An Alternative Route for Entrapped Inferior Orbital Nerve in Orbital Floor Fracture

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Abstract

Keywords

- ▶ orbital floor fracture
- ▶ infraorbital nerve
- ▶ paresthesia
- ▶ decompression
- ▶ alternative route

Orbital floor fractures pose a grave threat for injury to the infraorbital nerve, resulting in the patient suffering from a disturbing paraesthesia. It is challenging for the operating surgeon to release and secure the entrapped nerve with reconstruction of the orbital floor. We present an interesting case of orbital floor fracture with entrapped infraorbital nerve, wherein we have decompressed the nerve and provided it, a new course.

Zygomatico orbital fractures are common among traumatic facial bone fractures due to their prominent position.¹ Orbital floor fractures pose a great threat to infraorbital nerve, causing entrapment and compression. Acute loss of sensory function of the infraorbital nerve follows which may be due to compression, edema, ischemia, or contusion/neurotmesis.^{2,3}

Patients present with paresthesia in the lower eyelid, nasal vestibule, and upper lip. Though paresthesia along the course of the infraorbital nerve is documented, it is a relatively rare phenomenon.^{4,5} The incidence of long-term neurosensory disturbances vary from 10 to 50% in various studies.^{2,6}

The incidence of zygomatico-orbital complex fractures traversing along the infraorbital foramen resulting in persistent paresthesia has been well documented in the past.^{2,7} The most commonly documented cause of such neurological disturbance is due to the impingement of the nerve by fracture segments which have been reduced or fixed inadequately.³ The other most common cause which is cited is due to the formation of fibrous or callus tissue around the infraorbital nerve during the healing phase resulting in nerve compression.^{3–5} Therefore, there is need for decompression of the nerve, fracture reduction, and fixation. Milder nerve injury and early intervention have a better prognosis.⁸

A review of literature provides a very strong evidence and different techniques for decompressing the nerve. However,

the documented outcomes whether successful or not are not reported and individual methods are not documented, which can result in temporary or permanent sensory loss.^{9,10}

Case History

A 70-year-old male patient, Mr. DK, presented to the emergency department, 2 hours after a fall at home and sustaining injury to the right side of face. On assessment, he had right-sided periorbital edema, ecchymosis, tenderness along the right inferior orbital margin and maxilla, and decreased sensation over right cheek and right side of the nose.

The computed tomographic (CT) scan of the maxillofacial region revealed multiple fractures of the following (► **Figs. 1–5**):

- Both nasal bones
- Anterior, medial, and lateral wall of the right maxillary sinus with displaced fragments with hemosinus, fracture line passing through the right infraorbital foramen
- Lateral wall of right orbit
- Right zygomatic process

It also showed a large malar hematoma, stranding of the right facial tissues, and preseptal hematoma with the globe contents of normal CT attenuation and normal orbital muscles.

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Fig. 1 Pre-op CT.

The patient was posted for surgical intervention under general anesthesia. Approach was through right subciliary and gingivobuccal sulcus incision (► **Figs. 6–8**). The intra-operative findings revealed a tripod fracture (frontozygomatic, maxillary buttress, and infraorbital arch) with orbital floor fracture and a big hematoma. The fracture line on the orbital floor was overlying the infraorbital nerve canal. The

Fig. 3 Pre-op CT.

Fig. 2 Pre-op CT.

Fig. 4 Pre-op CT.

Fig. 5 Line diagram showing the line of fracture including the infraorbital foramen.

inferior orbital nerve was trapped in the fracture fragments. The hematoma was evacuated and the orbital floor contents were cleared (►Fig. 6).

The fracture was dissected, and the infraorbital nerve was released from the fracture site involving the foramen. Here, a neurosurgical instrument, bayonnette with upcut, was used to nibble away the floor of the orbit overlying the infraorbital nerve, thus exposing the nerve in its entire length for decompression (►Figs. 5–9, and 10). It must be emphasized at this point that, if the fracture is involving the orbital fissure, the dissection can be continued posterolaterally to decompress the infraorbital nerve totally. Care must be exercised while retracting the globe away from the orbital floor and to ensure that the dissection is always performed in subperiosteal plane. The infraorbital nerve is then carefully brought into the orbital cavity from the canal, made to traverse along the orbital floor, and brought out of the orbit above the infraorbital rim, thus providing an alternative route (►Figs. 9–11). The maxillary buttress was fixed with a four-holed L-

shaped, 1.5-mm titanium miniplate (►Fig. 12) and the infraorbital fracture with a five-holed infraorbital titanium miniplate (►Fig. 13). The orbital floor was reinforced with a semicircular shaped, double folded on itself, Prolene mesh of size 4 cm × 3 cm. A “V”-shaped gap was created in the mesh for the nerve to pass through and lie over the mesh without any tension (►Figs. 9–13, and 14).

Postoperatively, the patient was assessed and followed up for complications, but he had no complications (►Figs. 15–17). The paresthesia due to the nerve injury resolved completely in 3 months (►Figs. 18–22). The fixation was stable (►Figs. 22 and 23).

Discussion

Most of the orbital floor fractures lie across the infraorbital foramen and canal.¹¹ The frequency of association with infraorbital nerve injury has been reported by Sakavicius et al⁸ as 64.4% and by Schilli as 95%.¹²

Fig. 6 Subciliary approach showing hematoma.

Fig. 7 Subciliary approach showing the fracture.

Fig. 8 Intraoral approach.

Infraorbital Nerve Anatomy

The infraorbital nerve is a branch of the maxillary nerve, given off in the pterygopalatine fossa, which then enters the infraorbital canal along with the artery and vein and exits through the infraorbital foramen (→ **Figs. 24** and **25**). It has four branches: inferior palpebral, external nasal, internal nasal, and superior labial.¹³

The artery lies superomedially and is interwoven with three to eight fascicles of the infraorbital nerve. The vein lies in the loose connective tissue sheath and is inferior to it.

The distance between infraorbital margin and foramen is 12 mm maximum and 3 mm minimum, while the distance between the infraorbital foramen and pyriform aperture is 22 mm maximum and 12 mm minimum¹⁴ (→ **Fig. 25**).

Variations of infraorbital nerve include the following (→ **Fig. 26**):

Fig. 9 Line diagram showing floor reconstruction by Prolene mesh, decompressed and intraorbitally rerouted infraorbital nerve and osteosynthesis of infraorbital margin fracture.

Fig. 10 Rerouted infraorbital nerve intraorbitally.

Fig. 11 Rerouted infraorbital nerve.

Fig. 14 Orbital floor reconstruction with Prolene mesh.

Fig. 12 Zygomaticomaxillary buttress fixation.

1. A bifurcated nerve running in two separate osseous canals and emerging out of two separate infraorbital foramina.¹⁵
2. The nerve may run in a canal (complete roof present) or canal plus groove.

Fig. 13 Fabricated Prolene mesh.

3. The foramen may be oval, round, or semilunar.
4. There may be accessory or supernumerary infraorbital foramina. Kazkayasi et al found them to be doubled in 5%, tripled in 5%, and more than three times in 0.3%.¹⁶

Surgical Management of Orbital Floor Fractures

Indications for surgical intervention are as follows:

1. Enophthalmos of more than 2 mm at any time during first 6 weeks
2. Diplopia persisting for more than 2 weeks
3. Large orbital floor defect of 1 cm² and above
4. Significant hypoglobus

The resulting paresthesia when the nerve is entrapped or compressed is an indication for immediate intervention. The usual method is to release the entrapped nerve, replace it in the canal, and reconstruct the orbital floor.¹²

Fig. 15 Early post-op.

Fig. 16 Early post-op.

Fig. 18 Late post-op.

The approaches could be subtarsal, subciliary, transconjunctival, and upper gingivobuccal sulcus incisions. Kotrashetti et al have described a modified technique to transpose infraorbital nerve into orbital floor, wherein they have approached the fracture through gingivobuccal sulcus incision while we have used subciliary and gingivobuccal sulcus

incision for our surgical approach.¹⁷ However, gingivobuccal sulcus incision is not sufficient in cases where the fracture is comminuted, involving the posterior floor of the orbit or in cases where the decompression of infraorbital nerve from the canal is planned as is in our case.^{10,17,18} The graft used for repair of the floor of orbit is autologous membranous bone,

Fig. 17 Late post-op.

Fig. 19 Good eye movements.

Fig. 20 Late post-op.

Fig. 22 Post-op image.

Fig. 21 Late post-op.

Fig. 23 Post-op image.

Fig. 24 Normal anatomy of infraorbital nerve.

cartilage, iliac bone, split rib, or fascia lata. Alloplastic materials can also be used, such as titanium mesh or polypropylene mesh.¹⁹

Chronic neurosensory disturbance is a common postoperative problem experienced by the patients who have undergone open reduction and internal fixation of zygomatic-orbital and orbital floor fractures.^{2,5,6} In comminuted fractures of the orbital floor fractures involving the posterior area

Fig. 25 Normal anatomy of infraorbital nerve.

and posterolateral area of orbital fissure, the entrapped infraorbital nerve blocks the operative area and prevents visualization of the fracture site. If the operating surgeon is inexperienced or careless, rough dissection can cause bleeding due to rupture of orbital branch of infraorbital artery. These problems can restrict the operating surgeon in manipulation around the nerve resulting in incomplete reduction of orbital floor fractures.^{9,10,18,20} Suboptimal reduction and fixation of fracture can in turn lead to restriction of ocular movements due to the remaining entrapped periorbital tissue and enophthalmos postoperatively.¹⁰

Although various methods have been tried to avoid these residual symptoms, satisfactory results have not been achieved. Some studies even advocate a secondary corrective surgery in such patients.^{5,9,20}

Fig. 26 Positions of the infraorbital nerve.

Our case has a varied method of management of entrapped infraorbital nerve compared with other studies.^{1,12} In this situation, sacrificing the nerve or leaving it entrapped would result in lifelong paresthesia for the patient. Hence, we came up with the innovative idea of allowing the canal to open onto the orbital floor, thus communicating with the orbital cavity. The entrapped nerve was rerouted from its original path and the orbital floor was reinforced with a double-folded Prolene mesh (→Figs. 9 and 10). Postoperative follow-up showed excellent recovery of the desensitized areas, thus favoring the new route as a good alternative for the entrapped nerve. There was no difficulty in reducing the fracture after decompression and rerouting of the infraorbital nerve.

Conclusion

Since fractures of the zygomatico-orbital complex are common, varied clinical presentations are encountered. Therefore, it becomes necessary to attempt newer techniques in surgical modalities to achieve a good result in unusual clinical situations. We found that the entrapped infraorbital nerve can have its course altered to traverse along the orbital floor and yet achieve a good result, with respect to nerve regeneration and recovery from paresthesia. Hence, we recommend that intraoperative decompression and rerouting intraorbitally should be considered especially in cases of zygomatico-orbital and orbital floor fractures involving the infraorbital nerve and the foramen.

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