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# Reconstruction of Inferior Orbital Wall Bony Defects: Autogenously Bone Graft Versus Titanium Mesh

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## ABSTRACT

This study was designed to compare our clinical findings on the uses of autogenous bone and cartilage grafts versus titanium mesh implants to repair posttraumatic inferior orbital wall defects.

*Patients and Methods:* Twenty patients, who suffered orbital blow-out fractures as an isolated injury or as a part of multiple facial fractures with defect in the inferior orbital wall, were submitted to inferior orbital wall reconstruction and operated on Al-Hossen, Bab-Elsharia Al-Azhar University and Al-Haram hospitals. Each inferior orbital wall was reconstructed using either an autogenous bone and cartilage grafts or titanium mesh. Computed tomography scans were taken before the operation and at 2 weeks, 6 months and one year postoperative relatively. Follow-up reporting of aesthetic outcomes, patient's satisfaction and functional complications as regard diplopia, enophthalmos, numbness, gaze restrictions, size of bony defect after treatment, bone and cartilage growth, or resorption.

*Results:* Autogenous bone and/or cartilage grafts shows advantages than uses of titanium implant bridging of orbital floor as well as long time of postoperative edema and preorbital fat resorption following the using of titanium mesh especially if the orbital floor is a part of multiple facial bones fractures.

*Conclusion:* Autogenous bone and/or cartilage grafts shows some of cosmetic advantages more than titanium implant bridging of orbital floor reconstruction, but titanium mesh has advantages of availability and easier short procedure without donor site morbidity and bone and/or cartilage grafts thickening or resorption.

**Key Words:** *Orbital bone defects – Bone graft – Titanium mesh.*

## INTRODUCTION

Fracture inferior orbital floor is a common presentation in facial trauma either as isolated blowout or as a part of pan facial fracture. According to the force applied on the globe during the trauma, the more the severity of applied force the more the comminuting fracture, mainly of the orbital floor due to relatively strong bones of orbital roof and lateral wall. Early clinical presentation may be diplopia and lid oedema however periorbital oedema, ecchymosis, subconjunctival hemorrhage, subcutaneous emphysema, infraorbital nerve anaesthesia or hypothesia, dystopia, enophthalmos and damage to the globe should be rolled out during examination. Unfavorable aesthetic and functional outcomes are frequent when it is treated inadequately.

Edema and ecchymosis usually resolve in two up to three weeks but enophthalmos may increase gradually by the time because of the orbital fat degeneration and fibrosis. Normally the eye ball is supported by the inferior suspensory (Lockwood's) ligament, in case this support is compromised, the eye ball is displaced downwards and resultant diplopia and/or cosmetic disfigurement is troublesome **[1]**.

Orbital fractures are managed by different surgical specialties including ophthalmologists, otolaryngologists, plastic and maxillofacial surgeons **[2]** and the fracture patterns vary considerably in their location as well as in their degree of severity **[3]**.

The early functional reconstruction of inferior orbital wall aims to eye ball normal reposition. Autogenously tissues were the first material used to reconstruct the internal orbit **[4]** and has been the gold standard to provide framework for facial skeleton and orbital walls **[5]**. But routine bone grafting is unnecessary, even in large floor defects and titanium mesh implants are a simple and reliable option for orbital floor repair **[6]**. Autogenous bone ensures the re-establishment of bony continuity across the defects and it becomes incorporated into the host as new bone, larger volumes of graft material necessary for complex reconstructions are likely to be better tolerated than equal volumes of alloplastic materials **[1]**. The other advantages of autogenous bone are its relative resistance to infection, lack of host response against the graft and lack of concern for late extrusion [7]. Donor site morbidity, variable graft resorption, and limited ability to contour some types of the bone top the list of disadvantages [7].

## PATIENTS AND METHODS

Twenty patients, who suffered orbital blow-out fractures as an isolated injury or as a part of multiple facial fractures with defect in the inferior orbital wall were divided into two groups (A and B), were submitted to inferior orbital wall reconstruction and operated on Al-Hossen, Bab-Elsharia Al-Azhar University and Al-Haram Hospitals. Each inferior orbital wall was reconstructed using either an autogenous bone, cartilage grafts or titanium mesh. Clinical assessment, ophthalmic and neurosurgery consultation in addition to computed tomography scans were taken before the operation and at 2 weeks, 3, 6 months one year postoperative relatively.

Group (A): Ten patients were submitted for orbital floor reconstruction using autogenous grafts.

| No. of pt. | Age /y | Sex | Cause of trauma | Side | Size of the defect /mm | Associated facial fracture | Associated Inferior orbital rim fractures | Timing of interferences /days | Approaches |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | M | Sports | Lt. | 15 | No | No | 6 | Subciliary |
| 2 | 22 | F | R.T.A | Lt. | 15 | Yeas | Yeas | 10 | Subciliary |
| 3 | 23 | M | Falling from height | Rt. | 17 | Yeas | Yeas | 15 | Through the wound |
| 4 | 25 | M | R.T.A | Lt. | 25 | Yeas | Yeas | 15 | Subciliary |
| 5 | 25 | F | R.T.A | Lt. | 20 | No | No | 14 | Trans-conjunctival |
| 6 | 27 | M | R.T.A | Lt. | 18 | Yeas | Yeas | 13 | Subciliary |
| 7 | 32 | M | R.T.A | Rt. | 25 | No | No | 14 | Subciliary |
| 8 | 38 | M | Fighting | Rt. | 10 | No | No | 7 | Trans-conjunctival |
| 9 | 43 | M | R.T.A | Rt. | 13 | Yeas | Yeas | 14 | Through the wound |
| 10 | 46 | F | R.T.A | Lt. | 10 | No | Yeas | 10 | Infera-orbital |

Group (B): Thirteen orbital floor defects of 10 patients were submitted for orbital floor reconstruction using titanium mesh implant.

| No. of pt. | Age /y | Sex | Cause of trauma | Side | Size of the defect /mm | Associated facial fracture | Associated Inferior orbital rim fractures | Timing of interferences /days | Approaches |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | M | R.T.A | Rt. | 15 | Yeas | Yeas | 10 | Subciliary |
| 2 | 24 | F | R.T.A | Bilateral | Lt. 10 & Rt. 20 | No | Rt. Side | 7 | Lt. Subciliary & Rt. inferaorbital |
| 3 | 24 | F | R.T.A | Rt. | 20 | Yeas | No | 12 | Inferaorbital |
| 4 | 30 | F | R.T.A | Bilateral | Lt. 15 & Rt. 20 | No | Yeas | 14 | Subciliary |
| 5 | 31 | M | Sports | Lt. | 10 | Yeas | No | 8 | Subciliary |
| 6 | 35 | M | R.T.A | Bilateral | Lt. 21 & Rt. 17 | Yeas | Yeas | 7 | Through the wound |
| 7 | 40 | F | Fighting | Rt. | 22 | Yeas | Yeas | 10 | Through the wound |
| 8 | 45 | F | R.T.A | Lt. | 20 | Yeas | Yeas | 12 | Subciliary |
| 9 | 45 | M | Fighting | Lt. | 15 | No | No | 7 | Subciliary |
| 10 | 48 | M | R.T.A | Lt. | 25 | Yeas | Yeas | 9 | Inferaorbital |

A total of 20 patients have 23 orbital floor fractures presented as isolated orbital floor fracture or one of pan facial fractures, only three patients presented with bilateral orbital wall factures were included in our study from June 2009 to March 2014. Twelve patients were males and 8 were females, aged from 19 to 48 years old, the mean age is 33.5. Surgery was performed as ranged from 6 days up to 15 days from the trauma date as possible to allow the serious associated injuries had been managed like as ophthalmic, neurological and orthopedic injuries as well as the swelling to be subsiding and a more accurate examination of the orbit. All patients were presented with more than 1cm and up to 2.5cm orbital floor defect.

*Group (A):* Ten were submitted for orbital floor reconstruction using autogenous bone graft, 6 (60%) cases were reconstructed by graft harvested from Lt. side costochondral ribs, three (30%) from iliac crest bone and one (10%) from calverial bone. All cases treated by autogenous grfts over corrected by 10 to 20% of the defect size.

*Group (B):* Thirteen orbital floor defects of 10 patients were submitted for orbital floor reconstruction using titanium mesh implant (malleable). All titanium meshes were fixed by miniplate and screws into the inferior orbital rim, and the autologus grafts are inserted without. The associated infraorbital wall fractures are reduced and fixed with miniplates and screws. The operations were performed by the same team of plastic surgeons. The patients were evaluated pre-and postoperatively aesthetic outcomes and functional complications as regard diplopia, enophthalmos, numbness, gaze restrictions, postoperative edema, and size of bony defect after treatment, bone overgrowth, and/or resorption. Computed tomography scans were taken before the operation and at 2 weeks, 6 months and one year postoperatively.

## RESULTS

A total of 23 orbital floor reconstruction of 20 patients (12 "60%" males and 8 "40%" females), with an average age of 32.6 years, underwent orbital floor reconstruction using an autologous grafts in 10 orbital floor defects of 10 cases (43.4%) and titanium meshed for orbital floor in 13 (56.6%) orbital floor defects of 10 cases. All patients achieved good cosmetic and functional outcomes, with improvement in enophthalmus in malleable titanium mesh implant and at early postoperative time, there are no great advantages over uses of bone or cartilage grafts.

In group (A) of 10 patients (43.4%) unilateral orbital floor defects treated with autologous grafts reconstruction, 2 patients (20%) presented with cosmetic minimal deformities and asymmetry 3 months postoperative time due to partial iliac bone graft resorption (Figs. 1,2).

Elsewhere in group (B) of 10 patients treated with titanium mesh reconstruction (13 orbital floor defects), 5 patients with 7 (53.8%) orbital floor reconstruction was presented by enophthalmos (periorbital fat resorption) noticed 3 weeks post-operatively and continued up to the end of follow up period (Fig. 3). Three patients with 4 (30.8%) orbital floor reconstruction of titanium mesh re-construction group had residual diplopia postoper-atively that was probably due to orbital muscles entrapments and edema which improved spontane-ously 5 months later. So, there were no significant perioperative, but with long-term follow up some complications of titanium mesh were noted during a mean follow-up of 8 months.

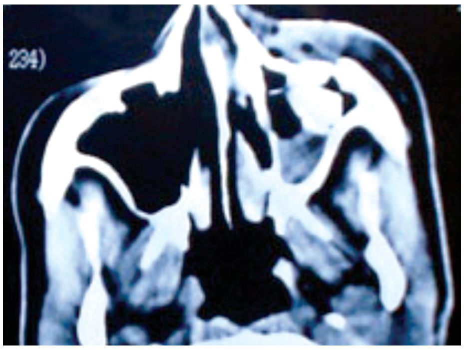


Fig. (1-A): Preop. CT scan axial view.

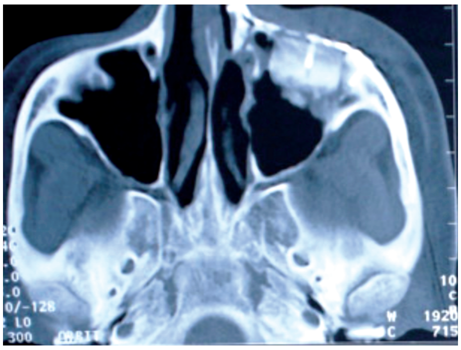

Fig. (1-B): Early Postop. CT scan axial view, (showing iliac bone graft).

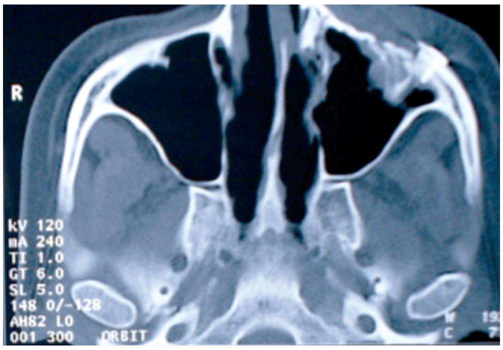


Fig. (1-C): 6 months postop. CT axial view, (showing bone graft in place).

Fig. (1-D): Preoperative.

Fig. (1-E): 8 months postoperative.

Fig. (1): 45 years old female patient presented with Lt. orbital blow out fracture with 20mm inf. orbital wall defect and inf. orbital rim fractures, treated by Lt. side iliac bone graft fixed by miniplates and screws into the reduced rim.


Fig. (2-A): Preop. CT scan coronal view.

Fig. (2-B): 3 moths postop. Coronal CT scan view.

Fig. (2-C): Interaop. Showing the rt. Orbital floor defect and comminution, with inferior orbital rim fractures, also the harvested costocondral graft.

Fig. (2-D): Showing the costochondral graft in place with reduction and fixation of the rim by miniplates and screws.

Fig. (2-E): Preoperative Photo.

Fig. (2-F): 9 months postoperative.

Fig. (2): 23 years old male patient presented with posttraumatic Rt. Inf. Orbital rim and floor defect (17mm) treated by costochondral graft with reduction and fixation of the fractured rim by mini plates and screws.

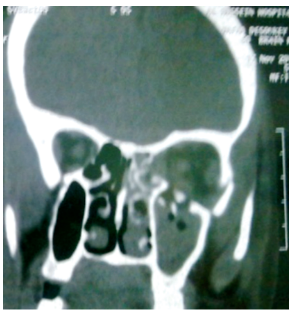

Fig. (3-A): Preop. CT. Coronal view.

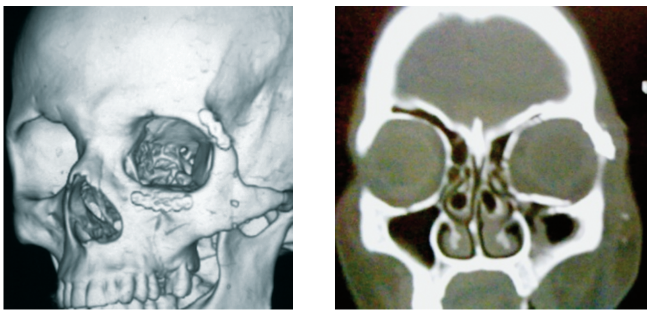

Fig. (3-B): Posop. CT. Coronal and 3D views.

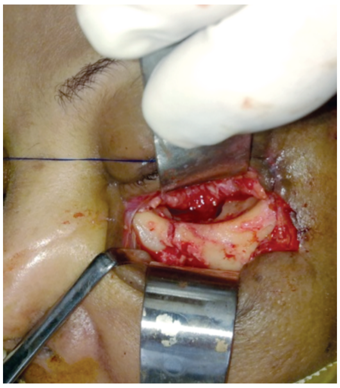

Fig. (3-C): Interaop. exposure of the Lt. inf. orbital wall and floor.

Fig. (3-D): Titanium mesh in place and fixed into reduced orbital rim with miniplates and screws.

Fig. (3-E): Preoperative photo.


Fig. (3-F): 11 months postoperative.

Fig. (3): 45 years old female patient presented with Lt. orbital floor, inferior and lateral walls fractures with floor defect 2cm treated by titanium mesh with reduction and fixation of the orbital walls.

## DISCUSSION

Orbital floor fracture is a serious injury requires functional and aesthetic restoration of the defect. Following the orbital trauma the globe usually does not rupture, and the resultant force is transmitted throughout the orbit causing a fracture of the orbital floor. Signs and symptoms are varied, from one patient to another. It may be asymptomatic with minimal bruising and swelling or functionally affect the globe function and appearance when presented by diplopia, enophthalmos, hypo-ophthalmia, and hypoesthesia of the cheek and upper gum on the affected side. Treatment is titrated to the degree of injury [8].

In all cases, of Cieślik et al., study [9], full improvement was affirmed, and there was no post-operative complication of any type and concluded that maxillary bone graft technique is a good and simple orbital floor reconstruction method. Shortening of surgery time and limitation of operative procedures are advantages of this method.

Our study agrees with that conclusion with more limitation of operative procedure when use titanium mesh implant without any bone graft harvesting. Almost we noticed a some of technical and follow-up superiority of autogenous bone graft over titanium mesh reconstruction, but with titanium mesh no donor morbidity no lengthy operation, no graft possible complications as regard resorption except in 2 cases (20%) or thickening and incidence of diplopia more with other specific complications for titanium implant like (enophthalmus) periorbital fat resorption, and that comes disagree with Al-Sukhun and Lindqvist [10] when they assessed aesthetic and functional outcome of orbital floor reconstruction performed with calvarial bone graft, titanium mesh or prolene mesh and their outcome of surgery with all three materials was satisfactory. Also we are not totally agreed with Al-Sukhun and, Lindqvist who said; no postoperative complications were seen except for mild hypoglobus in a case reconstructed with calvarial graft. Three materials, calvarial graft, titanium mesh, prolene mesh, have the potential to be useful reconstructive materials in orbital floor blowout fractures **[10]**.

Many surgeons are using porous polyethylene (MEDPOR) because of its ease of use (moldable and easily shaped) and its ability to become incorporated in the soft tissue. Its porosity, like other integrated implants such as hydroxyapatite, allows this material to remain firmly fixated in the position that the surgeon places it **[11]**.

But we agree totally with Eran Zunz **[12]** when they concluded that reconstruction of orbital floor fractures after trauma using autologous bone grafts is safe and associated with a low rate of complications, because we find significant difference and less advantages when we used titanium implant, so we believe in their conclusion as regard, combining the appropriate surgical approach with multidisciplinary teamwork results in excellent cosmetic and functional outcomes and allows for efficient and comprehensive postoperative management.

In our study we put the graft when defect is 1-2.5cm to secure better functional reconstruction of the floor, and we think this more adjusting in the reconstruction more than Al-Sukhun and Lindqvist **[10]** work when they used graft or mesh for larger orbital floor defects.

*Conclusion:*

Autogenous bone grafts although it has been the gold standard to provide framework for facial skeleton and orbital walls **[5]**, so it shows more advantage than titanium implant bridging of orbital floor, regardless of titanium mesh availability and easier short procedure without donor morbidity, bone graft thickening or resorption. Despite the relatively high cost of porous polyethylene (MEDPOR) in Egypt, but have advantages over the titanium mesh; its ease of use (moldable and easily shaped) and its ability to become incorporated in the soft tissue.

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