Reconstruction of Post-traumatic Internal Orbital Wall Defects with Titanium Mesh

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Abstract

Introduction The management of orbital injuries is one of the most interesting and difficult areas in facial trauma. The improper reconstruction of the orbit frequently results in ophthalmic complications. Though a number of materials are available for use in orbital wall reconstruction, at present titanium mesh could be considered to be the ideal orbital floor repair material.

Materials and Methods The study involved patients with symptomatic zygomatico-orbital fractures requiring orbital wall reconstruction. Under general anaesthesia the floor of orbit was explored and reconstructed with contoured titanium mesh after repositioning of the entrapped orbital contents. The patients were on periodic follow-up for 6 weeks where clinical and radiographic data were recorded.

Result Ten male patients age ranging from 22 to 53 years (mean 29.88 years) received titanium implants for impure orbital fractures (eight patients) and pure orbital floor fractures (two patients). The main cause of fractures was road traffic accidents. They also complained of enophthalmos ($n = 7$), diplopia ($n = 4$), infraorbital nerve paresthesia ($n = 6$), dystopia ($n = 1$) and epiphora ($n = 2$). No implant extrusion or infection was seen. The symptoms were corrected in six patients with enophthalmos, three with diplopia, four with infraorbital nerve paresthesia and all patients with epiphora. Dystopia persisted post-surgically in one patient.

Conclusion Titanium orbital implants were used to confirm titanium as a useful repair material for orbital floor

fractures. Their use leads to less morbidity as no donor site operation is needed. Also it provides favourable healing as it is biocompatible.

Keywords Orbital blowout · Titanium mesh · Diplopia · Orbital floor fractures

Introduction

The management of orbital injuries is one of the most interesting and difficult areas in facial trauma. The consequences of an orbital injury are dramatic. They vary from loss of vision, diplopia, loss of an eye, epiphora, a disturbing loss of facial sensation to an unsightly and unacceptable appearance of the eye and the hard and soft tissues around it. These injuries demand careful attention to detail but they are often underestimated and undertreated [1].

Damage to the walls themselves can cause disorders such as diplopia, enophthalmos, and much less frequently vertical dystopia. It is therefore mandatory to reconstruct the orbital walls with the same care one invests in repair of orbital rims [2].

A host of materials have been used to reconstruct the internal orbit. We did a prospective study for the management of post-traumatic orbital internal wall defects with titanium mesh implants to provide long term chemically inert, biocompatible material which can replace autogenous bone grafts. The demerits include the need for a donor site and its complications.

Patients and Methods

Ten patients (ten male patients between 22 and 53 years of age) with internal orbital wall fractures were randomly

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selected and treated in our institution after obtaining ethical clearance between 2009 to 2011. The study involved patients with symptomatic zygomatico-orbital fractures requiring orbital wall reconstruction.

Patients presented with orthoptic symptoms including diplopia, dystopia, and enophthalmos or other associated symptoms like nerve paresthesia or epiphora.

All patients were operated under general anaesthesia given through a nasendotracheal tube.

All patients were evaluated by the ophthalmologist for errors in vision, presence of diplopia, enophthalmos or dystopia and a thorough clinical history was recorded. Routine presurgical blood investigations and radiographs or CT (computed tomography) scans were obtained.

Diplopia charting was done clinically in all nine cardinal positions of gaze pre-operatively and post-operatively.

Following thorough skin preparation with betadine and spirit, tarsorrhaphy was done for the eyelid and infraorbital incision was placed in all cases and fracture site exposed. The entrapped orbital tissues were repositioned and walls reconstructed using cut and contoured 0.4 mm titanium mesh [SYNTHES MatrixNEURO Mesh Plate, contourable, Pure Titanium]. The mesh was fixed to the infraorbital rim using 2 mm titanium screws to ensure graft stability.

The surgical skin defect was closed primarily in layers taking care to prevent any tension across suture line.

All patients were evaluated for the correction of their preoperative complaints through clinical and radiological tests for a period of 6 weeks. Coronal CT scans with 3D reconstruction was done in all cases postoperatively following reconstruction (Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9).

Results

The main aim of the investigation was to evaluate clinically the efficiency of use of titanium mesh used for reconstruction of orbital floor post traumatically.

In our study the most common mode of injury causing orbital wall fractures were associated with road traffic accidents (50 %), followed by self fall (37.5 %).

Majority of fractures involving orbit were caused by indirect forces associated with fractures of zygomatico maxillary complex with 80 % of the study sample being orbital fracture of impure type and two patients with pure orbital blow out fractures. Minimum time lapse between trauma and surgery was 5 days and maximum period was 26 days.

Our study showed no cases with infection of the surgical site. None of cases showed any other complications associated with use of alloplastic materials like implant migration, extrusion of implant or hypersensitivity. Epiphora was noted in two patients (20 %) preoperatively on fractured side which resolved considerably over the period of 2 weeks. None of the patients complained of epiphora upto 6 weeks following surgery.

Our study showed correction of diplopia in 87.5 % of patients. Persistence of double vision was only noted in one patient in extreme upward gaze, this error in the vision did not affect the patient's day to day activities.

Enophthalmos was seen in 70 % of patients included in the study preoperatively. Correction of enophthalmos was seen in 87.5 % of our patients, on the 6th week following surgery only one patient showed signs of enophthalmos.

Fig. 1 Case 1 pre-operative and post-operative profile view

Fig. 2 Case 1 pre-operative and postoperative worm eye view

Fig. 3 Case 1 before and after intraoperative reconstruction

Fig. 4 Case 1 preoperative and 1 post-operative radiographs

Though the possibility of late post-operative enophthalmos is a possible sequale, all our patients were reviewed after 1 year and did not show any signs of enophthalmos to date.

Dystopia was present in one patient (12.5 %) preoperatively which persisted after surgery. The patient presented with severe impure blowout fracture with comminuted ZMC fracture. The extent of the injury to the ZMC region with loss of bone could be thought to be a reason for persistence of hypoglobus in the present study.

In our study 60 % of the patients reported numbness over the infraorbital and lateral part of the nose following trauma. Patients showed considerable improvement over time and 50 % of patients involved in the study had no complaints of paresthesia over 6 weeks of surgery.

None of our cases showed any obvious entrapment of the orbital muscles on surgical exposure. Though orbital

connective tissue and fat were noticed to be entrapped in the fracture site none of the cases showed any obvious restriction of globe movement.

Discussion

The orbital floor is most vulnerable to fracture because of thinness of the maxillary roof, existence of the infraorbital canal and curvature of the floor. Immediately behind the orbital rim, the floor is concave, whereas further back, it becomes convex and is called posterior ledge or bulge, where the bony structure becomes thicker and less deformed in the orbital floor fracture. [3].

Reconstruction of this posterior bulge or retrobulbar bulge by proper contouring of the titanium mesh before insertion

Fig. 5 Case 1 post-operative 3D reconstruction scan

into the defect has to be strictly followed to ensure that the antero-posterior globe position is maintained after reconstruction (Fig. 10). Failure to achieve this step during surgery could result in late post-operative enophthalmos.

There has been extensive debate over the standard of care of orbital floor and wall fractures. Recommendations of treatment range from exploration to observation. Clinical indicators such as muscular entrapment or incarceration, persistent diplopia, infraorbital nerve paresthesia, potentiation of the oculocardiac reflex, enophthalmos, hypoglobus, severe orbital emphysema, as well as various radiographic

criteria have all been proposed as indications for surgical intervention. Of these, entrapment, diplopia, and hypoglobus, with or without enophthalmos, seem to be the most common clinical signs for surgical intervention [4].

The ideal material for orbital reconstruction remains controversial. It should be cheap, biocompatible, readily available, easy to manipulate and insert in the operating room and it should allow fixation to the host bone by screws, wire, or sutures.

The more elastic materials are unable to withstand the dynamic stresses of large defects. Resorbable implants may be prone to foreign-body reaction, implant exposure, and having only fibrinous connective tissue remains after resorption. The disadvantages of autologous bone grafts include minimal contourability and a donor site defect. In addition, implant resorption can occur.

High complication rates have been reported in use of some alloplastic materials [5–8].

Our study showed excellent biocompatibility with no post surgical infection with use of titanium mesh.

Our study shows excellent results in correction of post traumatic orthoptic problems with titanium mesh for orbital floor fractures. Only one patient showed persistence of double vision at the end of 6 weeks following reconstruction in only extreme upward gaze. Some alloplastic materials like porous polyethylene implants have shown persistence of diplopia in 25–30 % of patients [5, 9].

Correction of enophthalmos yielded excellent results with titanium mesh with 87.5 % of the test sample showing resolution of the symptoms. One patient who showed persistent enophthalmos presented with extensive injury (panfacial trauma) to surrounding bony structures with loss

Fig. 6 Case 2 preoperative and post-operative profile view

Fig. 7 Case 2 pre preoperative and post-operative worm eye view

Fig. 8 Case 2 before and after intraoperative reconstruction

Fig. 9 Case 2 preoperative and post-operative coronal CT scans

Fig. 10 Reconstruction done with contoured titanium mesh

of bony architecture. At the 6th week following surgery there was significant improvement in globe position and volume with mild persistent enophthalmos compared to the uninjured eye. Extensive injury could be postulated to be the reason for difficulty to correct the globe volume satisfactorily.

Numbness over the skin in the infraorbital region was noticed in 60 % of the patients which was seen to persist over a period of 2 weeks following surgery and slowly resolved over 6 weeks with 50 % of patients showing no symptoms of paresthesia.

Conclusion

Titanium mesh has a long track record of reconstruction of large orbital floor defects and correction of globe

malposition. Care has to be taken in reconstruction of the retrobulbar bulge with titanium mesh by adequate contouring of the mesh in this critical area to ensure proper globe position.

Some advantages of titanium mesh plates are availability, biocompatibility, easy intraoperative contouring, and rigid fixation. Disadvantages are difficulties with ease of insertion. Any rough edges on the mesh tend to catch on prolapsed orbital fat. Removal of the titanium mesh after the healing period is challenging due to scar tissue that grows through the mesh perforations.

This study highlights the ability of the alloplastic mesh to satisfactorily correct post traumatic orbital sequelae including enophthalmos and diplopia.

Titanium mesh can be considered to be the ideal orbital floor repair material.

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