

# External mandibular fixation for gunshot fractures: report of 2 cases

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## ABSTRACT

High-energy ballistic injuries may cause comminuted facial fractures. Treatment of such fractures might be challenging because of infection and soft- and hard-tissue loss. These cases may not be amenable to open reduction and internal fixation. We present 2 cases of gunshot fractures, for which external fixation was used as a surgical step before definitive treatment. With the use of external fixation, existing infection had been controlled and soft tissues had been restored, which allowed oral rehabilitation with reconstruction plates and autogenous bone grafting, if needed.

**Keywords:** Comminuted fracture; external fixator; mandible.

## INTRODUCTION

Ballistic facial injuries may happen as a result of intentional or unintentional firearm injuries and industrial accidents.<sup>[1]</sup> They may be classified as either perforating or penetrating.<sup>[2]</sup> Penetrating wounds are caused by missiles of low impact velocity, such as handgun bullets, with a small point of entry leading to the missile being embedded in tissue. Perforating wounds are typically produced by higher velocity bullets, which create an exit wound that is often larger than the entrance.<sup>[3]</sup>

In the treatment of maxillofacial ballistic trauma, several approaches exist. Extent of the ballistic trauma is a key factor for determining which treatment method is the most suitable for each case. Treatment methods include closed reduction, open reduction with internal fixation and external fixation.<sup>[4]</sup> Since closed reduction and open reduction with internal fixation are more frequently used, oral and maxillofacial surgeons are more familiar with these methods than the external fixation method.

External fixation, first described by Lambotte in the 20<sup>th</sup> century for the management of fractures of the limbs and first used by Ginestet for the mandible, still remains as a useful method for the fixation of mandibular fractures.<sup>[5,6]</sup> In case of comminuted fractures, gross infection, large amount of bone and soft-tissue loss external fixation is the gold standard, since open reduction and internal fixation (ORIF) may not be possible. It is also beneficial for intracapsular condyle fractures.<sup>[7]</sup>

Uniphase and biphasic external fixators are used for mandibular fixation. These systems use surgically implanted with percutaneous pins or Kirschner wires and different types of connectors that can be manipulated to optimize the reduction of fractures. They remain in place for 8–10 weeks until second surgery, if needed.<sup>[8]</sup>

The main philosophy of this fixation technique is to prevent disruption of periosteal perfusion of viable bony fragments and achieve primary soft-tissue healing in comminuted and infected trauma cases. The external fixation also creates an

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optimal “time window” for definitive reconstruction.<sup>[9]</sup>

We report treatment of two Libyan civil war fighters with multiple-fragmented gun-shot comminuted mandibular fractures managed with external mandibular fixation and autogenous reconstruction.

## CASE REPORT

### Case 1

A 22-year-old male Libyan civil war fighter was tracheostomized due to massive neck hematoma after sniper shot. The bullet entered from his right cheek and exited from his neck just ventral to carotid system. Hemorrhage had been controlled with local pressure, and the patient was transported to Turkey for trauma management.

Patient's written consent was taken. Clinical examination revealed right eye proptosis due to Horner's syndrome, swelling on the right submandibular area, and the presence of a tracheostomy fistula in the neck (Fig. 1). Exudation was present in the right posterior mandibular sulcus. Computed tomography CT examination revealed multiple comminuted mandibular fractures with the presence of metallic foreign bodies. The teeth in right quadrants were all absent (Fig. 2). Gentamycin and metronidazole were prescribed according to an antibiogram obtained from intraoral culture.

With the cessation of exudation after 5 days, the patient underwent reduction and stabilization of the mandibular fractures using uniphase external fixation system (TST orthopedics, Istanbul, Turkey) under general anesthesia. Intraoral necrotic bony fragments and foreign bodies were removed.



Figure 1. Pre-operative facial view of patient 1

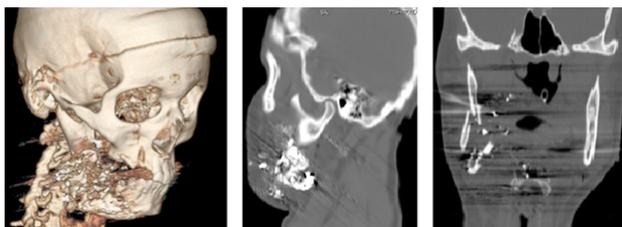


Figure 2. Gunshot fracture, multiple fragmentation is observed

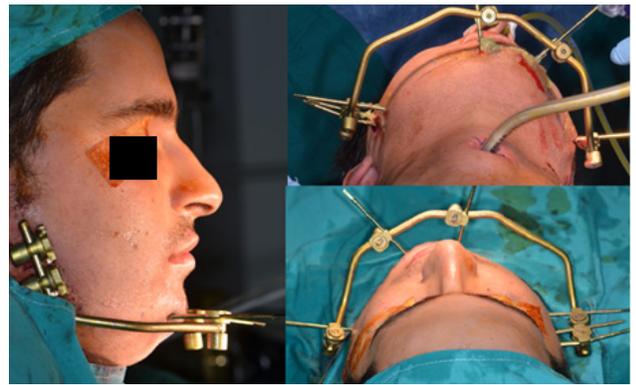


Figure 3. External fixator in situ

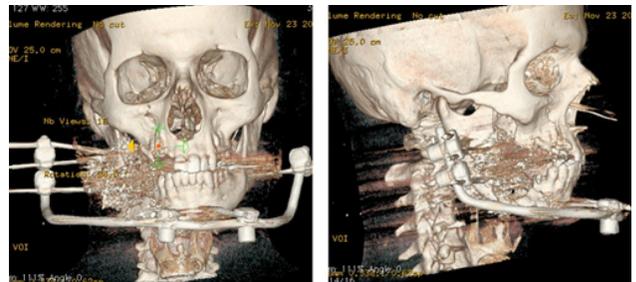


Figure 4. Post-operative 3D images

Occlusion on the left side was established with 4 intermaxillary fixation screws and wires that were removed at the end of the procedure. Stab incisions and trocar were used to drill pin holes. A total of 6 pins were placed. Stable occlusion and sufficient stability of fragments were ensured (Fig. 3). The patient was observed overnight at intensive care unit.

Postoperative CT scan showed good fracture reduction (Fig. 4). Adequate mouth opening was achieved, and occlusion was stable on the left side. The patient received soft-tissue laser therapy to achieve rapid intraoral mucosal healing. Closed fixation and acceptable stability of fracture stumps with external fixator provided rapid resolution of facial edema and optimal intraoral healing.

After 2 months following external fixation, the patient underwent removal of the external fixator and mandibular reconstruction with free autogenous iliac bone graft and 2.7 mm reconstruction plate (Electron Medical, Istanbul, Turkey) (Fig. 5). The postoperative period was uneventful, and the patient was discharged with full intraoral dental rehabilitation including dental implants and full ceramic fixed partially dentures.

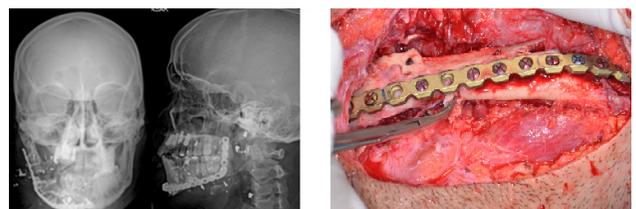


Figure 5. Defect bridging with 2.7 mm profile reconstruction plate and autogenous grafting

## Case 2

A 27-year-old Libyan male fighter, a victim of a bomb explosion, was transferred from the battlefield with airplane to Istanbul for trauma management. He had multiple facial lacerations, comminuted mandibular fracture, and hemorrhage. Hemorrhage was controlled at the battlefield, and he was referred to our hospital for trauma management (Fig. 6).

Patient's written consent was taken. CT scans showed metallic foreign bodies and multiple fragmented comminuted mandibular fracture due to bomb explosion on his left mandible (Fig. 7). Debridement of the oral cavity and primary closure of facial lacerations was performed on the first night at bedside under intravenous sedation.

After 2 days, he underwent reduction and external fixation of mandibular fracture under general anesthesia. Foreign bodies and necrotic bone fragments were removed. Occlusion was established using intermaxillary fixation screws and wires on the right side of mandible, which were removed at the end of the procedure. Four pins were placed on each bone segment with stab incisions or through existing lacerations. The U-bar of the external fixator (TST orthopedics, Istanbul, Turkey) was adapted to the pins placed transcutaneously (Fig. 8). Pin holes and facial lacerations were covered with antibiotic ointment and gauze tampons.

The patient recovered successfully and underwent a second surgery for ORIF at 1.5 months. A 3D model was obtained



Figure 6. Pre-operative facial view of patient 2



Figure 7. 3D and axial CT images of multiple fragmented and comminuted fracture. Foreign metallic bodies were dispersed throughout the face



Figure 8. Soft tissue repair and external fixator in situ. Post-operative 1.5 months photograph

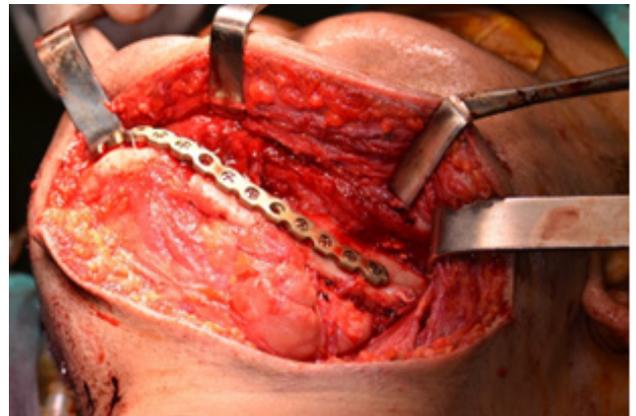


Figure 9. Defect bridging with 2.7 mm profile reconstruction plate

from the CT images and 2.7 mm reconstruction plates were prepared before the surgery. Under general anesthesia, the external fixator was removed and mandibular reconstruction was performed using submandibular approach (Fig. 9). Remaining foreign bodies were removed. There was no need for any grafting procedure because the mandibular basis was about 1 cm and maintained its continuity.

## DISCUSSION

Ballistic wounds are associated with a high incidence of maxillofacial injuries requiring surgical intervention.<sup>[10]</sup> Their causes and patterns differ considerably, which indicate the treatment modality to be used.<sup>[11]</sup> ORIF is the most preferred treatment option of such maxillofacial fractures.<sup>[10,12]</sup> However, external fixation still remains as the gold standard in the management of complex mandibular fractures, especially complicated and comminuted high-energy gunshot fractures.<sup>[13]</sup>

Cases of gross comminution, infection, soft- and hard-tissue loss may not be amenable to ORIF, because this treatment modality requires large periosteal stripping which may impair blood supply, thus leading to nonunion or bone necrosis.<sup>[14]</sup> In such cases, external fixation technique can be used until sufficient bone volume is obtained for internal fixation or bridging of defects for final reconstruction.<sup>[15,16]</sup>

Comminuted mandibular fractures caused by explosive devices are associated with high-infection rates and postoperative complications.<sup>[17]</sup> In cases of excessive infection in soft tissues, incisions on the skin surface may lead to the progression of the existing infection and even further tissue loss. In external fixation technique, small skin incisions are sufficient for the placement of the pins used for stabilization, eliminating these risks.<sup>[18]</sup>

Besides these advantages, external fixation technique has a high complication rate of up to 35%.<sup>[7]</sup> The high complication rate of this technique is explained by the fact that generally it is used for severe cases of comminuted fractures. These complications include post-operative infection, cellulite development around the pins, non-union, malocclusion, and screw loosening. There are also risks of facial vessel damage or inferior alveolar nerve damage in atrophic mandibles. Rarely, mucocele, sialocele, and salivary fistula may develop due to damage to the parotid gland. It has been reported that skin burns may occur if precautions are not taken during drilling procedure or acryl polymerization.

In these presented cases, external fixation technique was used as a first stage surgery for patients' permanent rehabilitation. Patients were ready for advanced grafting and final treatment after 10 days–8 weeks recovery period. During the use of external fixation devices, existing infections regressed and no new infection occurred. During this process, patients maintained good mouth opening, masticatory function, and oral hygiene. Soft-tissue coverage for further grafting procedures was obtained. None of the mentioned complications were observed at any stage of the rehabilitation period.

## Conclusion

Management of traumas to the lower third of the facial skeleton might be challenging. Even though ORIF is the most preferred technique, external fixation is useful and sometimes mandatory in selected cases. Cases of comminution, gross infection, and large amount of tissue loss might benefit from external fixation. Therefore, it is important for all oral and maxillofacial surgeons to have adequate knowledge on this technique.

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OLGU SUNUMU - ÖZ

## Ateşli silah yaralanmalarında eksternal fiksasyon: İki olgu raporu

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Yüksek enerjili balistik yaralanmalar çok parçalı fasiyal kırıklara yol açabilmektedir. Bu kırıkların tedavisi enfeksiyon ve sert ve yumuşak doku kaybı nedeniyle zorlayıcı olabilir. Böyle vakalar açık redüksiyon ve internal tespit için uygun olmayabilir. Bu raporda eksternal fiksasyonun esas tedavi öncesinde cerrahi bir aşama olarak uygulandığı 2 ateşli silah yaralanması vakası sunuldu. Eksternal fiksasyon uygulaması ile var olan enfeksiyon kontrol altına alınmış ve yumuşak dokular tamir edilmiştir. Bu sayede rekonstrüksiyon plakları ve gerekli ise otojen kemik greftleme yardımı ile oral rehabilitasyona uygun ortam sağlanmıştır.

**Anahtar sözcükler:** Çok parçalı kırık; eksternal fiksasyon; silahlı ateş yaralanması.

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