Case Report

Reduction and fixation of comminuted fractures of the midface by using a Hoffman-type external fixator: A case report

Masakatsu Hihara*, Masashi Kihara, Michika Fukui, Toshihito Mitsui, Natsuko Kakudo

Department of Plastic and Reconstructive Surgery, Kansai Medical University, Osaka, Japan

ABSTRACT

Internal fixation using plates remains the gold standard for facial fracture fixation. External wound fixators are rarely used. In the present study, we successfully treated multiple comminuted facial fractures with midfacial depressions by using a Hoffman-type external fixator and achieved good functional and cosmetic results. Internal fixation using plates is sometimes problematic in comminuted facial fractures, such as those associated with high-energy trauma. Depending on the fracture pattern, a Hoffman-type external fixator, which is a single pillar type of external fixator, can be effective.

© 2022 The Authors. Published by Elsevier Ltd on behalf of British Association of Plastic, Reconstructive and Aesthetic Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Introduction

We experienced a case of a patients in whom the use of a single-pillar external fixator was beneficial for treating comminuted facial fractures for which rigid internal fixation was difficult.
Case Presentation

A 44-year-old woman was transported to our hospital for emergency care after a collision while riding in a car. On arrival, she had consciousness impairment. Her vital signs were as follows: blood pressure, 135/88 mmHg; heart rate, 65 beats per minute; and oxygen saturation, 98%. She had persistent oral and nasal bleeding. The midface was flattened. A radiological examination revealed frontal bone fractures, bilateral maxillary and zygomatic fractures, and a naso-orbito-ethmoid (NOE) fracture with midface depression (Figure 1). In addition, the patient also had a traumatic pneumothorax, rib fractures, a right humerus bone fracture, and a right carpal bone fracture. The right orbital cavity was markedly enlarged, accompanied by a ruptured right eyeball. After immediate tracheostomy, while stabilizing the patient’s general condition, we decided to plan an orthognathic repair of multiple crushed facial bone fractures in parallel with treatments such as humerus and carpal bone fracture repair.

Surgical intervention

Because of the crushed NOE and maxillary fractures, it seemed too difficult to repair the fractures by internal fixation with a common miniplate alone. Ten days after the injury, we finally decided to perform a repair with a Hoffman’s external fixator, which is used for extremity fractures. Because of the significant enlargement of the inter-zygomatic process, we first manually tried to shorten the transverse facial diameter. Next, after half pin insertion in the thicker cortical part of the maxilla and zygomatic body, the zygomatic and maxillary bones were guided to improve the enlarged left infraorbital volume and distance between the zygomatic processes, and then cross-linked with a frame (Figure 2). In addition, the minimum number of required titanium miniplates was used as an adjunct to complete repair through an additional bilateral sub-ciliar incision and a right lateral brow incision. After subsequent ruptured enucleation surgery, the external fixator was removed at 4 weeks.

Figure 1. Three-dimensional CT revealed frontal bone fractures, bilateral maxillary and zygomatic fractures, and a naso-orbito-ethmoid (NOE) fracture with midface depression.
Figure 2. After half-pin insertion in the thicker cortical part of the maxilla and zygomatic body, the zygomatic and maxillary bones were guided to improve the enlarged left infraorbital volume and the distance between zygomatic processes, and then cross-linked with a frame.

Figure 3. Three-dimensional CT images during the treatment course. The transverse facial diameter was shortened, and the midspace was reconstructed to nearly its original position.
postoperatively, and aperture training was initiated. Three-dimensional CT images during the course of treatment are shown (Figure 3). At six months after surgery, the patient achieved an incisal distance of 35 mm and can eat food normally without occlusal dysfunction. Although a prosthetic eye has been inserted in the right orbit, the patient has returned to her former occupation (Figure 4).

Discussion

In most cases, internal fixation with miniplates is the gold standard for facial fracture repair; thus, the use of an external fixator is extremely rare. However, external fixators can be indicated even for facial fractures when internal fixation itself is difficult due to the shattered bone fragments or when there is a risk of infection due to the placement of numerous metal miniplates as foreign bodies. The first reason is that in comminuted fractures, the more periosteal dissection aimed at internal fixation is performed, the more the bone loses continuity with the soft tissue and the more the bone fragments are scattered. The second reason is that periosteal dissection reduces blood flow to the free bone fragments and infection and bone absorption are matters of concern.

External fixators can be divided into two types: the ring type, in which multiple pillars support a ring around the affected area, and the single-pillar type, in which the fixator pillar is positioned in one direction above the affected area. We already reported a case of multiple facial fractures treated with a ring-type external fixator using an Ilizarov-type external fixator in 2019. On the other hand, facial bone fracture treatment using a single-pillar external fixator also has a long history. However, the use of single-pillar external fixators is extremely rare, with only a few reports of the application of bone extenders to mandibular fractures in recent years. There are no reports of treatment with a single-pillar external fixator for multiple facial fractures, mainly in the midface.

Hoffman’s external fixator, a single pillar type of external fixator, is simple to operate and has been used for primary fixation of long-tube fractures, mainly in the extremities. It can be applied to
complicated fracture patterns and bone defects, and bone lengthening for pseudo-articular joints, and can also be used with a frame to provide three-dimensional correction.8

Internal fixation with metal miniplates is sometimes difficult in comminuted facial fractures, such as those associated with high-energy trauma, and the use of a single-pillar external wound fixator is extremely useful because it allows for three-dimensional bone fragment reconstruction. In this study, we successfully achieved good functional and cosmetic results using a Hoffman-type external fixator to fix multiple comminuted facial fractures with midfacial depressions. Our present case report is educational because there are no similarly detailed case reports in the literature.

Conclusion

Hoffman’s external fixator, a single-pillar external fixator, may be useful for treating comminuted facial fractures, depending on the fracture pattern.

Funding

None declared.

Ethical approval

Not required.

Informed consent and patient details

Written informed consent was obtained from the patient for the publication of this case report and the accompanying images.

Declaration of Competing Interests

There are no conflicts of interest to declare.

References

1. Sharabi SE, Koshy JC, Thornton JF, Hollier Jr LH. Facial fractures. Plast Reconstr Surg. 2011;127(2):25e–34e.
2. Carvalho PHR, da Hora Sales PH, da Rocha SS, Cavalcanti AMM, de Jesus Rodrigues, Mello M, Junior J. Treatment of comminutive fractures by firearm projectiles with adapted wrist external fixator. Oral Maxillofac Surg. 2019;23(4):501–505.
3. Hihara M, Yagura T, Takegawa M, Kakudo N, Morimoto N, Kusumoto K. A novel fixation method for panfacial fracture using an ilizarov-type external fixator. Trauma Case Rep. 2019;22:100214.
4. Roberts WR. Control of mandibular fragments by external fixation. Br Dent J. 1946;80:257 passim.
5. Alencar MCM, Bortoli MM, Silva T, Silva E, Laureano Filho JR. Suitability of Wrist External Fixator for Treatment of Mandibular Fracture. J Craniomaxillofac Surg. 2018;29(4):e371–e372.
6. Marti-Flich L, Schlund M, Raoul G, Maes JM, Ferri J, Wojcik T, et al. Twenty-four years of experience in management of complex mandibular fractures with low cost, custom-made mandibular external fixation: A 65-patient series. J Stomatol Oral Maxillofac Surg. 2020;121(3):242–247.
7. Deininger C, Hofmann V, Necchi M, Deininger S, Wichlas F. Off-Label Treatment for Severe Craniofacial Fractures in Low-Income Countries-A Novel Operation Method with the External Face Fixator. J Clin Med. 2022;11(6).
8. Schund F, Andrianne Y, Burny F. Treatment of forearm fractures by Hoffman external fixation. A study of 93 patients. Clin Orthop Relat Res. 1991(266):197–204.