kaya
Department of Orthodontics, Faculty of Dentistry
Hacettepe University, Ankara, Turkey
e-mail: ortodem@hotmail.com