CLINICAL STUDY

Medpor porous polyethylene implants in orbital blowout fracture repair

S.G.J. NG, S.A. MADILL, C.F. INKSTER, A.J. MALOOF, B. LEATHERBARROW

Abstract

Purpose **Various materials are used in orbital blowout fracture repair. We describe a series of patients with orbital blowout fractures that were repaired using porous polyethylene (Medpor) sheets.**

Methods **A non-comparative interventional case series is described of 30 blowout fractures of 30 patients aged 7–60 years (median 29 years) who underwent orbital blowout fracture repair with Medpor sheets. The mean follow-up was 19.1 months (minimum 5 months). The indication for surgery in 6 cases was non-resolving diplopia. The remaining 24 cases had surgery for enophthalmos. Ten cases underwent primary or secondary hydroxyapatite orbital implantation at the same time as orbital floor blowout fracture repair. Data were collected on post-operative motility and diplopia, enophthalmos, cosmesis, complications and re-operations.**

Results **In no case was diplopia worsened by blowout fracture repair. Where surgery was performed for the correction of enophthalmos, late surgery did not compromise the surgical results. There were no intraoperative complications. The one major complication was a case of recurrent implant infections leading to implant removal. There were 3 minor post-operative complications: 2 cases of post-operative infraorbital anaesthesia and one case of a palpable titanium screw. Re-operations were performed for pre-existent diplopia, lid laxity, socket abnormalities and mid-facial deformities. None of these arose from the blowout fracture repair.**

Conclusions **The study suggests that in orbital blowout fracture repair Medpor implants are safe and effective with few complications. Late surgery for enophthalmos is technically more difficult but is not associated with poorer functional or cosmetic results.**

Key words Blowout fracture, Medpor, Orbital implant, Porous polyethylene

S.G.J. Ng
S.A. Madill
C.F. Inkster
A.J. Maloof
B. Leatherbarrow
Manchester Royal Eye Hospital
Manchester, UK

Mr Brian Leatherbarrow ✉
Manchester Royal Eye Hospital
Oxford Road
Manchester M13 9WH
UK

Tel: +44 (0)161 276 5569
Fax: +44 (0)161 272 6618
e-mail: bollin@mighty-micro.co.uk

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Medpor (Porex Surgical, College Park, GA) is a porous alloplastic graft material made of a stable hydrocarbon polymer porous polyethylene. It has been used in various forms for bony and soft tissue reconstruction for nearly 50 years.[1] It is now commonly used in facial bone reconstruction,[2–5] conferring advantages in vascular and bone infiltration, non-resorption, non-degeneration, high tensile strength, resistance to stress and fatigue, proven biocompatibility, and a virtual lack of soft tissue reaction. Rapid tissue growth occurs into the pores, which enhances tissue adhesion and reduces the risk of implant infection.[6,7]

Patients and methods

Patients under the care of one consultant oculoplastic and orbital surgeon at the Manchester Royal Eye Hospital who had orbital blowout fracture repair with Medpor sheets from 1994 to 2000 were retrospectively reviewed. Only patients with a minimum of 5 months follow-up were included. In a number of cases, primary enucleation or evisceration was also performed at the time of blowout fracture repair. Another subset of patients was anophthalmic and underwent secondary orbital implantation at the same time as blowout fracture repair. Following a review of the records, the patients were recalled for assessment by two of the authors (S.N., C.I.). The following criteria were assessed: ocular motility, diplopia, enophthalmos, cosmesis and surgical complications. If unable to attend, patients were invited to complete a questionnaire or discuss the results of surgery by telephone.

Surgical technique

The surgery was performed by the consultant (B.L.) and a number of surgeons in training. All cases were performed under general anaesthesia. Access to the fractures was via a subciliary incision made with a Colorado needle. The plane of dissection was between the orbicularis muscle and the orbital septum. To avoid orbital fat prolapse, perforation of the orbital septum was avoided. The periosteum of the inferior orbital rim was exposed and incised. The subperiosteal space was entered along the

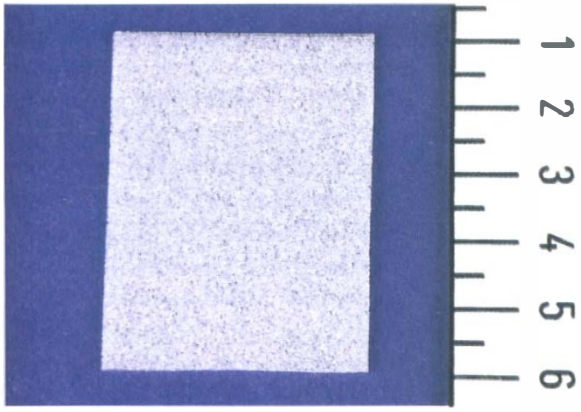

Fig. 1. *Medpor sheet.*

orbital floor. Orbital soft tissues and fibrous tissue were lifted out of the fracture site and reposited. Care was taken to not damage the infraorbital nerve and the inferior rectus muscle. A Supramid sheet was used as a template of the bony defect. An ultrathin (0.85 mm thick) Medpor sheet (Fig. 1) was then cut to size. During insertion of the Medpor sheet the Supramid sheet and a retractor were used to retract orbital soft tissues away from the fracture site (Fig. 2). Where there was insufficient support for the Medpor sheet, a supporting titanium plate was used (4 cases). For combined floor and medial wall fractures, one wing of the plate was angled upwards to cover the defect in the medial wall. A forced duction test was performed to ensure there was no residual soft tissue incarceration in the fracture site. The periorbita was closed with 5.0 Vicryl and the skin with a continuous 7.0 Vicryl suture. A Frost suture was inserted at the end of the operation. In cases where primary or secondary hydroxyapatite orbital implantation was required, this was performed after the blowout fracture repair. A firm pressure dressing was applied. This was removed after 1 h and the vision checked. Hourly vision checks were performed for 12 h with the pressure dressing being replaced each time. After 12 h ice packs were applied at intervals to reduce swelling. Upward digital massage was started on the first post-operative day and continued for several weeks.

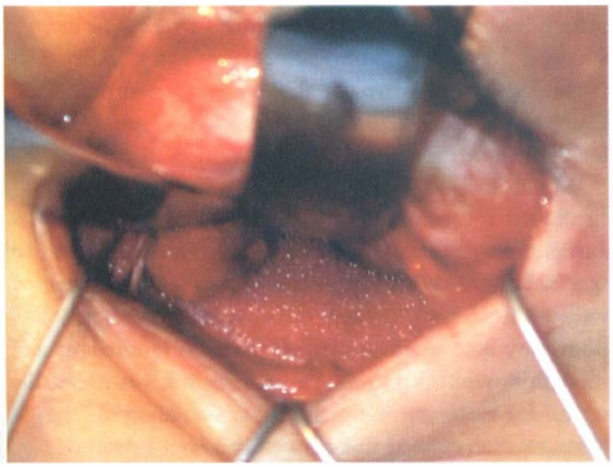

Fig. 2. *Medpor sheet* in situ *covering orital floor defect. A Supramid sheet and Sewell retractors are being used to retract the orbital soft tissues out of the fracture site.*

Table 1. *Surgery for diplopia*

No. of cases	6 (20% of total)
Mean time of surgery	7.4 days[a]
Post-operative clinically significant diplopia	2
No. undergoing further surgery	2

[a]Excludes 1 patient who did not present until 7 months after injury.

Intraoperative intravenous cefuroxime 1 g was administered on implant insertion. Post-operative medications consisted of oral cephalexin 500 mg q.i.d. for 1 week, oral paracetamol and codeine and topical chloramphenicol to the lid wound.

Results

There were 30 cases in the study. The age range was 7–60 years with a mean of 32 years. There were 22 males and 8 females. The mean follow-up was 19.1 months (Table 1). Ten cases underwent early surgery within 1–2 weeks of injury. Twenty cases underwent later surgery more than 2 weeks after injury (Fig. 3).

Six cases (20% of total) had surgery for symptomatic diplopia. The cause of the diplopia was soft tissue incarceration in the fracture site demonstrated on a CT (computed tomography) scan and confirmed by forced duction testing. Five of these cases were seen acutely at our institution and underwent surgery within 11 days (mean 7.4 days) of the injury. The remaining case was referred from another area having undergone unsuccessful blowout fracture repair 7 months previously (Table 1). No case had diplopia worsened by surgery. Four of the 6 cases had no clinically significant diplopia post-operatively. Some of these cases had insignificant upgaze limitation or diplopia only in the extremes of gaze. Two cases required subsequent strabismus surgery: one case with persistent inferior rectus underaction and another case with a superior oblique palsy dating from the original injury.

The indication for surgery in the remaining 24 cases (80%) was enophthalmos. These cases underwent non-urgent surgery 2 weeks or more after the injury. There were two groups of cases (Table 2). Group 1 (10 cases) had a mean interval of 75.9 months between injury and surgery. Five cases in this group underwent secondary hydroxyapatite orbital implantation in addition to orbital blowout fracture repair. These cases had undergone primary enucle.ation elsewhere and were referred for

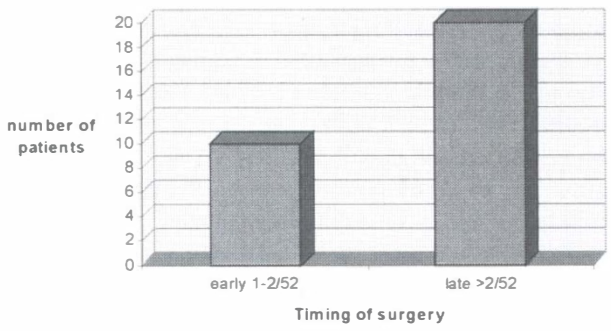

Fig. 3. *Timing of surgery.*

Table 2. *Surgery for enophthalmos*

No. of cases	24 (80% of total)
Mean time to surgery	
Group 1 (anophthalmic)	75.9 months
Group 2 (non-anophthalmic)	24.2 months
Overcorrected	0
Undercorrected	2

correction of post-enucleation socket syndrome (PESS) due to orbital volume deficiency. Another 5 cases in group 1 underwent primary enucleation (1 case) or evisceration (4 cases) at the time of orbital fracture repair.

Several cases had previously unrecognised blowout fractures that were only diagnosed when pre-operative orbital CT scanning was performed. Group 2 consisted of 14 cases with large blowout fractures involving more than half the orbital floor. This group underwent surgery to prevent late enophthalmos. In this group the mean time to surgery was 24.2 months with 12 of the 14 cases having surgery within 10 months of the injury.

Twenty-two of the 24 patients who had surgery for enophthalmos were highly satisfied with their cosmetic result. The 5 anophthalmic patients who had secondary orbital implants combined with blowout fracture repair reported the most significant cosmetic improvements after surgery: improved fit of their artificial eyes and reduced superior sulcus deformities. The improved fit of artificial eyes was also associated with markedly reduced socket pain. Two of the 24 patients were not satisfied with their cosmetic result. One patient who had a pure blowout fracture repair complained of slight undercorrection. In this case exophthalmometry revealed 2 mm of enophthalmos and further surgery was not required. Another patient with complex blowout fractures of the medial wall and orbital floor combined with a fracture of the lateral orbital rim also reported a sunken appearance of the operated eye. Exophthalmometry demonstrated 4 mm of enophthalmos.

During the follow-up period there were 7 operations performed after the initial blowout fracture repair (Table 3). Two operations were for persistent motility problems that had been present pre-operatively. Three of the anophthalmic patients underwent further surgery: 1 had a lower lid tightening procedure, another had inferior fornix deepening sutures and 1 had a hydroxyapatite orbital implant exchange. Two patients had maxillofacial surgery for mid-face bony deformities caused by their initial injury. No patient who had a pure blowout fracture repair had residual post-operative enophthalmos requiring further surgery.

There were no intraoperative complications (Table 4). The only major post-operative complication was a case of recurrent severe pain associated with swelling and tenderness around the orbital floor. CT scanning did not reveal any abscess formation or sinusitis. Three episodes of pain ocurred 6, 31 and 34 months after surgery. Each episode resolved after the administration of systemic antibiotics. There was no evidence of fistula formation. An implant infection was diagnosed and the patient had the implant removed 36 months after the original surgery. There were 3 minor complications. One patient whose Medpor sheet was supported by a titanium plate had a palpable titanium screw at the inferior orbital rim. Two had infraorbital nerve anaesthesia not present pre-operatively. Although not recorded as a complication of surgery, 3 patients reported chronic sinusitis in the ipsilateral maxillary sinus.

Table 3. *Indications for re-operation*

Persistent motility problems	2
Enophthalmos after pure blowout fracture repair	0
Lid deformity	1
Other	4

Table 4. *Complications*

Intraoperative	0
Post-operative	
Major	1
Minor	3

Discussion

A wide variety of autogenous grafts and alloplastic materials are used for orbital blowout fracture repair. Autogenous donor sites include the calvarium, iliac crest, rib and mandible. The disadvantages of autogenous bone grafts are a second operative site with potential morbidity, prolonged surgical time and unpredictable resorption.[8] Alloplastic materials are either absorbable (e.g. polyglactin film) or non-absorbable (e.g. silicone, titanium mesh and polyamide mesh sheets – Supramid).[9] Medpor is a non-absorbable alloplastic implant. It has proven biocompatibility, is flexible, strong and porous. The porosity enables vascular and bony in-growth leading to tissue adhesion and a reduced risk of infection.[3,7] In contrast, most alloplastic implants develop a capsule at the graft/host interface that is virtually avascular. This leads to a greater risk of bacterial infection.[9–11] In animal models, maxillary sinus mucosa has been shown to grow over the surface of the Medpor.[12] Supramid is a commonly used alloplastic implant that is porous like Medpor but induces an inflammatory response and contracts by 15% of its volume. These factors may affect its *in situ* stability.[2] The use of synthetic hydroxyapatite has also been reported.[13] Compared with Medpor it is brittle when handled and lacks flexibility. Medpor is more rigid than alloplastic materials such as Supramid while retaining some flexibility and minimal memory. Provided there is sufficient support for the Medpor sheet around the rim of the fracture, it will support the orbital soft tissues without flexing. A Medpor sheet covering the orbital floor may be curved upwards on one side to cover a medial blowout fracture. We have found this especially useful for restoring the post-bulbar convexity of the inferomedial wall. If this convexity is not restored, undercorrection of the enophthalmos is likely.[9] On insertion the rough surface of the Medpor can drag orbital soft tissues in a posterior direction. This can lead

to post-operative motility disturbance and implant extrusion. To avoid this we recommend the use of a smooth Supramid sheet to retract the orbital soft tissues. Autoclaved X-ray film has also been used for the same purpose.[14] It is essential to perform a forced duction test after inserting the Medpor sheet. Forward displacement of the implant and restricted motility will be apparent if the sheet has caused soft tissue drag or entrapment.

When there was insufficient remaining bony rim to support a Medpor sheet, we fixated a titanium plate to the inferior orbital rim and placed a Medpor sheet on top of it. Screw fixation, suture fixation and titanium fixation of channelled Medpor sheets have also been described.[15,16] In the ophthalmic literature complications arising from alloplastic orbital floor implants are uncommon. Implant infection and extrusion are the commonest complications cited in most studies. Studies using alloplastic implants have reported infection rates of 0.4–4%.[10,17] A 10 year retrospective review of the records of four oculoplastic surgeons using alloplastic implants reported 17 complications. Fourteen cases required implant removal. The causes of implant removal were fistulas, cellulitis, implant migration, implants impinging on the lacrimal sac, motility restriction, overcorrection and haemorrhage into the capsule around the implant. The total number of cases was not stated and a complication rate was not given.[18] A recent study of 37 Medpor implants implanted by an oculoplastic surgeon reported 3 complications. There was one orbital infection requiring implant removal, a case of undercorrection and on case of a palpable implant.[19]

Our results are comparable with these previous series. We encountered 1 major complication with recurrent implant infection leading to implant removal. To avoid implant removal, systemic antibiotics have been shown to control infection around Medpor orbital implants.[19] This was suggested to our patient but he chose to have his implant removed. Several patients undergoing primary or secondary hydroxyapatite orbital implantation at the same time as orbital blowout fracture repair later developed minor signs of PESS. In no case was there incomplete fracture reduction so we presume there was inadequate volume correction from the orbital implant. In such cases, stacking of Medpor sheets or blocks posterior to the globe implant may help prevent PESS.[19] Inadequate reduction of zygomatic and medial wall fractures is a potent cause of late enophthalmos. We believe this was the main contributory factor in our patient who had 4 mm of post-operative enophthalmos. Three patients reported symptoms of chronic sinusitis. Since maxillary sinus pathology is frequently encountered after middle face fractures,[20] we do not regard sinusitis as a complication arising from surgery.

The use of a subciliary incision has been questioned because of the risk of post-operative lower lid retraction.[21] We have not had any case of post-operative lower lid retraction that was not already present pre-operatively. Lid retraction was prevented by vigorous post-operative lid massage starting on the first post-operative day and continuing for several weeks.

All patients seen acutely at our institution whose indication for surgery was diplopia had surgery within 11 days. Young patients with the so-called white-eyed blow-out fracture (a hairline orbital floor fracture with restricted motility but few other clinical findings) had surgery within 3 days, as has been recommended recently.[22] In our study 1 patient with non-resolving diplopia did not have surgery at our institution until 7 months after his injury. He had had surgery elsewhere and was referred with persistent diplopia due to incomplete fracture reduction. Surprisingly, his diplopia resolved completely after we performed his second blowout fracture operation. It is more usual for such cases with longstanding motility defects to eventually require squint surgery.

In many patients who underwent surgery to prevent late enophthalmos or who had blowout fracture repair combined with hydroxyapatite orbital implantation the interval between injury and surgery was months or years. Delayed surgery is technically more difficult because of fibrous tissue formation in the orbital soft tissues around the fracture. There is a greater risk of haemorrhage. The infraorbital nerve is more difficult to isolate. Consequently there is a greater risk of infraorbital anaesthesia as occurred in 2 of our patients. Despite the long time interval between injury and surgery a highly satisfactory cosmetic result was achieved in 22 of the 24 cases in this group.

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