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Review Article

### USE OF POROUS POLYETHYLENE IMPLANTS FOR ORBITAL RECONSTRUCTION- A REVIEW

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#### ABSTRACT

Treatment of orbital injuries has long been a formidable challenge to the maxillofacial surgeon. Surgical treatment has ranged from packing of the maxillary antrum to total orbital reconstruction with autogenous or synthetic material. Porous high density polyethylene (Medpor) is a biocompatible large pore, high density polyethylene implant. It is well tolerated by surrounding tissues and its porous structure is rapidly infiltrated by host tissue. It is a highly stable and somewhat flexible porous alloplast that has rapid tissue in growth into its pores.

**Keywords:** Alloplastic, Occuloplastic, Allogenic, Polyethylene, Fibrovascularisation.

#### INTRODUCTION

Trauma to the face frequently results in fractures of the internal orbit that may produce small crack in the floor to extensive multiple wall defects<sup>1,2</sup>. Treatment of orbital injuries has long been a formidable challenge to the maxillofacial surgeon.<sup>3</sup> Sequelae of inadequate or improper orbital fracture management, such as enophthalmos, restriction of ocular motility and ocular or orbital dystopia, present cosmetic and functional problems are very difficult if not impossible to correct. The management of orbital fractures is highly controversial<sup>4,5</sup>. Surgical treatments has ranged from packing of the maxillary antrum to total orbital reconstruction with autogenous or synthetic material<sup>2</sup>.

Materials for reconstruction of orbital floor are classified as autologous, allogenic, or alloplastic materials. Autologous material are generally biodegradable and include septal cartilage, ear cartilage, bone from the calvaria, interior or lateral maxillary antrum wall, mandibular coronoid process, mandibular symphysis, rib and iliac crest. Allogenic material includes lyophilized dura, lyophilized cartilage and banked bone. Alloplastic can be further subdivided into non-resorbable and resorbable materials. Nonresorbable material includes Silicone, Teflon, Medpor and Titanium mesh. Examples of resorbable materials include poly (L-lactide),

polydioxanon (PDS), Vicryl mesh (polyglatin-910) and polyglycolic acid<sup>6,7</sup>.

The ideal material for reconstruction of orbital floor should be strong enough to support the orbital contents, reshapable to fit the orbital floor defect, and biocompatible without side effects. If the material is alloplastic, it should be cost effective and capable of sterilization without deterioration of its chemical composition, should be nonallergenic, non-carcinogenic, and radiopaque<sup>1,8,9</sup>. Material should be easily cut and sized in operating room, and it should be able to be shaped to fit orbital contour and retain its new form without memory. It should allow fixation to host bone by screw, wire, suture, or adhesive. It should not potentiate growth of microorganisms nor promote resorption of underlying bone or distortion of adjacent tissues. The material should be capable of removal without damage to surrounding tissues. The material should be permanently accepted and it should be easily available. To date, no single material has been universally successful in meeting every one of these criteria. However some come close<sup>1</sup>.

The factors influencing the choice of biomaterial for use in orbit are

- 1) Size of defect,
- 2) Involvement of multiple walls,
- 3) Adaptation to internal contours,

- 4) Restoration of proper volume,
- 5) Presence of adjacent sinus cavity,
- 6) Prevention of displacement,
- 7) Risk of further trauma,
- 8) Adhesion/restriction of ocular mobility,
- 9) Early versus late repair<sup>5</sup>.

Autogenous grafts are best tolerated by the surrounding tissues. However they require a second surgical procedure to harvest, which may increase the morbidity<sup>10,11</sup>.

The main advantage of alloplastic non resorbable material is that it is volumetrically stable and does not resorb. High density porous polyethylene (HDPE) commercially available as Medpore is strong yet flexible and is easy to contour and shape using scissor or scalpel, and it can be molded into desired shape. It comes in several different thicknesses, including 0.85-1.5-, and 3-mm sheets<sup>1</sup>.

#### **Porous polyethylene**

Porous polyethylene has been used as an alloplastic material in oculoplastic and craniofacial surgery since it was approved by the food and drug administration for commercial use in 1984<sup>1</sup>. High density porous polyethylene (HDPE) commercially available as Med pore ( porex surgical, college, park, GA) since 1985.<sup>3</sup> It is a versatile material used as a substitute for both bone and cartilage and as an alternative to silicone for facial reconstruction<sup>1</sup>. HDPE is a pure polyethylene implant that is highly biocompatible and processed specifically to include and control pore size. it is insoluble in tissue fluids, does not resorb or degenerate, incites minimal surrounding soft tissue reaction, and possesses high tensile strength.<sup>1,6</sup> The material is easy to shape, is strong yet flexible, is highly stable, and permits tissue in growth into its pores. Pore size has been demonstrated to directly influence the rate and amount of bony and fibrovascular in-growth into its pores. Pore size is engineered to range in size from 100 to 200µm, with more than 50% being larger than 150 µm, an ample size for fibrovascular ingrowth<sup>12,13</sup>.

Animal studies have demonstrated that tissue in-growth and formation of mucosal lining occur even when the implant is placed over an open maxillary sinus. Fibrovascular in growth minimizes capsule formation, plays a vital role in maintaining the local host immune response within the implant providing resistance to infection, and provides stability to the implant to prevent migration and exposure.<sup>1,6</sup> fibrovascular in-growth has not been shown to cause extraocular muscle restriction by soft tissue adherence to the implant. HDPE is available in many different forms. Thin sheeting (0.85 to 3.0) is most commonly used for internal orbit applications and is easily cut to form with scissors. The material should be soaked in an antibiotic solution before placement within the orbit. It is easily and reliably stabilized with screws<sup>3</sup>.

HDPE is widely accepted for its role in correcting both acute injuries and late exophthalmos. Romano et al reviewed the use of HDPE in 140 patients with facial fractures; 128 of these patients had implants placed within the orbit. In there series there was 1 instance of implant infection requiring removal and no cases of implant migration or extrusion. Karesh and Horswell reviewed 21 patients who underwent late correction of enophthalmos using HDPE. There were no cases of infection or extrusion. Rubin et al reported their results of 37

orbital reconstructions using HDPE. One patient developed infection necessitating implant removal, a second patient had a palpable implant requiring revision 12 months later<sup>3</sup>. Mustafa Y. et al reviewed the use of thin and ultra-thin porous polyethylene sheets in 26 patients with fractures of the orbital floor. No implants extruded and there were no signs of inflammatory reaction<sup>9</sup>.

The main disadvantage of reconstruction of the internal orbit with porous polyethylene is that it is not radiopaque so its position cannot be easily visualized on immediate postoperative CT scans. The density of porous polyethylene is similar to the nonfat orbital soft tissue<sup>3,14</sup>.

## **DISCUSSION**

Porous polyethylene implants are widely used for orbital reconstruction. They are easily molded and contoured according to the shape and size of the defect. Med pore supports fibrous in growth into its pores, which are extensively interconnected. The surrounding capsule is generally thin and pliable with a minimal inflammatory response<sup>14,15</sup>. Fibrovascular in growth does not cause extra ocular muscle restriction by soft tissue adherence to the implant. Fibro vascularisation and tissue in growth also provide positional stabilization, which prevents migration and extrusion, and resistance to infection<sup>14</sup>.

## **CONCLUSION**

Porous polyethylene is a very reliable material for orbital reconstruction, with good long term success obtained from several investigators in a diversity of applications and circumstances. Technically it is easy to work, strong yet somewhat flexible, and carries the possibility for obtaining a precise three dimensional orbital reconstruction. Its large open-pore structure allows for rapid vascular, soft-tissue, and bone in growth that serves to stabilize the implant in relation to the surrounding tissue.

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