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ORIGINAL ARTICLE

Correction of Post-Traumatic Enophthalmos by Orbital Floor Reconstruction with Titanium Mesh

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ABSTRACT

Aim: To see the efficacy of titanium mesh in orbital floor reconstruction to correct the post-traumatic enophthalmos in orbito-zygomatic complex fractures.
Methods: This retrospective study was carried out in the department of Oral and Maxillofacial Surgery, University College of Medicine & Dentistry, University of Lahore, Pakistan from January 2017 to January 2020. All patients who had enophthalmos after orbito-zygomatic fractures and were treated for orbital floor reconstruction with titanium mesh were included in the study. Computer tomography (CT scan) was done to diagnose and measure the orbital floor defect. Pre-operative and post-operative hertalex ophthalmometry was done to measure and compare the enophthalmos.
Results: Among the 30 patients, 23 were male and 7 were female. The mean age of the patients was 30±5.80 years. Fourteen patients had right and 16 patients had left side orbitozygomatic complex fracture. The mean orbital floor defect size was 1.72±0.78 cm preoperatively measured by CT scan. There was a correction of enophthalmos in 23 patients out of 30(76.66%).
Conclusion: Titanium mesh is a commonly used and easily available material for the correction of orbital floor defects. It is efficacious in terms of the correction of post-traumatic enophthalmos resulting from orbito-zygomatic complex fracture.
Keywords: Enophthalmos, titanium mesh, orbitozygomatic fractures

INTRODUCTION

Zygoma is the most prominent bone of the middle face and it forms the orbital floor and the lateral wall of the orbit. Due to its prominence, the chances of its fractures are very high approximately 40% of all craniofacial trauma[1]. In Pakistan, the frequency of orbitozygomatic complex fractures is quite high and is associated with other facial fractures[2]. Etiology is usually road traffic accidents, interpersonal violence, falls, and sports injuries. A displaced orbitozygomatic complex fracture involves the fracture of the orbital floor, inferior orbital rim, frontozygomatic suture, zygomatico-maxillary buttress with or without zygomatic arch.

Ocular findings and injuries are relatively common complications of orbito-zygomatic complex fracturesranging from 2.7 to 90%[3]. The signs and symptoms of orbital floor fractures include diplopia, enophthalmos, hypoglobus, extraocular muscle entrapment, and infraorbital nerve anesthesia[4,5]. Amongst these diplopia and enophthalmos are the most common and most severe[6]. The main causes of post-traumatic enophthalmos are bony orbital volume expansion, fat herniation into the maxillary antrum, and soft tissue atrophy[7]. Another cause of late enophthalmos is orbital fat atrophy. For correction of enophthalmos and diplopia, the orbital volume should be restored and extraocular muscles entrapment should be released[8].

Enophthalmos is troublesome and it gives poor aesthetics to the patient. Enophthalmos can be measured with Hertel exophthalmometry and CT scans later can measure the increase of orbital volume with accuracy.An increase in 1cm^3 of orbital volume causes 0.8 mm of enophthalmos[9].

Standard views for the diagnosis of orbitozygomatic complex fractures are occipitomental and submentovertical[10]. To have a better understanding of the nature and extent of the orbit fracture, measurement of orbital volume, and planning the surgical plan, coronal and axial slices of computed tomography are helpful[11].

Reconstruction of the orbital walls and floor defects can be done with: autografts, xenografts, allografts, metallic and nonmetallic materials, alloplastic bone substitutes with varying degrees of success[12]. However, the optimal materials and methods to use, are still controversial[13]. Titanium mesh has advantages of stability, easily contour able according to the anatomy of the orbit, and readily available material in the market. Disadvantages are that it is not cost-effective, foreign body reaction, and in case of infection second-time surgery under general anesthesia is needed.

The goal of this study was to assess the correction of enophthalmos in patients treated with orbital floor reconstruction with titanium mesh after fractures of orbito-zygomatic complex.

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MATERIAL AND METHODS

This is a retrospective study carried out in the Department of Oral and Maxillofacial Surgery, University College of Medicine & Dentistry, University of Lahore, Pakistan from January 2017 to January 2020 after ethical board approval. A total of 30 patients were included in this study that went for open reduction internal fixation and orbital floor reconstruction with titanium mesh under general anesthesia for their post-traumatic enophthalmos after the orbitozygomatic fractures. Orbital floor reconstructions after the tumor ablation surgeries were excluded. Patients with bilateral orbital floor defects were also excluded as it was difficult to compare the reconstructed orbital volume in these patients having no control. Fixation of the zygomatic bone was done with miniplates at three points (zygomaticomaxillary buttress, infraorbital rim, and frontozygomatic suture) and orbital floor defects were reconstructed titanium mesh. The diagnosis of enophthalmos was established by hertalex ophthalometery clinically and confirmed by the CT scan. Enophthalmos was checked at follow-up visits, on 1st, 3rd and 6th weeks clinically by hertalex ophthalmometery. Immediate CT scan was done postoperatively to assess the reduction of fractures.

RESULTS

There were 23 male and 7 female patients in this study.The mean age of patients was 30±5.80 SD years with a minimum of 19 years and a maximum of 40 years of age. Fourteen patients had right and 16 patients had left side orbitozygomatic complex fracture. Twenty-five patients (83.33%) have orbital floor fractures dueto road traffic accidents, three patients (10%) had interpersonal violence and two patients (6.66%) had a fall history. The maximum and minimum orbital defect was 2.5cm 0.94cm respectively. The patient's mean orbital floor defect size was 1.72±0.78 cm.

Table 1 describes the correction of enophthalmos at different intervals during the follow-up. At the 6th week of follow-up, enophthalmos was corrected in 23 patients (76.66%) out of 30 patients. Other seven patients accepted the results (esthetics) which were still far better than their post-traumatic deformity. Post-operative enophthalmos was clinically measured by the hertalex ophthalmometry and was compared with the unaffected side. The value of hertalex ophthalmometry on the unaffected side of the same patient was the cutoff value to decide the presence or absence of enophthalmosIf the measured value by hertalex ophthalmometry on the affected side was the same as on the unaffected side, we labeled it as “Absent exophthalmos” and if there was a discrepancy of value on both sides we labeled it as Enophthalmos present.

Table 1: Follow up visit

Enophthalmos	1st week	3rd week	6th week
Present	5	7	7
Absent	25	23	23
Total	30	30	30

DISCUSSION

In literature, there are controversies about the best material for orbital floor reconstruction[13]. Ideal material should have properties of coiling resistance, easily molding ability, deformation-resistant, and biocompatible. For achieving the pre-traumatic shape of the orbital floor, the reconstructionmaterial should have the property of mold-ability in three dimensions to correct the orbital volume. There is not any signal material available that is successful in restoring the orbital volume without complications.

Enophthalmos is a troublesome sequel of the displaced orbitozygomatic complex. Kwamoto et al 1982 reported that displace malar bone is the most common cause of enophthalmos and our results parallel this study because we face enophthalmos in every patient as a symptom of orbital floor fracture.[14]In our study, the age range of most of the patients was 20 to 30 years. Males were more as compared to females and it is consistent with previous studies.The study carried by Tong et Al. showed that in their study male gender predominates[15]. In 2007, Jaquieryet et al. conducted a study on seventy-two patients, and out of these sixty-five were male[16]. In another study carried by Sakakibara et al in 2009 male gender predominates[17]. In our society males are the dominant earning hand of the families so they are more prone to accidents, fights, and falls. So the previous studies are consistent with our study in having male predominance.

A. W. Sugar et al (1992) showed that titanium mesh has a good strength even when used with a minimum thickness and the best available biocompatible alloplastic material.[18]This is true in our study titanium mesh is malleable and can easily be placed to produce the contours of orbit. Secondly, it is non-resorbable and can be fixed to the inferior orbital rim so chances of dislodgement can be minimized and do not lose its strength. Sugar et al. showed an infection rate of (10%) i.e. in his series of 10 cases 1 got infected; in our study (10%) i.e. 3 out of 30 patients had to suffer from the infection.We admitted those three patients in the ward and administered intravenous antibiotics and daily washed the wound. Two patients had recovered from infection and in one case we have to trim the exposed plate and assisted the secondary wound healing.

Bachelet et al used custom-made titanium mesh in their patients and had a complication rate of 12% due to the malpositioning of the implant.[19]In our case, the infection was due to loose hardware at the infra orbital margin. We had to remove the loose screws again. Our seven patients (23.33%) out of 30 had still enophthalmos postoperatively. We think the main reason was difficulty in the adaptation of the titanium mesh in these patients. Three of these seven patients also had a medial wall fracture that we didn’t reconstruct. The inability to regain the orbital volume properly might be the second reason.

Ellis and Tan (2003) compared the titanium mesh and calvarial bone graft for reconstruction of the orbital floor and they observed that titanium mesh was easy to adapt according to the defect size as compared to the calvarial bone graft. They suggested both materials could be used successfully.[20]A study by Wahdan et al. concluded that titanium mesh can be used for the larger defects of the orbital floor with fewer chances of infection. They stated that the cost is the only limiting factor in its common use[21].

Lang‘s 1983 report that sunken eye is due to the expansion of orbital cavity, Pfeiffer 1943, Manson et al. 1986 and Cope MR 1999 reported that enophthalmos following trauma is due to the orbital volume enlargement[24].

Lee WT 2009 reported that orbital floor defect of 0.55cm will result in 1mm of posttraumatic enophthalmos, Chen CT 2008 found that with every 1 cm^3 increase of orbital volume 0.8mm of enophthalmos is present and Wang et al. observed that the increase of 1cm^3 orbital volume resulted in 0.89mm of enophthalmos[25]. A.W.Sugar et al 1992 suggested that titanium mesh is a useful material for the reconstruction of orbital wall and floor defects up to 2.5cm[18] we also had the same experience.

We have studied the titanium mesh reconstruction for orbital floor reconstruction of larger defects that’s the strength of our study. Our study has limitations like limited sample size and uncontrolled variables due to retrospective study. Patients in our study were not preselected or randomized into groups so the future recommendation is to do randomized control trials and compare the titanium mesh with other autologous or synthetic material for reconstruction of the orbital floor. We faced the problem of adaptation of titanium mesh per-operatively so it’sour recommendation to use the custom-made titanium mesh to avoid lengthy surgery time and for having more promising results.

CONCLUSION

Reconstruction of orbital floor defect in orbitozygomatic complex fractures can be done with titanium mesh as its commonly available synthetic material which has good efficacy to correct the post-traumatic enophthalmos.

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