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View Topic

Implants, Soft Tissue, High-Density Porous Polyethylene (Medpor)

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Synonyms, Key Words, and Related Terms

Medpor, Medpor implants, facial augmentation, facial reconstruction, implants, porous high-density polyethylene, fibrovascular ingrowth, craniofacial implants, orbital implants, orbital reconstruction, nasal implants, full-thickness skin grafts, skin grafts, auricular reconstruction, ear reconstruction, tracheal reconstruction, thyroid cartilage reconstruction, chin augmentation, mandibular reconstruction

Products

Soft-tissue implants made with porous high-density polyethylene (PHDPE) are marketed in the United States under the trade name Medpor.

Category

Soft-tissue implant

Device details

Porex Surgical, Inc

- Medpor (see the following image)

Photograph of various sizes of Medpor implant used for temporal filling. Photo courtesy of Porex Surgical.

Design Features

Porous high-density polyethylene (PHDPE) is formed by sintering small particles of high-density polyethylene to create a strong firm material that can be molded using hot water.[1] Pore sizes range from 100 to 250 µm, with 50% being larger than 150 µm. This feature is important, because previous animal studies have shown that pore sizes greater than 100 µm encourage tissue ingrowth.[2, 3]

Many different sizes and shapes of Medpor are available. Medpor comes in prefashioned models or can be tailored to a specific patient's needs based on stereolithographic reconstruction from a 3-dimensional (3-D) computed tomography (CT) scan. Medpor is radiolucent on CT scans and magnetic resonance images (MRI), causing no interference with postoperative imaging, although a new version with titanium mesh embedded in the Medpor is radiopaque with minimal scatter and is MRI safe.[4]

Biocompatibility

The basic structure of Medpor is a simple carbon chain that makes it the reference standard for an inert substance in assays of tissue reaction.[5] Early studies of Medpor implants demonstrated fibroblast ingrowth that prevents capsule formation and promotes stabilization of the implant.[6, 7] De Potter and colleagues demonstrated fibrovascular ingrowth in vivo in patients who underwent orbital Medpor implantation[8]; serial MRI examinations showed enhancement as early as 1.5 months postoperatively. Over long periods, bone eventually incorporates at the implant-bone interface, providing additional stability.[4, 9]

The fibrovascular ingrowth has also been suggested to aid in preventing infection.[10] This was first demonstrated in a rabbit model of implants being placed adjacent to the maxillary sinus in orbital fractures. Numerous human studies have since borne out low rates of infections with these implants.[4, 11]

In 2009, Mavrikakis and colleagues published a histologic examination of explanted lower eyelid Medpor spacers that showed microscopic vascular ingrowth, although gross vascularization was not noted.[12]

Indications

Although a complete discussion of all possible uses of Medpor is beyond the scope of this article, some of the more common areas are covered in detail, with mention made of less common areas.

Craniofacial implants

Liu and colleagues performed 611 Medpor implants for craniofacial defects in 598 patients.[4] Medpor was used most often after frontotemporal approaches, followed by retrosigmoid, subtemporal, and craniofacial approaches. Liu et al reported no infections and no wound breakdowns, although some of the implants were in contact with the frontal sinus.[4]

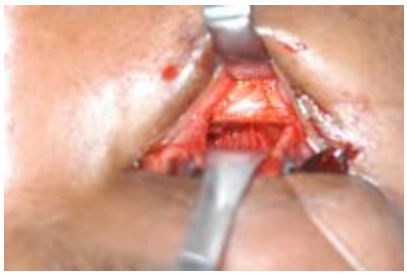
Park and Guthikonda used Medpor to reconstruct the sellar floor after transsphenoidal hypophysectomy in cases of intraoperative cerebrospinal fluid leak.[13] They noted excellent results with good compatibility based on postoperative magnetic resonance imaging (MRI).

Rapidis and Day reported results of using Medpor for filling in temporal defects after temporalis flap reconstruction of various head and neck defects (see the image below).[14] The implants were used in various patients, including those who received both preoperative and postoperative radiation. Rapidis and Day reported no extrusions and a return of normal temporal height in more than 90% of their patients.

Photograph of various sizes of Medpor implant used for temporal filling. Photo courtesy of Porex Surgical.

Orbital implants

Medpor has been used in the orbit for orbital reconstruction after enucleations, correction of lower eyelid retraction, and orbital fracture repair (see the following images). This high-density porous polyethylene (PHDPE) soft-tissue implant has been safely used to repair lower eyelid retractions in patients in whom more conventional attempts at surgical correction have failed after animal models demonstrated its safety.[15], [16], [17] Although, in one study, one exposure through the anterior eyelid was found, the same study reported the ability to apply full-thickness skin grafts directly over the implants with good success.[17]



Preoperative photograph of an orbital floor fracture being repaired through a transconjunctival incision.

Intraoperative photograph through a transconjunctival incision after placement of Medpor in the orbital floor.

Medpor has also been used extensively for repair of both orbital floor and medial orbital wall fractures.[1, 18, 19, 20, 21, 22, 23, 24, 25] Approaches include endoscopic, subciliary, transconjunctival, and subtarsal. In repair of orbital floor fractures, the implants have been fixated with sutures, screws, or even suturing of the periosteum over the implant, with good results.

Medpor has been shown in experimental studies to support the load of the orbital contents, even in the event of additional orbital contents, and bend, not break, with excess force.[26, 27] Estimations based on computed tomography (CT) scans of orbital volume after repair of unilateral orbital fractures with Medpor showed that orbital volume between the fractured and nonfractured sides did not significantly differ.[28]

Nasal implants

Reports in the literature also show Medpor used in nasal septorhinoplasty. Medpor has been used as an extended spreader graft for correction of middle third deformities and airway narrowing.[29, 30, 31] No extrusions or infections were reported in these studies. Other reports have described the use of Medpor as dorsal augmentation or for further correction of dorsal or tip irregularities. In one study by Karnes and colleagues, 2 implant extrusions were reported in a 12-year follow-up.[32]

Grafting

Full-thickness skin grafts have been directly grafted over Medpor. In a 2-part article by Ozdemir and colleagues, grafting was shown to have good results.[33] In the first part of the article, a rabbit model was used to demonstrate tissue ingrowth into the implants and full-thickness skin graft viability. The best results were obtained when grafting was undertaken 6 weeks postimplantation, after neovascular ingrowth was seen in almost all of the pores. In the second part of the study, delayed skin grafting was performed on Medpor implants as part of a 3-stage reconstruction procedure in 7 patients, with excellent results reported.

Auricular reconstruction

Medpor implants have also been used for a core auricular reconstruction. Early reports date back to 1993, when Wellisz reported the reconstruction of a helix after a burn injury.[34] Since then, Medpor implants have been used for microtia repair and helical reconstruction after trauma (see the image below). Reports have described a precontoured Medpor auricular construct that is then covered with a pedicled temporalis fascia flap with full-thickness skin graft. Romo and colleagues reported a 4% complication rate in 250 cases of microtia repair over 11 years.[35] The most common complication was skin necrosis, although they reported no cases of total loss of the construct.

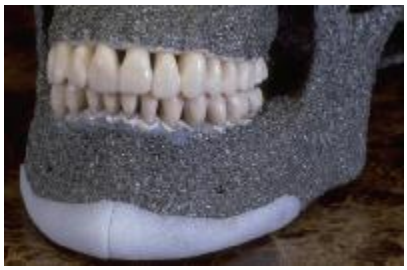
Photograph of various sizes of Medpor implant used for auricular reconstruction. Photo courtesy of Porex Surgical.

Another study on Medpor in auricular reconstruction from Romo and colleagues demonstrated the ability to use the construct as a multistage procedure for auricular reconstruction.[36] During the second stage of the procedure, when lobule reconstruction is undertaken, they also performed bone-anchored hearing aid (BAHA) implant placement and showed success with the combined procedure.[36]

Other locations for reconstruction

Animal experiments have been performed with Medpor in tracheal and thyroid cartilage reconstruction.[37, 38] In the laryngeal implant in rabbits, histologic examination revealed a lack of acute inflammatory reaction with the material. Incorporation of the Medpor was seen in as little as 2 weeks.

Medpor implants have also been used in the dental field for mandibular reconstructions and by reconstructive and cosmetic surgeons for chin augmentation (see the following images).



Photograph of mandibular contour chin augmentation implant. Photo courtesy of Porex Surgical.

Photograph of geniomandibular groove implant used for chin augmentation. Photo courtesy of Porex Surgical.

Clinical Trial Evidence

See the sections Design Features, Indications, and Complications.

Clinical Implementation

For information on clinical implementation, see the section Indications.

Follow-up/Monitoring

No additional follow-up or monitoring is needed for the implants beyond the routine follow-up required for the condition being treated with the implants.

Complications

Medpor implants carry low overall complication rates; the most common reported complications include persistent pain, paresthesias, implant exposure, infection, and subsequent implant removal. Certain areas of implant placement have also been shown to carry higher rates of complications. In an evaluation of their extrusion rates, Sevin and colleagues showed 3 extrusions in 52 implant placements over 4 years.[39] These implants were placed in the nasal dorsum and in the zygomatic area and were used as a construct for microtia repair. Of note, none of their orbital, chin, or mandibular implants required removal.[39]

In a retrospective analysis of 285 implants, Cenzi and colleagues found that implants of the nose, maxilla, and ear were at an increased risk of failure.[40] They analyzed age, sex, underlying disease states, site of implant, type of insertion, primary stability fixation method, and outcome to evaluate failure trends. In addition, the risk of implant failure in patients with various syndromes was statistically significantly increased.[40] Of note, screws and sutures were found to carry the same risk of complications.

As with all implants, Medpor should be used carefully in areas of irradiation. In a dog study, Kim showed that dogs with Medpor implants needed more time to heal after radiation than nonradiated controls.[41] In addition, when they irradiated dogs 4 weeks after Medpor implantation, the irradiated group showed delayed osteoblastic activity compared with the controls, although this group showed increased activity over the presurgical radiation group.[41]

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Test Questions

Question 1:

Which of the following is a head and neck area in which Medpor has not been used in humans?

A. Orbit
B. Nose
C. Trachea
D. Temporal area
E. Maxilla

The correct answer is C: Although tracheal reconstruction and laryngeal surgery that involve Medpor have been performed in animal studies, no human studies of tracheal reconstruction with Medpor have been undertaken.

Question 2:

Medpor is thought to be resistant to infection because of which of the following?

A. Fibrovascular ingrowth
B. Antibacterial impregnation
C. Inability to form biofilms over the material
D. Pore size that causes increased inflammation
E. All of the above

The correct answer is A: Medpor is thought to be resistant to infection because of fibrovascular ingrowth. The fibrovascular ingrowth has also been suggested to aid in preventing infection (Merritt, 1979). This was first demonstrated in a rabbit model of implants being placed adjacent to the maxillary sinus in orbital fractures. Numerous human studies have since borne out low rates of infections with these implants (Liu, 2004; Romano, 1993).

Question 1 (T/F):

Medpor is composed of sintering small particles of high-density polyethylene to create a strong firm material that is malleable when heated in water.

The correct answer is True: Medpor is made of polyethylene and softens when placed in water hotter than 180°F.

Question 2 (T/F):

Pore sizes of Medpor implants range from 50-100 µm.

The correct answer is False: Pore sizes range from 100-250 mm, with 50% being larger than 150 mm.

Question 3 (T/F):

Medpor can be used for microtia repair.

The correct answer is True: Reports have described a precontoured Medpor auricular construct that is then covered with a pedicled temporalis fascia flap with full-thickness skin graft. Romo and colleagues reported a 4% complication rate in 250 cases of microtia repair over 11 years (Romo, 2006). The most common complication was skin necrosis, although Romo et al reported no cases of total loss of the construct.

Question 4 (T/F):

Skin graft placement during implant placement rather than in a delayed fashion offers the best results for full-thickness skin grafting over Medpor.

The correct answer is False: The best results in a rabbit model were shown to occur when grafting was undertaken 6 weeks postimplantation, after neovascular ingrowth was seen in almost all of the pores.

Further Reading

MULTIMEDIA

Media file 1: Photograph of various sizes of Medpor implant used for temporal filling. Photo courtesy of Porex Surgical.

Media type: Photo

Media file 2: **Preoperative photograph of an orbital floor fracture being repaired through a transconjunctival incision.**

Media type: Photo

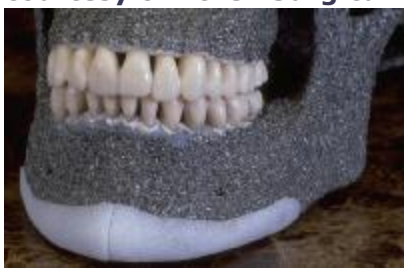
Media file 3: **Intraoperative photograph through a transconjunctival incision after placement of Medpor in the orbital floor.**

Media type: Photo

Media file 4: **Photograph of various sizes of Medpor implant used for auricular reconstruction. Photo courtesy of Porex Surgical.**

Media type: Photo

Media file 5: **Photograph of mandibular contour chin augmentation implant. Photo courtesy of Porex Surgical.**



Media type: Photo

Media file 6: **Photograph of geniomandibular groove implant used for chin augmentation. Photo courtesy of Porex Surgical.**

Media type: Photo

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