Journal of Plastic, Reconstructive & Aesthetic Surgery (2015) 68, 219—225

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Persistent diplopia after fractures involving the orbit related to nerve injury

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Received 10 June 2014; accepted 21 October 2014

KEYWORDS
Facial fractures;
Long-term follow-up;
Sequelae;
Diplopia;
Nerve injury

Summary *Background:* Fractures in the facial skeleton are common and may lead to orbital sequelae caused by the injury and/or the surgery. In this long-term follow-up, we examined the nature of sequelae after facial fractures involving the orbit and whether a higher complexity of the fractures produced more sequelae compared to simpler fracture patterns, and if so, to what extent.
Methods: Patients surgically treated for facial fractures involving the orbit at the Karolinska University Hospital with a follow-up duration of ≥3 years were included in this retrospective study and were examined by a neuro-ophthalmologist. Based on the location and severity of the fractures, the patients were divided into four groups according to fracture complexity: 1) isolated zygomatic fracture, 2) isolated orbital floor blowout fracture, 3) zygomatic fracture combined with blowout fracture and 4) bilateral or multiple fracture patterns.
Results: Out of 154 patients, 81 patients (53%) attended follow-up examinations, 65 male (80%) and 16 female (20%). The duration of follow-up was 3.0—7.6 years (mean of 4.9 years). The incidence of diplopia was 3.7%, visual loss 2.5%, dystopia 4.9% and visible enophthalmos (>2 mm) 8.6%. Severe diplopia (2.5%) was due to nerve injuries. Visual loss was encountered only in group 4 with complex fractures. Fracture complexity had an effect on the presence of any sequelae, with group 4 presenting a higher percentage of patients with sequelae than the other three groups. However, no statistically significant effect of group could be found on

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http://dx.doi.org/10.1016/j.bjps.2014.10.040
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the individual, quantitative output values of dystopia and enophthalmos.
Conclusions: In this study, severe persistent diplopia in patients was due to nerve injuries, which emphasizes the need for preoperative ophthalmologic examinations, in all patients with fractures involving the orbit. A higher fracture complexity was found to lead to a higher percentage of patients presenting sequelae.
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Introduction

Facial fractures are common, especially among young males, with traffic accidents, sports and assault[1–6] being the main causes of injury. The treatment has improved markedly after the introduction of mini- and microplates instead of wires.[7] Open reduction and internal fixation (ORIF) with titanium plates and screws as described by Gruss, Manson, Rohrich and Hammer is the standard treatment in most trauma centres today.[1,8–11]

Even when fractures are reduced and fixated to an anatomical position, there may be sequelae caused by the injury, for example, diplopia, visual loss, dystopia, enophthalmos, scarring, soft tissue affection and sensory disturbances.[1–6,12,13] Additionally, surgery in itself may cause sequelae, for example, scarring, ectropion, scleral show, nerve injuries[1,5,8,9,14–16] and, although exceptional, blindness.[17,18] Persistent diplopia has been attributed to non-anatomical reconstructions of the orbit as well as injury to the intraorbital musculature.[1,6,13] However, neuro-ophthalmological causes have not been well studied in the literature related to facial fractures.

At the Stockholm Craniofacial Center of the Karolinska University Hospital, we used ORIF in dislocated facial fractures with the exception of isolated zygomatic arch fractures. During the period studied, initially, a subtarsal and thereafter a subciliary incision were used to visualize the infraorbital margin, the zygoma and the orbital floor. Depending on the fracture, this was combined with an incision in the upper lid and/or in the oral sulcus. In complex fractures, a bicoronal incision was used when needed. For orbital floor blowout fractures, we used porous polyethylene implants to reconstruct the orbit. All patients were examined with a post-operative computed tomographic (CT) scan to confirm the reduction of the fractures to enable reoperation if there was insufficient reduction.

The aim of this study was to evaluate the long-term result after ORIF in facial fractures involving the orbit with regard to objective parameters such as diplopia, vision, dystopia and enophthalmos. Furthermore, we wanted to study whether or not more complex fractures involving the orbit led to more or different ophthalmologic sequelae.

Methods

A total of 167 patients treated for facial fractures involving the orbit between 1998 and 2004 met the criteria for inclusion in this retrospective study. Patients with isolated frontal sinus fractures and isolated zygomatic arch fractures were excluded. The duration of follow-up was $\geq$3 years from surgery as there is most likely no more improvement in nerve function after 2 years. The study has been approved by the Stockholm ethical board with approval number 2013/517-31/2.

Depending on the location and severity of the fractures, the patients were divided into four groups:

1. Isolated zygomatic fracture.
2. Isolated orbital floor blowout fracture.
3. Zygomatic fracture combined with blowout fracture.
4. Bilateral or multiple fracture patterns.

Orbital symptoms at admission were reviewed from medical records. Diplopia in extreme gaze only was considered mild; diplopia in more than one direction was considered moderate, whereas diplopia in all directions and/or primary gaze was considered severe. Minor retinal bleedings, Berlin's oedema or bleeding in the anterior chamber with no major visual loss was considered as affected vision. A visual acuity of finger count (1 m) or less was considered as visual loss. Visible enophthalmos or proptosis ($>$2 mm) was also registered.

Examinations

A senior neuro-ophthalmologist (S.P.M.) examined eye movement/diplopia, vision, dystopia and enophthalmos. If the patient had affected eye movements with diplopia, he or she was further examined with Lee's screen. Vision was examined with a standardized screen, with correction for refraction when needed. Visual acuity between 0.8 and 1.0 or better, with or without correction for refraction, was considered normal. Lower vision was accepted if this was due to other ophthalmologic diseases such as cataract and glaucoma not associated to the trauma. Enophthalmos was measured with a Hertel exophthalmometer. Dystopia was measured with a ruler.

Data extraction and analysis

The initial data were extracted from medical records by M.F. and revised by E.N. These data and the examination data were imported into an Excel spreadsheet by M.F. and revised by E.N. Orbital symptoms at admission were extracted from medical records and also imported into the Excel spreadsheet by E.N. All judgements regarding the degree of symptoms and sequelae were carried out by E.N.

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