# MATERIALS FOR ORBITAL FLOOR RECONSTRUCTION POST TRAUMA: A REVIEW LITERATURE

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***ABSTRACT***

***AIM: TO REVIEW THE VARIOUS MATERIALS USED FOR RECONSTRUCTION OF THE ORBIT IN MAXILLOFACIAL TRAUMA CASES.***

***BODY: Orbital bone fractures are in fact very often associated with trauma to the maxillofacial region due to road traffic accidents, assaults, war injuries, resulting in either a blowout fracture or a blow in fracture of the floor, fracture of the lateral wall of orbit, medial wall of orbit, posterior wall of orbit, roof of orbit, infraorbital and supraorbital rim of orbit. These defects cause various forms of morbidity to the patients and thus need to repaired without much complications. There are various materials that have come to be in use in the reconstruction of the orbit which fall into the three main categories of autologous, allogenic and alloplastic materials. We shall in this review literature delve into the deeper aspects of most of the commonly available and some of the newer materials being used, so as to understand the benefits and complications of using them.***

***CONCLUSION: We can conclude that there is no single grafting material which is suitable for all cases every time without any complications. Thus, traditional materials are to be used until a more viable material is found.***

***KEYWORDS: ORBITAL RECONSTRUCTION, ORBIT FRACTURE, GRAFT FOR ORBIT.***

## 1. INTRODUCTION

The maxillofacial region of the face consists of various important structures which are enclosed within the protective maxillofacial skeletal structure. During significant trauma to the maxillofacial region, the orbital bones are very often fractured, which cause a plethora of morbid features, such as decreased intra orbital volume, enophthalmos, exophthalmos, increased intra orbital pressure, optic neuropathy, diplopia, retrobulbar hemorrhage, difficulty in movement of the eyeball, ocular muscle entrapment, formation of fistulae and orbital epithelial cysts. Traditionally orbital wall defects were repaired with autologous bone graft materials. But recent advances in material research has yielded various alloplastic and allogenic reconstructive materials to be used for orbital wall defects. Among allogenic graft materials the most commonly used one is freeze died irradiated bone. Alloplastic materials that are frequently used and which are still in research are of two types: porous and non-porous. Non porous materials consist of titanium plates, Hyaluronate/carboxymethylcellulose, Nylon, Silicone, Polytetrafluoroethylene. Porous materials consist of Hydroxyapatite, Composite implants, Poly-L/DL-lactide plates/polyglycolic acid, Tissue engineering and bone regenerative materials.

## 2. DISCUSSION

### AUTOLOGOUS GRAFT MATERIAL

These are materials harvested from the patient's own body. They are the traditional grafting materials that have been used over several decades. For orbital reparative surgeries, autologous bone is harvested from the iliac crest, maxillary buttress, mandibular symphysis, calvaria, Ribs. They are of the highest biocompatibility, cheap, causes very less instances of post-operative infection, easily integrate with the host site and has the least chance of extrusion. However, it also has the most unpredictable rate of resorption giving rise to other post-operative complications such as enophthalmos, diplopia and unpredictable orbital volume and it also is associated with donor site morbidity thus adding to patient discomfort. This type of graft material is also usable only in repairing small defects, as large volumes of bone cannot be harvested without causing severe morbidity.

### ALLOGENIC GRAFT MATERIAL

Allogenic grafting materials are harvested form a different individual than the host but are of the same species. For orbital bone defect repair, at one point of time freeze dried irradiated allogenic bone blocks were used. They are very cheap, quite biocompatible and showed acceptable results, but their use is controversial in nature and is widely avoided in present scenario since it was shown to cause a fatal CREUTZFELDT-JAKOB PRION disease in some cases. More research is needed in the field of prion related diseases in order to implement these materials for orbital defect repair surgeries.

### ALLOPLASTIC

These are biocompatible artificially manufactured grafting materials. They are generally easy to fabricate, cheap, easy to use and show less adverse effects post operatively. They are of two major types- non-porous, porous.

**NON-POROUS**: Non-porous materials were the first materials to be used for repair of defects of the orbit. They are easily available, cheap, easy to handle intra-operatively show comparable or decreased post-operative complications to porous materials, but they also show higher incidence of post-operative infection, intrusion and migration.

(1) **Hyaluronate/carboxymethylcellulose** – It was 1$^{st}$ used in 1965 by Rowning and Walker. It was primarily used in abdominal surgeries as an absorbable adhesion barrier in the form of Sodium Hyaluronate and Carboxy Methylcellulose. In human trial studies it has shown successful correction of the orbital defect with complete resolution of diplopia. Due to its natural constituents it is easily resorbed and rarely show any inflammatory reaction. Further research is needed to determine whether it has optimal rate of resorption and if it can be successfully used for large fracture of the orbit.

(2) **Silicone –** Silicone is a readily available and very cheap material and it has been used for orbital defect repair since the early 1960s. Research has shown that when used solely for the reconstruction of small orbital floor defects (<1 cm2), the rate of necessary revision surgery secondary to postoperative complications is pretty less. However, considerable amount of post-operative complications has been reported, such as formation of squamous epithelial cyst of the orbit, intense foreign body reaction resulting in diplopia and fibrous encapsulation, resulting in infection, extrusion and migration of the implant.

(3) **Nylon** – it is a non-porous, non-resorbable polyamide sheet graft material of varying thickness (0.05 - 2 mm), used for the orbital defect repair. It was 1$^{st}$ used in 1965 by Browning and walker. It has shown good results in resolving diplopia and enophthalmos when fixed to the inferior orbital rim, but has also shown various post-operative complications such as infection with Aspergillus fumigatus, extrusion, migration, capsular hematoma, fistula, abscess and hyperostosis of the implant.

(4) **Polytetrafluroethylene** – This is a reliable cheap material which was previously used, but now is generally avoided as materials with better physical attributes, biocompatibility and lesser post-operative complications are available with comparable prices.

(5) **Titanium –** Titanium is the most biocompatible alloplastic graft material. It shows very strong osseointegration, it is very easily contoured, is easily stabilized and shows acceptable levels of fibro vascularization. However, titanium also gives rise to certain material specific complications like intense fibrotic reaction between the implant and periorbital tissues, resulting in extraocular motility restriction, cicatricial eyelid retraction. Also due to osseointegration it is extremely difficult to remove the implant if required.

**POROUS:** These materials generally yield much better results than that of non-porous materials in the form of lesser instances of extrusion, migration, infection. They are easily molded intra-operatively. Also, porous materials cause fibrovascular ingrowth thus reducing the chance of extrusion, migration and fibrous encapsulation.

(1) **Porous polyethylene –** This is a highly biocompatible material which allows vascularization and bone formation due to its high porosity of about 100 – 200 µm. this allows for complete fixation and immobilization, reducing any chance of migration or extrusion of the implant. It is available in various thickness and is easily contoured according to need. It shows comparable results to autologous bone grafts in terms of repair of defect, reduction of enophthalmos, resolving diplopia, and reduced post-operative complications.

(2) **Hydroxyapetite –** This is a naturally occurring highly porous, brittle, very costly material which is very difficult to mold intra-operatively. Studies have shown that due to irregular resorption it is prone to post-operative enophthalmos. Thus, this material is not preferred at all.

(3) **Composite Implants –** It is now one of the most commonly used materials for orbital defect repair. It comprises of a titanium mesh core sandwiched between two layers of porous polyethylene. It allows fibro vascularization and fixation due to the porous nature thus eliminating the chance of extrusion or migration of the implant. It is highly malleable thus allows easy shaping intra-operatively. It is also easily contourable. It shows very high biocompatibility and can come with impermeable coating on one or both sides to prevent orbital tissue adherence. Although retrobulbar

hemorrhage and hematic cysts have been reported in some cases, it is extremely rare and generally due to chronic irritation to periosteum.

(4) **Poly-L/DL-lactide plates/polyglycolic acid -** Poly-L-lactic/polyglycolic acid plate (PLLA-PGA) has only recently been approved to the used-on humans, in 1996. It is also the 1st polylactide plate to be used for orbital defect repair. It is a bioresorbable, biocompatible, Osseo inductive, thermoplastic graft material. It generally consists of 82% PLLA and 18% PGA to form 0.5 mm sheets which can be shaped and bent according to the contour of the orbit by applying heat to it. This material can be used to repair large orbital defects and has enough strength to support the contents of the orbit. Another advantage of this material is that is has a very controlled rate of resorption thus it allows the deposition of newly formed bone to naturally heal the defect through Osseo inductive property. More research is needed to observe long term adverse effects and to bring the cost of the material to real world values.

(5) **Tissue Engineering and Bone Regeneration –** this represents the bleeding edge of research into graft materials. biodegradable polymers and copolymers, such as the EH-PEG hydrogels are being researched as a means to deliver Bone Morphogenic Proteins to the injured tissue in order to initiate cartilage and the gradually bone formation by stimulation of osteoprogenitor cells present in the periosteum. β Tricalcium phosphate fortified with bone marrow stromal cells are also under research to be of viable use as a grafting material for orbital defects. These constructs can be 3D printed according to the host site anatomy using detailed three-dimensional computerized tomographic scans of the fracture site.

## 3. CONCLUSION

Many studies have been undertaken and uncountable literatures have been published regarding the advantages and the viability of any one specific grafting material for the repair of orbital defects. Thus, all of this helps us come to a conclusion that there is not single grafting material yet which would be suitable for all and any case. There is yet more research to be done on existing readily available materials for their long-term adverse effects, more research needs to be done to control the rate of resorption of resorbable materials and more research needs to be done for experimental materials to make them a viable option. Till then traditional materials such as Autologous Bone graft and Composite materials such as PPE-Ti mesh will serve to be the gold standard in orbital defect repair surgeries.

## CONFLICTS

No conflicts

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