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Case Series

Orbital floor fracture reconstruction using autologous bone graft: its outcome, advantages and disadvantages

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ABSTRACT

Orbital floor fractures are commonly encountered facial injuries requiring precise reconstruction to restore orbital volume and prevent functional and cosmetic sequelae. This retrospective study evaluated the outcomes, advantages, and disadvantages of orbital floor reconstruction using autologous iliac crest bone grafts in 20 patients aged 18 to 60 years, all presenting with unilateral orbital floor fractures involving more than 50% of the floor or associated with diplopia or extraocular muscle entrapment. All patients underwent reconstruction within 14 days of injury. Pre- and postoperative assessments included computed tomography (CT)-based orbital volume calculations, anteroposterior globe positioning, and clinical evaluations of diplopia, infraorbital nerve function, and ocular motility. The mean preoperative orbital volume difference between the fractured and contralateral sides was significantly reduced from 5.1 cm^3 to 0.2 cm^3 postoperatively ($p<0.001$), with correction of enophthalmos achieved in 90% of cases. Diplopia resolved in 6 of 7 patients postoperatively, and infraorbital nerve hypoesthesia showed improvement in the majority. No cases of graft resorption were observed on follow-up imaging, and only one patient experienced mild, self-limiting donor site morbidity. These outcomes demonstrate that iliac crest bone grafting is a reliable and biocompatible option for orbital floor reconstruction, offering excellent anatomical and functional restoration without the complications associated with alloplastic materials. Compared to titanium mesh, previously shown to provide good radiological and clinical results, iliac bone grafts offer the added advantage of biological integration. Given its favourable safety and efficacy profile, iliac crest bone remains a valuable material for complex orbital floor reconstruction.

Keywords: Orbital floor fracture, Iliac crest bone graft, Orbital reconstruction, Autologous bone graft, Enophthalmos, Diplopia, Orbital volume restoration, Muscle entrapment

INTRODUCTION

Orbital floor fractures are among the most frequently encountered facial injuries, typically resulting from blunt trauma such as road traffic accidents, physical assault, or falls. These injuries can lead to a variety of functional and cosmetic complications, including diplopia, enophthalmos, infraorbital nerve hypoesthesia, and limited ocular motility. Proper and timely reconstruction of the orbital floor is essential to restore orbital volume, support the globe, and prevent long-term sequelae.[1,2]

Surgical reconstruction is generally indicated in cases of persistent diplopia, clinically significant enophthalmos (≥2 mm), entrapment of orbital contents, or when more than 50% of the orbital floor is involved radiologically. CT imaging is critical for diagnosis and preoperative planning, allowing precise assessment of orbital volume, fracture size, soft tissue herniation, and globe displacement.[3,4]

A wide array of materials is available for orbital floor repair, including alloplastic implants such as titanium mesh, porous polyethylene, and resorbable polymers, as well as autologous materials like cartilage and bone grafts. Autologous bone remains the gold standard in many settings due to its excellent biocompatibility, osteoconductivity, and structural strength. Unlike synthetic implants, autologous bone grafts have minimal risk of foreign body reaction, infection, or extrusion.[5,6]

The iliac crest is a commonly preferred donor site for autologous bone grafts in orbital reconstruction. It offers an ample quantity of both cortical and cancellous bone, allowing the graft to be shaped precisely to the defect. Its structural strength and biological activity make it especially suitable for large or complex orbital defects.[7,8] However, iliac crest bone graft harvesting can be associated with donor site morbidity, including postoperative pain, gait disturbance, hematoma, and, in rare cases, infection or sensory disturbances.[9,10]

Despite these challenges, iliac crest bone grafting continues to be a reliable and durable method for orbital floor reconstruction. This retrospective study evaluates the clinical and radiological outcomes of orbital blowout fracture reconstruction using iliac crest bone grafts in 20 patients. It specifically focuses on the restoration of orbital volume and globe position as measured by CT imaging, and assesses functional improvements such as resolution of diplopia and recovery of ocular motility. The advantages and disadvantages of this technique, including potential complications, are also critically discussed.

CASE SERIES

This retrospective study was conducted at the department of plastic and reconstructive surgery, a tertiary care centre located in Jaipur, Rajasthan. Medical records from January 2022 to May 2025 were reviewed to identify patients who met the study criteria.

Patients aged between 18 and 60 years with a diagnosis of unilateral orbital floor fracture were considered for inclusion. Eligibility was limited to those who presented with CT evidence of greater than 50% orbital floor involvement, entrapment of orbital soft tissue or extraocular muscles, or the presence of diplopia following trauma. Only patients who had undergone orbital floor reconstruction using autologous iliac crest bone graft and had complete preoperative and postoperative CT imaging available were included. A minimum clinical follow-up period of six months was required. Patients with bilateral orbital fractures, prior orbital surgeries, systemic bone diseases such as osteoporosis/osteogenesis imperfecta, incomplete records/inadequate follow-up were excluded from study.

A total of twenty patients who met the inclusion criteria were enrolled. Demographic and clinical data were collected, including age, gender, aetiology of trauma, side of fracture, time elapsed between injury and surgical intervention, and presenting symptoms. Each patient underwent a detailed preoperative clinical assessment, which included evaluation for diplopia in various gaze positions, assessment of extraocular muscle movement, palpation and sensory testing of the infraorbital nerve distribution, and clinical estimation of enophthalmos when possible, using Hertel exophthalmometry.

Table 1: Demographics and clinical data.

Variables	Value
Mean age (in years)	34.7±9.2
Gender	Male: 14 (70%), female: 6 (30%)
Aetiology of trauma	Road traffic accident: 11 (55%), physical assault: 5 (25%), fall from height: 4 (20%)
Side of fracture	Right: 12 (60%), left: 8 (40%)
Time from injury to surgery	<7 days: 15 (75%) 7-14 days: 5 (25%) >14 days: 0
Presence of diplopia	Yes: 7 (35%), no: 13 (65%)
Muscle entrapment on CT	Present: 5 (25%), absent: 15 (75%)
Infraorbital nerve hypoesthesia	Present: 15 (75%). absent: 5 (25%)
Mean orbital floor defect size (cm²)	2.4±0.6

Radiological assessment was based on high-resolution, non-contrast CT scans of the orbits taken in axial and coronal views with 2 mm slice thickness. Preoperative and postoperative CT scans were analysed to calculate the volume of the orbit on both the fractured and unfractured sides. The orbital volume was measured using semi-automated three-dimensional volumetric reconstruction. Additionally, anteroposterior displacement of the globe was measured on axial CT scans as the distance from the interzygomatic line to the posterior pole of the globe. The size of the fracture, degree of soft tissue herniation, and muscle entrapment were also assessed.

Table 2: Radiological assessment.

Parameters	Pre-op	Post-op	P value
Orbital volume-affected side (cm³)	32.5±2.8	27.6±2.5	<0.001
Orbital volume-unaffected side (cm³)	27.4±2.6	-	-
Orbital volume difference (cm³)	+5.1±1.2	+0.2±0.6	<0.001
Anteroposterior globe displacement (mm)	4.6±1.1	0.8±0.5	<0.001
Muscle entrapment on CT	Present in 5 (25%)	Resolved in 5 (100%)	-
Soft tissue herniation	Present in 20 (100%)	Resolved in 18 (90%)	-

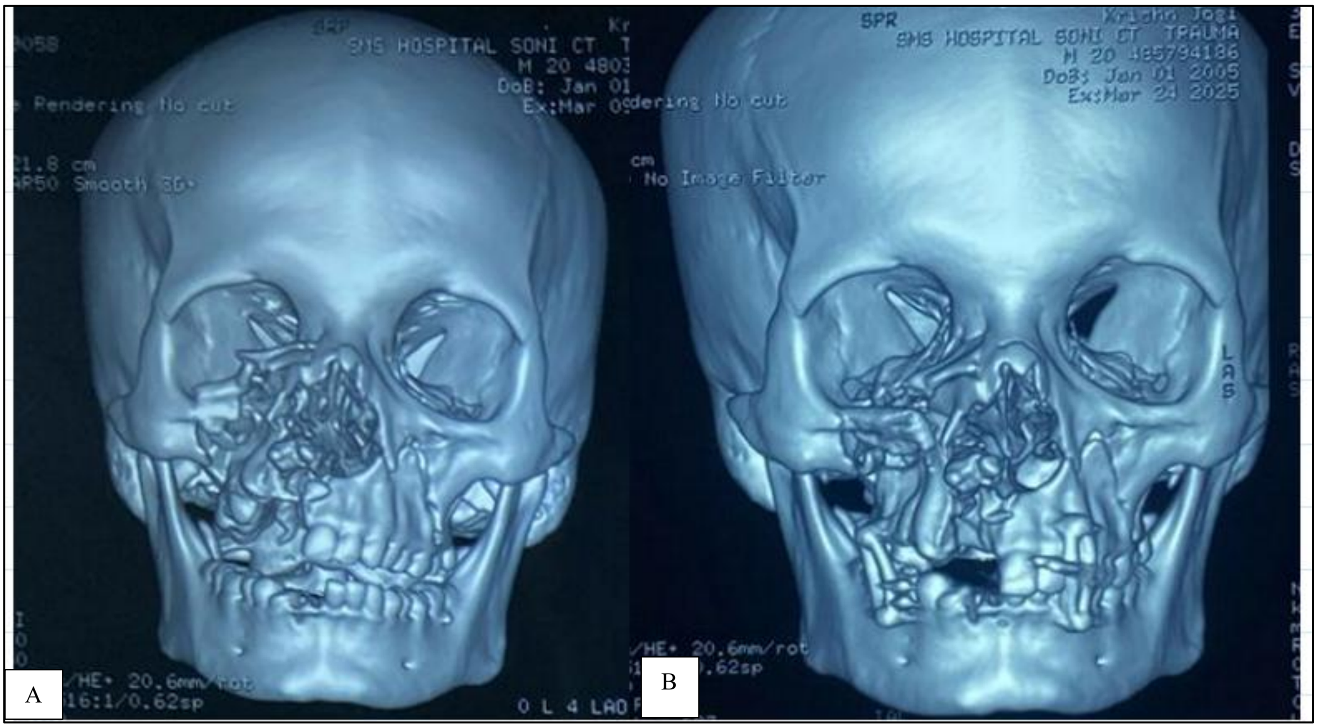

Figure 1 (A and B): Pre (left) and post (right) operative images of a patient who underwent iliac bone graft reconstruction for right orbital floor.

All surgical procedures were performed under general anaesthesia by experienced plastic surgeons. A subciliary approach was selected based on aesthetic and anatomical considerations. After exposure of the orbital floor and careful repositioning of any prolapsed orbital contents, an autologous bone graft was harvested from the anterior iliac crest using a separate sterile field.

The harvested graft was shaped to match the defect and then carefully placed in position to reconstruct the orbital floor. In some cases, the graft was stabilized using resorbable sutures. Closure of both the orbital and donor sites was completed in layers, and appropriate dressings were applied. Postoperatively, patients were managed with antibiotics, corticosteroids, and analgesics according to institutional protocols.

Clinical follow-up was conducted at one week, one month, three months, and six months after surgery. During follow-up visits, patients were evaluated for resolution of diplopia, improvement in ocular motility, restoration of infraorbital nerve sensation, and correction of enophthalmos. Postoperative CT imaging at one week was used to reassess orbital volume and globe position. Any complications, including graft displacement, infection, donor site morbidity, or graft resorption, were documented.

Preoperative and postoperative orbital volumes and anteroposterior globe positions were compared using paired student's t tests. A p value less than 0.05 was considered statistically significant.

Table 3: Clinical outcome.

Outcome parameters	N (%)
Resolution of diplopia	6/7 (85.7)
Persistent diplopia at 6 months	1/7 (14.3)
Improvement in extraocular movement	20 (100)
Correction of enophthalmos	18 (90)
Residual enophthalmos >2 mm	2 (10)
Infraorbital nerve sensation recovery	12/15 (80)
Donor site morbidity	1 (5)
Infection or graft displacement	0 (0)
Graft resorption on imaging	0 (0)

DISCUSSION

Orbital floor fractures are among the most commonly encountered midfacial injuries following blunt trauma and are often associated with complications such as enophthalmos, diplopia, and infraorbital nerve hypoesthesia. Accurate reconstruction of the orbital floor is essential not only to restore facial aesthetics but also to prevent long-term functional deficits. Various materials have been employed for orbital reconstruction, including alloplastic implants, xenografts, and autogenous bone grafts. In this study, we evaluated the efficacy and outcomes of orbital floor reconstruction using autologous iliac crest bone grafts.

Our results indicate that iliac crest bone grafts offer excellent outcomes in restoring orbital volume and correcting enophthalmos. The mean orbital volume difference between the affected and unaffected side reduced from 5.1 cm^3 preoperatively to 0.2 cm^3 postoperatively, which was statistically significant. This aligns with previous literature that emphasizes volume restoration as a crucial determinant in correcting enophthalmos and ensuring globe symmetry.[11,12] Orbital volume discrepancies of more than 2 cm^3 have been associated with clinically significant enophthalmos.[13]

The anteroposterior displacement of the globe also significantly improved postoperatively, reflecting the anatomical realignment achieved through surgical intervention. Clinically, enophthalmos was corrected in 90% of cases, with only 2 patients exhibiting residual depression exceeding 2 mm. These results are comparable to outcomes achieved using titanium mesh and porous polyethylene, although autogenous bone provides the added benefits of biocompatibility and osteointegration without the risks of foreign body reaction or extrusion.[14,15]

Diplopia, commonly due to soft tissue or muscle entrapment, was present in 7 patients preoperatively and resolved in 6 following reconstructions. All patients showed improvement in extraocular movements, confirming the efficacy of anatomical decompression. These findings are consistent with earlier studies showing high rates of diplopia resolution when orbital anatomy is adequately restored.[16]

Autologous iliac crest bone offers several advantages over synthetic materials. Its natural curvature and mechanical strength make it suitable for large floor defects. Additionally, the presence of both cortical and cancellous bone allows for adequate support and integration with surrounding tissues.[17] In our study, no cases of infection, graft displacement, or resorption were observed. The absence of graft resorption on follow-up imaging is particularly noteworthy, as resorption is a concern with costal cartilage and calvarial grafts.[18]

Donor site morbidity is often cited as a drawback of autologous grafting. However, in our series, only one patient (5%) experienced mild postoperative discomfort, which resolved spontaneously. Previous studies have reported similar low complication rates, especially when careful harvesting techniques are employed.[19,20] Compared to calvarial and rib bone harvesting, the iliac crest allows for easier access, better contouring, and lower morbidity, making it a practical and patient-friendly choice.[21]

The study's limitations include its retrospective design and relatively small sample size, which may limit the generalizability of the findings. Furthermore, the lack of a control group using synthetic implants restricts direct comparative analysis. However, the consistent improvement in both radiological and clinical parameters supports the effectiveness of iliac crest bone grafts in orbital floor reconstruction.

The findings of this study complement those reported by Shah and Thakurani, who assessed orbital floor reconstruction using titanium mesh and demonstrated reliable correction of enophthalmos and orbital volume with minimal postoperative complications.[22] While titanium mesh offers the benefits of ease of intraoperative contouring and reduced donor site morbidity, our use of autologous iliac crest bone graft provides the additional advantages of biological compatibility, osteoconductivity, and complete integration into native bone without foreign body risks or graft resorption. Both approaches showed comparable improvements in orbital symmetry and functional outcomes, suggesting that the choice of reconstructive material can be tailored based on defect characteristics, surgeon expertise, and patient-specific factors.

Autologous iliac crest bone grafting is a reliable and effective option for orbital floor reconstruction, especially in cases involving large defects, soft tissue herniation, or muscle entrapment. It offers excellent anatomical and functional outcomes with minimal donor site morbidity and should be considered a valuable alternative to synthetic materials.

CONCLUSION

Orbital floor reconstruction using autologous iliac crest bone graft is a safe, reliable, and effective technique, particularly in cases involving large defects, muscle entrapment, or significant orbital volume loss. Our study demonstrates that this method provides excellent anatomical restoration with significant improvement in enophthalmos, orbital volume symmetry, and ocular function. The absence of graft resorption and minimal donor site morbidity further support its clinical utility.

When compared to other materials, such as titanium mesh, iliac crest grafts offer the unique advantage of biological integration and long-term stability without the risk of foreign body complications. Both techniques yield favorable outcomes, and the choice of reconstructive material should be guided by defect characteristics, availability, and surgeon expertise.

Future prospective studies with larger sample sizes and longer follow-up periods are needed to further validate these findings and to establish clearer guidelines for material selection in orbital floor reconstruction.

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