

Mandibular symphysis graft versus iliac cortical graft in reconstructing floor in orbital blow out fracture: A comparative study

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ABSTRACT

Aim: The purpose of this study was to clinically and radiologically assess and compare the outcome of internal orbital reconstruction with an iliac bone graft and mandibular symphysis graft in orbital blow out fractures. **Materials and Methods:** Eight consecutive patients with unilateral orbital blow out fractures were enrolled in this prospective study. CT scan imaging and volumetric assessment of the orbit was done for all patients using GE Discovery VCT Workstation 4.4. Patients with defect of area less than 2 cm² and orbital volume expansion of less than 4.7 cm³ were treated with mandibular symphysis graft, in contrast the others were treated with a medial cortical graft from the anterior ilium. At each follow-up visit, globe posture, diplopia, and eye movements were assessed. Coronal and sagittal computed tomography and volumetric assessment were used to observe graft posture, bone defects and contour. **Results:** Group I cases showed that orbital volume changes of less than 2cm³ can be effectively reduced. Group II cases showed that orbital volume changes of more than 4.5 cm³ could not be effectively restored in spite of using large iliac graft. All eight patients had satisfactory correction of hypoglobus. Diplopia and ocular motility restriction resolved in all affected patients post operatively between 4th day and 2nd week. At 3-month follow-up, computed tomography demonstrated that the middle section of the orbital floor was well elevated in all 8 orbits. All grafts were still *in situ*, with density measured in Hounsfield units revealed that the Mandible Symphyseal graft was denser. **Conclusion:** The mandibular symphysis graft is a good, simple reconstructive option in small orbital floor defects with orbital volume change less than 4.71 ml. In larger defects with huge orbital volume changes that require more volume of graft, iliac graft is useful albeit, perfect, volumetric restoration is not always possible

Keywords: Diplopia, enophthalmos, hypoglobus, orbital blowout, volumetric assessment

INTRODUCTION

Maxillofacial trauma has become the commonly reported casualty in India due to the rising rate of road traffic accidents and acts of interpersonal violence. Orbital fractures represent one of the commonest conditions encountered in maxillofacial trauma, be it the blow out fracture or as part of complex fractures. Blow out fracture results in esthetic deficits including enophthalmos, hypoglobus, dystopia and functional deficit including diplopia, restricted ocular movements and infraorbital nerve paresthesia.^[1]

The goals of reconstruction^[2] of fractures of the orbital floor are to free the incarcerated or prolapsed orbital tissue from the fracture defect and to span the defect with an implant to recover the volume of the orbital cavity and rectify the position of the eyeball. Various authors have advocated the use of autogenous grafts from sites such as calvarium, auricular cartilage, nasoseptal cartilage, anterior wall of maxillary sinus, contralateral coronoid process, mandibular symphysis, rib and ilium. The choice of the graft depends on the size of the defect, location of defect, curvature of orbit in the region, condition of lining sinus and

donor site preference.

Iliac bone is comparable to calvarial bone in the immediate and secondary repair of orbital wall deformities following blow out fracture². Iliac bone is easy to harvest, and the medial cortex of the anterior iliac crest is relatively easy to shape to fit the internal orbital wall.^[2,3,4] Few studies are available concerning immediate reconstruction with iliac bone according to which good aesthetic and functional results can be achieved.

Mandibular symphysis is a reliable intraoral site for harvesting graft, with strong and thick cortical bone available. The site is currently widely used as donor site for grafting in ridge augmentation for dental implant placement. But it has not been widely studied as donor for orbital floor reconstruction. Krishnan V, and Johnson JV (1997)^[5] substantiates the usefulness of Mandibular symphyseal graft for floor defects less than 2 cm diameter. Montazem A (2000)^[2] stated that the average bone volume available from mandibular symphysis is 4.71 ml and 4.84 ml.

The purpose of the present study was to clinically and radiologically assess and compare the outcome of internal orbital reconstruction with an iliac bone graft and mandibular symphysis graft in orbital blow out fractures. This comparative study is first of its kind to compare use of two bone grafts based on orbital volume changes.

MATERIALS AND METHODS

The present study included eight cases (two groups) of orbital blow out fracture with associated Zygomatico-maxillary complex fracture, who reported to the department of Oral and Maxillofacial Surgery in our centre. We treated the orbital floor defects in group I using mandibular symphysis graft (four cases) and group II using iliac cortical graft (four cases).

The inclusion criteria for selection of patients included presence of Impure orbital blowout fracture of floor, enophthalmos, hypoglobus, diplopia, radiological evidence of orbital content herniation in floor defect and mechanical restriction in ocular motility (positive forced duction test).

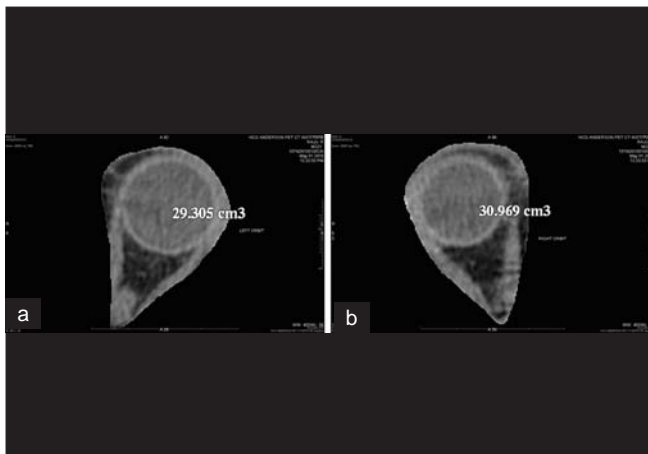


Figure 1: Orbital volume assessment with CT scan volume viewer

The exclusion criteria included systemic conditions contraindicating surgery, generalized bony disorders, optic neuropathy/post-trauma blindness, globe perforation/retinal detachment, affected eye is the only seeing eye and any positive history of fracture in mandible (group I) and pelvis (group II).

All eight patients were male patients in age range of 21-40 years. All cases except for three were treated within 6 weeks of trauma.

Preoperative assessment of the patients was done [Table 1]. Computed Tomography (CT) scan imaging was done for all patients using GE Discovery VCT Workstation 4.4. The area of defect was measured in cm². The volumetric assessment of the orbit was done with the aid of Volume viewer (an installed application) using 0.625-mm sections and measured in cubic centimeter (cm³) [Figure 1]. Patients with defect of area less than 2 cm² and orbital volume expansion of less than 4.7 cm³ were included under group I. The remaining cases with defect greater than 2 cm² and volume expansion more than 4.7 cm³ were included under group II.^[2]

Preoperative assessment

1. Evaluation of the patient included a thorough and detailed history, clinical examination including general examination and ophthalmological examination, facial photographs and radiographical examination [Table 1].
2. CT scan – Coronal, sagittal, axial views
 - 3D reformatted image
 - Area of defect assessment
 - Orbital volume assessment

The orbit was explored through the infraorbital approach or pre existing scar. After repositioning of the orbital content, the graft was placed subperiosteally [Figure 2]. The size of defect was measured using CT scan imaging, and the bone graft harvested from the medial wall of the anterior ilium or mandibular symphysis was trimmed with the drill bit to cover the defect. The graft harvested were corticocancellous bone from ilium by subcrestal window technique^[6,7] [Figure 3] and from mandible symphysis [Figure 4] by postage stamp technique.^[8,9] At the



Figure 2: a) Via infraorbital approach, orbital exploration and reconstruction with the graft done b) Orbital wall and rim fracture reduction and fixation

Table 1: Preoperative assessment

Case/age/sex	Treatment plan	Preoperative findings				
		Diplopia	Enophthalmos	IO nerve Paresthesia	Eyeball restriction	Visual acuity
CASE1 21/M	FLR with MSG	-	+	+	-	6/6
CASE2 19/M	FLR with MSG. Scar revision	-	+	+	-	6/6
CASE3 23/M	FLR with MSG, ORIF for rt. ZMC #	-	+	-	-	6/6
CASE4 28/M	FLR with MSG, ORIF for rt. ZMC #	-	+	+	-	6/6
CASE5 23/M	FLR with ICG, , ORIF for lt. ZMC #	+	+	+	+	6/6
CASE6 25/M	FLR with ICG. Open rhinoplasty, Malar AUG.	+	+	-	+	6/6
CASE7 38/M	FLR with ICG	-	+	-	-	6/6
CASE8 21/M	FLR with ICG, ORIF for rt. ZMC #	+	+	+	-	6/6

FLR - Floor reconstruction, MSG - Mandibular symphyseal graft, ICG - Iliac crest graft, ORIF - Open reduction and internal fixation, ZMC - Zygomaticomaxillary complex, AUG - Augmentation, IO - Infra orbital

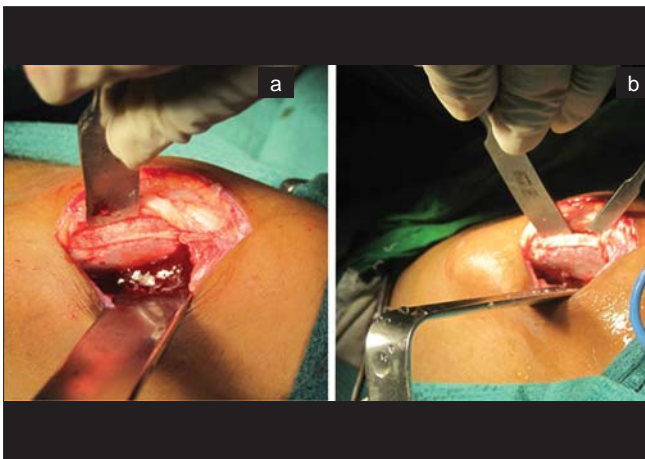


Figure 3: (a, b) Harvesting of corticocancellous graft from anterior iliac fossa by subcrestal window

posterior section and medial wall of the orbit, a stable bone was identified for bony support.^[10] The associated maxillofacial injuries were treated appropriately.

The success of the surgical repair and post operative status was evaluated at periods of 1 week, 1 month, 3 months and 6 months. The reconstruction was evaluated using the following parameters:

- Globe position and facial symmetry
- Diplopia charting
- Graft rejection- follow-up for 3 months
- Post operative extra ocular movements
- Post operative nerve (infra orbital) involvement
- Wound infection/ dehiscence
- Donor site morbidity
- Overall patient satisfaction
- CT-based orbital volume assessment

RESULTS

In the study eight cases of impure orbital blow out fractures were treated by floor reconstruction with autogenous bone grafts from mandibular symphysis [Figure 5] and anterior iliac crest/medial cortex [Figure 6 and 7]. All patients had impure blow out fracture of floor with infraorbital rim fracture, of which four patients had associated zygomaticomaxillary complex fracture. All the orbital

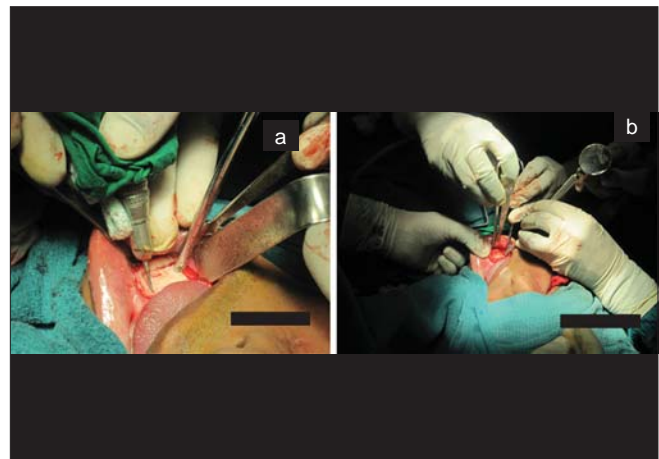


Figure 4: (a, b) Harvesting of graft from mandible symphysis by postage stamp technique

floor fractures except three were treated within 6 weeks of trauma. The three cases included post-traumatic secondary deformities.

All the cases were approached via infraorbital approach/pre-existing scar. The associated maxillofacial injuries like zygomaticomaxillary complex fracture were treated by reduction and fixation using stainless steel miniplate and screws. One case had a scar and contracture of upper eyelid with notching deformity, treated by scar revision.

The results [Table 2] of the CT-based study^[11,12,13] showed that the Orbital volume changes of less than 2cm³ can be effectively reduced (Group I cases). Orbital volume changes of more than 4.5 cm³ could not be effectively restored inspite of using larger iliac graft (Group II). Earlier the volumetric restoration, better was the results. The average density of the graft was higher in group I than group II. This could be a result of inherent high density of the mandibular graft than iliac graft, or the higher resorption of the iliac graft than mandibular graft. This can be confirmed only by further long-term follow-up of the cases.

Postoperative assessment

The success of the surgical repair and postoperative status was evaluated at periods of 1 week, 1 month and 3 months.

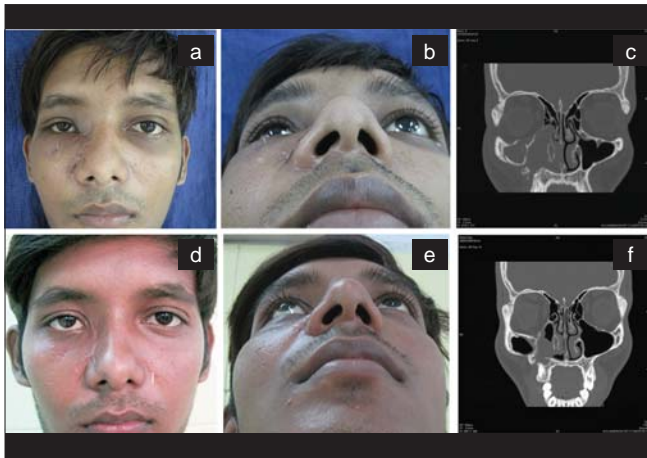


Figure 5: Group I a) -Preoperative view showing right eye with posttraumatic hypoglobus, b) Worms eye view showing enophthalmos, c) Preoperative CT coronal section showing fractured right orbital floor with herniation of orbital contents, d) Postoperative frontal view showing restored globe position with slight overcorrection evident from the scleral show, e) Postoperative worms eye view showing correction of enophthalmos, f) Postoperative CT coronal view showing the graft in-situ restoring normal contour

Globe position and facial symmetry

The patients were assessed for globe position in two planes in frontal plane the success of correction of hypoglobus was assessed using the canthal plane as guideline. All eight patients had satisfactory correction of hypoglobus. The degree of enophthalmos correction was assessed clinically in Worm’s view/ Hertel exophthalmometry (in cases applicable). The same assessment was also done using CT scan axial, coronal and sagittal sections. When compared to preoperative values, except for 2 (cases 7,8) enophthalmos was corrected satisfactorily to less than 1 cm³ difference [Table 2].

Diplopia charting

All patients were assessed for diplopia postoperatively and charted. Preoperatively three patients had symptomatic binocular diplopia. Diplopia resolved in all three patients postoperatively between 4th day and 2nd week. All except 1 (case 8) had diplopia in extreme upward gaze [Table 1].

Graft rejection

In the follow-up period of 3 months there were no signs or symptoms of graft rejection.

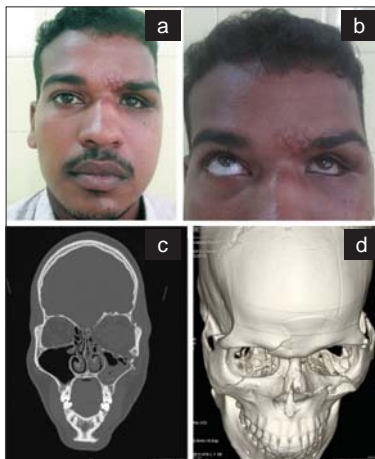


Figure 6: Group II a) preoperative view showing enophthalmos and hypoglobus in left eye, b) Preoperative view showing restricted left eyeball movement in upward gaze, c) Preoperative CT coronal section showing blow out fracture of left orbital floor and lateral wall increasing orbital volume, d) Preoperative 3D CT showing fracture and outward displaced left orbital floor and lateral wall

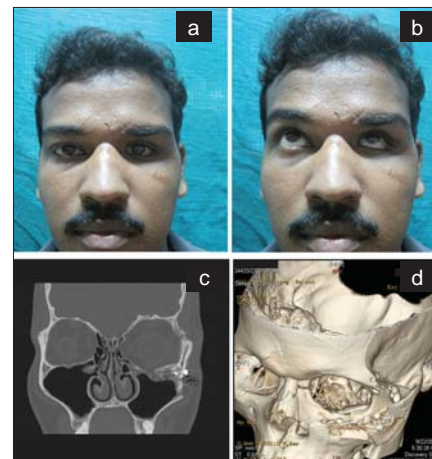


Figure 7: a) Postoperative frontal view showing restored orbital and globe position, b) Postoperative view showing no restriction in globe movement in upward gaze, c) Postoperative view showing graft in situ restoring orbital volume. Note lateral wall fracture has been reduced and fixed, d) Postoperative 3D CT showing restored orbital framework and floor

Table 2: Comparison of the pre and post operative orbital volume changes

Case/age/sex	Unaffected Side OV (cm ³)	Affected Side Preoperative OV (cm ³)	Postoperative OV (cm ³)	Preop OV change (cm ³)	Postop OV change (cm ³)	Graft density (Hounsfield) At 3 months
CASE1 21/M	29.305	30.969	29.517	1.664	0.212	968.29
CASE2 19/M	20.015	23.883	20.772	3.868	0.757	1113.1
CASE3 23/M	22.462	24.333	22.764	1.871	0.302	1281.2
CASE4 28/M	20.348	21.472	20.503	1.124	0.155	1734.5
CASE5 23/M	25.098	30.103	26.227	5.005	1.129	658.79
CASE6 25/M	26.438	31.852	27.728	4.414	1.290	651.36
CASE7 38/M	29.395	34.320	30.624	4.925	1.229	671.0
CASE8 21/M	22.097	27.38	23.494	5.283	1.397	773.2

OV – Orbital volume

Postoperative extraocular movements

Preoperatively two patients had limited ocular movements mainly in upward gaze. Both patients showed improvement in ocular movements postoperatively.

Postoperative nerve (infraorbital) involvement

Preoperatively all except three patients had infraorbital nerve paresthesia. Postoperatively three patients showed gradual improvement between 1st and 4th week. Two patients had persistent infraorbital nerve paresthesia which took 3 months to resolve [Table 1].

Wound infection/ dehiscence

In the 1st postoperative week, wound healing in all surgical sites were satisfactory with no signs of infection or hemorrhage.

Donor site morbidity

Group I: All the patients showed no evidence of mobility, loss of vitality, gingival recession of the lower anterior teeth. Esthetically, no change in chin contour or drooping of chin was noted.

Group II: All the patients showed no evidence of Meralgia paresthesia, hematoma or gait disturbance. All patients became comfortably ambulatory in 48 hours.

Donor sites showed uneventful healing in all eight cases. There was neither aesthetic deformity of chin nor functional deficit of lower limbs/ abdomen.

Overall patient satisfaction

At the follow-up examination none of the patients reported experiencing problems like infection, migration or extrusion of graft, which might have indicated complication. One patient, postoperatively had epiphora for 3 days which resolved spontaneously. All except one patient (case 8) were satisfied with the outcome of the surgery.

DISCUSSION

Iliac crest graft has been established as the gold standard for autogenous bone grafts for orbital floor reconstructions. It can yield enough volume of cortico-cancellous graft for restoring the volume loss of the floor of the orbit.^[3,6] However due to the associated donor site morbidity, necessity for additional training in harvesting and the distance from the surgical site, and its higher resorption rate due to its endochondral origin, an alternative graft site has been sought.

Mandibular symphysis is one of the best donor site for any osseous augmentation or reconstruction of the maxillo-facial skeleton since it is membranous.^[5] It is also closer to the surgical site. However the mandibular symphysis can only yield limited quantity of bone.^[2] Andre Montazem *et al* in their quantitative anatomic study of the mandibular symphysis as a donor site, examined 16 dentate cadaver mandibles. After monocortical osteotomy 5 mm anterior to the mental foramen, superior to the inferior border of the mandible, inferior to the anterior teeth root apices, cortico-cancellous blocks were harvested. The bone volume of the blocks were then quantitatively measured by

displacement volumetry using two methods. The average volumes of the cortico-cancellous grafts were calculated to be between 4.71 mL and 4.84 mL (range, 3.25 to 6.50 mL), respectively, for the 2 techniques of volumetry.^[2]

Due to the absence of similar studies, this single study alone was taken as the benchmark for deciding the donor site based on the volume of the graft required for reconstruction. Mandibular Symphysis was chosen as the donor site for any orbital volumetric change below 4.71 ml. All changes in volume above 4.71 ml were reconstructed using iliac graft.

In order to accurately measure the volume change, a CT based software was utilized. Similar volumetric assessments have been successfully measured by Suuronen *et al*^[11] and Bite *et al*^[12]. There are many other studies where the accuracy of CT volume analysis has been established.^[13,14]

In our study, it was found that the patients who received mandibular symphyseal bone grafts experienced lesser rate of resorption than the ones who underwent iliac bone graft.

The study confirms the theory that membranous bone has less tendency to resorb and therefore is the best choice for reconstruction of orbital volume defects.

CONCLUSIONS

The mandibular symphysis graft is a good, simple reconstructive option in small orbital floor defects with orbital volume change less than 4.71 ml. In larger defects with huge orbital volume changes that require more volume of graft, iliac graft is useful albeit, perfect, volumetric restoration is not always possible. Moreover, enophthalmos of long duration with orbital volume change exceeding 4 cm³ is difficult and unpredictable. These cases require further radiologic follow up to support the higher density and reduced resorption of the membranous bone-mandible symphysis compared to the endochondrally ossified bone-iliac cortical graft.

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