

## Six Cases of Bacterial Infection in Porous Orbital Implants

Jung-Ran You\*, Jin-Ho Seo\*, Yeong-Hoon Kim<sup>†</sup> and Woong-Chul Choi\*

\*Department of Ophthalmology, St. Mary's Hospital, Seoul, Korea; <sup>†</sup>Department of Ophthalmology, St. Paul's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea

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**Background:** We present 6 cases of bacterial infection that developed after porous orbital implant surgery.

**Cases:** Five patients with hydroxyapatite implants showed lid swelling, discharge, and suppurative granuloma 14 days to 3 years after surgery. The hydroxyapatite implants were removed 14 days to 41 months postoperatively, and synthetic porous polyethylene orbital implants were inserted. Thick discharge and conjunctival melting was noted 14 months after primary Medpor implant surgery in the sixth patient, and the infection was controlled by medical therapy.

**Observations:** The culture of specimens removed with swabs from the conjunctiva of patients and from the hydroxyapatite implants showed growth of *Staphylococcus aureus*, *Staphylococcus epidermidis*,  $\alpha$ -hemolytic streptococcus and peptostreptococcus in 4 patients, whereas *Streptococcus pyogenes* were cultured from the conjunctiva in the Medpor implant patient. Culture for the remaining patient was negative.

**Conclusions:** If there is continuous pain, injection, and discharge after porous implant insertion, bacterial infection in the implant should be considered immediately. Systemic antibiotics and topical eye drops should be administered without delay. If no improvement is observed, the implant should be removed and a different approach must be considered. **Jpn J Ophthalmol 2003;47:512–518** © 2003 Japanese Ophthalmological Society

**Key Words:** Hydroxyapatite implant, infection, synthetic porous polyethylene orbital implant.

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### Introduction

An ideal orbital implant must be inert, lightweight, biocompatible, biochemically stable, and should be well integrated into the orbital muscular system without causing fibrosis of the septated orbital connective tissues that comprise the system. Until now, hydroxyapatite (HA) and a synthetic high-density porous polyethylene orbital implant, known as Medpor, have been considered ideal for orbital implants. However, there still exists some possibility of the development of postoperative complications such as exposure, infection, and extrusion of the implant even with these ideal materials.<sup>1–10</sup> There are few true infections of the implant reported, but many of these have resulted in actual removal of the implant in order

to correct the symptoms. We present the bacteriological study results acquired from 6 cases of bacterial infection that developed after porous orbital implant surgery and our experience during treatment.

With the desire for prosthesis with excellent motility, research on motility coupled artificial eyes has progressed greatly since the 1980s. These efforts converged on the development of multiporous orbital implants, which satisfied many patients, although unwanted postoperative complications from various causes also occurred.

This study is mainly focused on the diagnosis and treatment experience from the following cases of bacterial infection that developed after porous orbital implant surgery.

### Case Reports

#### Case 1

A 46-year-old man who underwent evisceration and 20-mm HA insertion in another hospital due to traumatic left eyeball rupture.

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Correspondence and reprint requests to: Woong-Chul CHOI, MD, Department of Ophthalmology, St. Mary's Hospital, College of Medicine, The Catholic University of Korea, #62, Yoido-dong, Youngdeungpo-ku, Seoul 150-713, Korea

According to his medical record, exposure of the implant developed at the 14th postoperative day. Scleral graft was done 3 months postoperatively, which was followed by drilling 10 months later.

The patient visited our hospital 4 years and 7 months after the operation due to sudden lid swelling, profuse and mucopurulent eye discharge, and conjunctival dehiscence. Conjunctival swab culture showed growth of *Staphylococcus epidermidis*, which was sensitive to ciprofloxacin, gentamicin, clindamycin, and erythromycin. The patient was treated with intravenous cephmandole, tobramycin, oral ciprofloxacin, and topical ofloxacin eyedrops (6 times a day). On receiving the culture result, additional antibiotic medication (erythromycin ointment) was tried but there was no improvement. Bone scanning of the eyeball showed a high uptake of radiotracers in the HA implant on the delayed image, suggesting a well-vascularized implant. Magnetic resonance imaging (MRI) showed swelling of soft tissue around the implant in the T<sub>1</sub>-weighted image, suggesting periocular inflammation. But the implant itself was not well enhanced in the T<sub>1</sub>-weighted image.

The implant was removed 44 months after its placement and replaced by an 18-mm Medpor implant under general anesthesia. During the operation, the excess tissue edema made it difficult to separate the conjunctiva from the Tenon's capsule. So, we made interrupted sutures with 5-0 vicryl for these two layers and additional continuous sutures with 6-0 vicryl above it. Histopathologic examination of the removed HA implant disclosed inflammatory cell infiltration and fibrosis. The patient

showed no further subsequent problems by the time of the last examination, 3 years postoperatively.

### Case 2

A 38-year-old female patient who underwent evisceration and 18-mm HA insertion in another hospital 3 years previously due to phthisis bulbi. Drilling was done 6 months after evisceration. She had been blinded from a pricking injury to her left eye by a fingernail when she was 7 years old.

She visited our hospital complaining of purulent eye discharge near the implant. Eyelid swelling and chemosis had developed 3 years after drilling (Figure 1). After removing the sleeve peg, massive irrigation was done with normal saline mixed with chloramphenicol. Then, she was treated with intravenous cephmandole, piperacillin sodium, and topical ofloxacin eye drops for 1 month but showed no improvement.

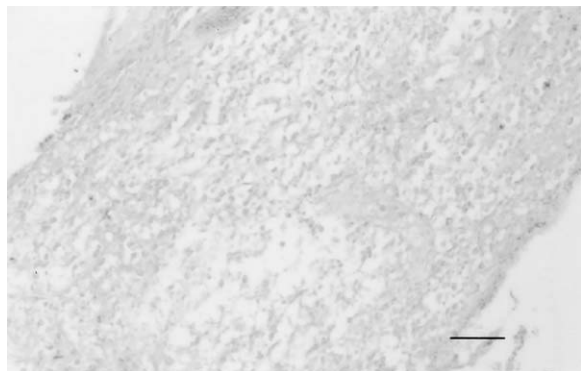
Culture of the conjunctival discharge was negative. Bone scanning showed hot activity. The implant was removed 37 months after its insertion and was replaced by an 18-mm Medpor. Culture of the removed implant showed peptostreptococcus. Histopathologic examination of the removed HA showed mild to moderate chronic inflammatory cell infiltration, especially at the core of the implant (Figure 2). After 16 months of follow-up, the patient showed no further signs of infection (Figure 3).

### Case 3

A 3-year-old girl who underwent enucleation and the insertion of an 18-mm donor sclera-wrapped HA insertion because of the diagnosis of retinoblastoma.



**Figure 1.** Case 2: (Right) Purulent eye discharge, (Left) Conjunctival swelling and purulent discharge near the hole is noted. Patient did not improve after topical and intravenous treatment. Hydroxyapatite implant was removed and replaced by an 18-mm Medpor implant.



**Figure 2.** Microscopic findings in hydroxyapatite implant removed from case 2. Chronic inflammatory cell infiltration with vascularization of the implant are shown. Bar = 100  $\mu$ m. Hematoxylin-eosin staining.

The patient was admitted to our hospital due to implant exposure and eye discharge on the 13th postoperative day. Because she resided far from the hospital, frequent follow-up management was not possible. Bacterial culture of the eye discharge showed *Staphylococcus aureus*. Intravenous cephadrine, oral augmentin syrup, and topical erythromycin eye drops were administered but the infection was not controlled. The implant was removed on the 27th postoperative day and replaced by an 18-mm Medpor. During surgery, we were unable to identify the proper location of the extraocular muscles after conjunctival dissection. So, Medpor was inserted into the original site of the previous implant. Histopathologic examination showed fibrosis, foreign body reaction, and acute inflammation. She showed no further inflammatory reactions by the last examination 18 months postoperatively.



**Figure 3.** Case 2: At 2 months postoperatively. Wound site shows no sign of infection; no conjunctival dehiscence. Patient showed no further signs of infection after 16 months of follow-up.

#### Case 4

A 36-year-old male patient who underwent evisceration and 18-mm HA insertion because of the diagnosis of congenital cataract, which developed after measles in his infancy.

Drilling was done 6 months later. Two years and 1 month after evisceration, he complained of exposed bony spicules and profuse eye wax. Erythromycin eye drops (4 times a day) was prescribed. One year after follow-up treatment, the patient revisited our clinic because of increased eye wax, ocular pain, conjunctival edema, and injection. He was admitted for HA infection. Bacterial culture of the eye discharge revealed *Staphylococcus aureus* and  $\alpha$ -hemolytic streptococcus. The infection was not controlled with intravenous cephadrine, oral ciprofloxacin, and ofloxacin eye drop and ointment. Three years and 6 months after evisceration, the infected HA was removed and replaced by an 18-mm Medpor. During surgery, we could not determine the original muscular insertion sites, so a new scleral window was made at the equator and Medpor was inserted into the previous implant pocket. The cross-section of the removed orbital implant showed a round, well-demarcated central core that was densely packed with inflammatory materials. Histopathologic examination showed acute inflammation at the center of the implant. Eleven days after Medpor insertion, tarsorrhaphy was done for conjunctival prolapse, and the patient was discharged. One year after the final operation, the wound site showed no further inflammatory signs.

#### Case 5

A 21-year-old female patient who underwent evisceration and an 18-mm HA insertion 2 years and 4 months previously at another hospital due to eyeball rupture. Drilling was done 1 year after primary surgery.

She visited our hospital complaining of purulent eye discharge and ocular pain that developed about 2 years after the initial operation. She was treated with oral cefaclor and topical ofloxacin, tobramycin eye drops, and ointment for a month but showed no improvement. We removed the sleeve peg and irrigated the core with gentamicin solution. No organisms were found from the conjunctival culture specimen. Oral ciprofloxacin and intravenous cephadrine were added but there was no improvement. Irrigation with chloramphenicol solution showed multiple fragmented HA particles and a foul odor discharge. Two years and 7 months after evisceration, the infected HA was removed and replaced by an 18-mm Medpor. During surgery, we found that the sclera was relatively well preserved. After scleral pocket irrigation with gentamicin solution, new scleral windows were

made at four different sites and Medpor was inserted. Five days postoperatively, the wound site showed no conjunctival dehiscence, and the patient was discharged 25 days postoperatively. Finally, 2 years after the Medpor insertion, the wound site was clear and showed no inflammatory sign.

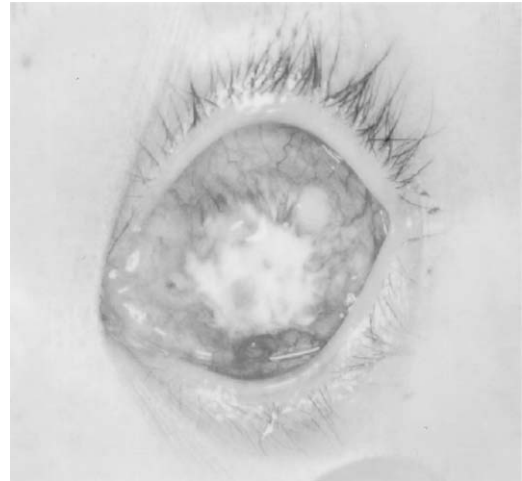
#### Case 6

A 20-year-old male patient who complained of cosmetic problems due to congenital glaucoma.

Unilateral enucleation was done and primary 20-mm donor sclera-wrapped Medpor was implanted in his left eye. The socket healed well without any postoperative complications. Medpor coupling post (MCP) insertion was done at 8 months postoperatively. The patient complained of sudden lid swelling and profuse eye discharge 6 months after the MCP insertion (Figure 4). Conjunctival dehiscence and implant exposure of  $7 \times 10$  mm was observed (Figure 5). Intravenous cephmandole and ofloxacin eye drops were administered. A conjunctival swab culture showed growth of *Streptococcus pyogenes*. Inflammation subsided 9 days after initiation of the antibiotics therapy. MRI showed high signal intensity at the posterior half of the implant on T<sub>1</sub>-weighted image (Figure 6). Coronal view of the MRI in T<sub>2</sub>-weighted image showed fluid collection in the inferotemporal portion of the left eye, suspected to be the focus of infection. Eight months later, the size of the defect expanded to  $12 \times 11$  mm, so a dermis graft was done with tissue from his right inner thigh to cover the exposed implant. Since



**Figure 4.** Case 6: Lid swelling and chemosis with profuse eye discharge occurred 6 months after Medpor coupling post insertion. Following initiation of antibiotic therapy, the inflammation subsided within 9 days.



**Figure 5.** Preoperative photograph in Case 6. Conjunctival dehiscence and implant exposure can be seen.

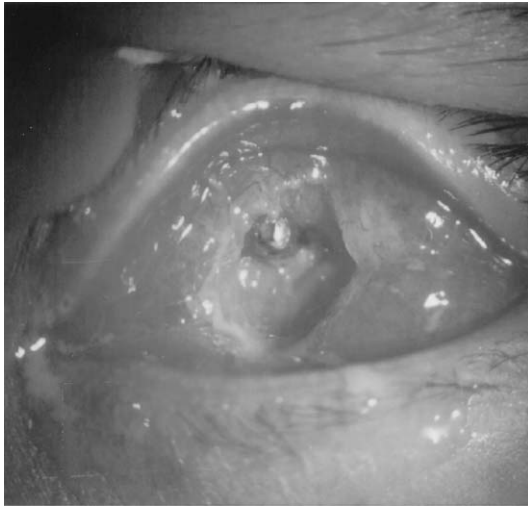
then, the implant has shown good motility and no further complications were observed at the last examination 8 months postoperatively (Figure 7).

### Discussion

Currently, HA and Medpor orbital implants are widely used after enucleation, evisceration, or for secondary implantation surgery. The HA implant is composed of a calcium phosphate salt complex of interconnected pores (average size,  $400 \mu\text{m}$ ). Fibrovascular tissues grow into these pores and thus permit good prosthesis motility. HA



**Figure 6.** Case 6. Axial view by orbital magnetic resonance imaging, T<sub>1</sub>-weighted image. Nine days after antibiotics therapy, there is a high signal intensity at the posterior half of the implant suspected to be the focus of infection.



**Figure 7.** Case 6: After dermis graft to cover exposed orbital implant, Medpor implant showed excellent motility and good fornix socket, and no further complications were observed during 8 months of follow-up.

also has good biocompatibility with human tissues. However, to prevent implant exposure and provide attachment sites for extraocular muscles, HA must be wrapped with donor scleral or fascial materials. Wrapping materials are especially important when using HA to cover its relatively rough surface and strictly interconnected structure. Unfortunately, these materials can be the source of various transmittable diseases such as hepatitis, AIDS, or other slow-virus mediated diseases. A synthetic high-density porous polyethylene orbital implant, Medpor, was first introduced by Dresner in 1991.<sup>13</sup> It has a hydrophobic and negatively charged surface and a pore size of about 150–400  $\mu\text{m}$  (mean, 200  $\mu\text{m}$ ). These pores act as the entry site for vascular ingrowth via surgical windows made in the wrapping material by the surgeon, which contribute to excellent implant motility. Its hydrophobic and negatively charged surface acts as a protective envelope by inhibiting the local adherence of bacteria. It is cheaper in price, lighter in weight, stronger than, and not as fragile as, HA. Extraocular muscles can be directly sutured to its surface, so that there is no need to use preserved scleral tissues as with HA. Moreover, there is a difference in the method of pegging; the MCP insertion technique leaves less dead space than the drilling of a hole which is necessary with HA. So this tight pegging system results in implant infection occurring less frequently. The HA and Medpor implants have multiple interconnected pores that are subsequently filled with fibrovascular tissue. Theoretically, this would prevent possible infection, but before complete vascularization, which usually takes several months, the risk of infection is

great for these implants, especially when they become exposed postoperatively.<sup>11–15</sup>

Since the initial appearance of HA and Medpor, various complications associated with their use have gradually been reported.<sup>10</sup> Recently, conjunctival dehiscence appears to be the most common problem. Noninfected exposures can be managed by various methods; in case of small size, simple observation can be done and for larger ones, freshening or advancing conjunctival edges, burring down the implant, patch grafts of various materials, or replacement can be used.<sup>2,16–19</sup> True infection of the implant is rare but feared because it may be difficult to control without removing the implant. Several culture-positive cases are documented in the literature. Glasgow and associates<sup>3</sup> reported 1 case of an infected HA implant that was culture-positive for *S. aureus*, requiring removal. Pathologic examination results showed necrosis and inflammation, but no microorganisms were demonstrated. Kaltreider and Newman<sup>5</sup> reported 3 cases of implant infection. The cultures were positive for *S. aureus*, coagulase-negative staphylococci, *Streptococcus intermedius*, *Haemophilus influenzae*, *Streptococcus pneumoniae*, and  $\alpha$ -hemolytic streptococci. Two of the three implants were removed, and one infection resolved after a revision procedure and advancement of the extraocular muscles. However, this latter patient died 4 months after the procedure, precluding long follow-up. Goldberg et al<sup>6</sup> reported a case of an infected silicone orbital implant that was removed and replaced by a sclera-wrapped HA sphere. Four weeks later, *S. aureus* infection was demonstrated on culture. The implant was ultimately removed and the socket healed. Poor fibrovascular ingrowth was documented, but no microorganisms were shown histopathologically.

There is also a report of fungal infected HA that was resolved after implant removal.<sup>9</sup>

It is not known whether bacteria enters the HA or Medpor implant during its placement or through an area of conjunctival dehiscence postoperatively or through the drilling hole. In our experience, except for 1 case of early infection in case 6 and another young patient in case 3, all 4 cases that had implanted HA developed infection after drilling procedures. Purulent discharge through the hole could be observed also. In all 5 cases of HA-implanted patients, we first removed the sleeve peg only, and waited for the infection to be controlled, but in vain. So we finally had to remove the original implant. Initially, we suspected that the drilling hole itself provided the nidus for bacterial growth with strong correlation to the poor implant vascularization, and that this would make medical treatment more difficult. However, in most cases, radiologic findings revealed that most HA implants were well vascularized. So, it is possible that the degree of

**Table 1.** Characteristics of Patients

Case No.	Sex/Age	Diagnosis	Type of initial Surgery	Culture Specimens	Culture	Time to Infection	Management
1	M/46	Eyeball rupture	Evisceration + HA	Conjunctival swab	<i>Staphylococcus epidermidis</i>	4 y, 7 mo	HA removal + Medpor implantation
2	F/38	Phthisis bulbi	Evisceration + HA	Removed implant	Peptostreptococcus	3 y	HA removal + Medpor implantation
3	F/3	Retinoblastoma	Enucleation + HA	Conjunctival swab	<i>Staphylococcus aureus</i>	13 d	HA removal + Medpor implantation
4	M/36	Phthisis bulbi	Evisceration + HA	Conjunctival swab	α-hemolytic streptococcus	3 y, 6 mo	HA removal + Medpor implantation
5	F/21	Eyeball rupture	Evisceration + HA	Conjunctival swab	Negative	2 y	HA removal + Medpor implantation
6	M/20	Congenital glaucoma	Enucleation + Medpor	Conjunctival swab	<i>Streptococcus pyogenes</i>	14 mo	HA removal + Medpor implantation Dermis graft

HA: hydroxyapatite, Medpor: synthetic porous polyethylene orbital implant.

implant vascularization did not contribute to the implant infection in our cases.

On the other hand, there can be some possible clinical discrepancy between radiologic findings and real tissue-vascularization, and this may obscure our precise decision about the “real” status of implant vascularization. Actually, in case 1, the implant showed a high uptake of radiotracers in bone scan but showed low signal intensity in T<sub>1</sub>-weighted image in MRI. As already known, gadolinium enhanced T<sub>1</sub>-weighted MRI images most clearly reveal the implant vascularization status by enhancing the blood vessels with relatively low flow rate. Other imaging studies are also used, but computed tomography, bone scan, ultrasonography, and color Doppler imaging all have variable limitations degrading their effectiveness as the evaluation method of implant vascularization.<sup>20</sup> We concluded that the implant infection was the result of bacterial penetrance by the route of the drilling hole, and finally HA provided the infection focus in the dead space, in other words, the drilling hole. As for case 3, in which drilling was not performed, early postoperative conjunctival defect may have been the cause of infection.

In our experience, meticulous preoperative care was insufficient to prevent implant infection. This includes a standard skin preparation before surgery with povidine-iodine (Betadine), soaking the implant in bacitracin (500 units per mL), various methods to facilitate fibrovascular ingrowth into the orbital implant,<sup>21</sup> and thorough education of the patient about wound hygiene.

Most of our cases of implant infection were HA-implanted patients, although we experienced 1 case of infected Medpor orbital implant also (Table 1). Infected Medpor orbital implant is, however, very rare. There can be several explanations for this low incidence. First, Medpor has been introduced and used more recently as an orbital implant than HA. Second, because Medpor leaves less dead space after motility coupling post procedures, it has the advantage over the HA. The dead space in the HA provides a potential space for fluid collection leading to abscess pocket. Third, Medpor has a hydrophobic and negatively charged surface that may provide additional protective effects against bacterial adherence, in other words, infection. In all of our cases we replaced an HA implant with a Medpor implant. First, because most of our patients were young and wanted the prosthesis with good motility. Second, we thought that with Medpor after MCP insertion there is relatively less chance of infection than with HA implants. But there is also a reported case of a medically uncontrolled infection after Medpor insertion. Wilson et al<sup>22</sup> reported a 68-year-old woman who experienced an infection of a porous polyethylene orbital implant caused by capnocytophaga after a dental procedure. The infection was unresponsive to both

topical and oral antibiotics and required removal of the implant. She is the first reported patient with an infected porous polyethylene orbital implant. The authors believed that infected integrated orbital implants should be removed because neither topical nor systemic therapy was effective.

If the drilling hole in the hydroxyapatite implant is the cause of infection, as Murray et al<sup>23</sup> presented, we anticipate a new type of coupling composed of magnetic prosthetics and implants will become available. A newly developed titanium pegging method is now being used. The drilling tool gradually enlarges the hole and the sleeve peg is inserted with the least amount of dead space. This technique achieves tight contact between the implant and peg and minimizes the dead space between them. As a result, it may finally reduce the incidence of implant infections that occurs after drilling. More clinical trials and experience may be needed before these new materials can be used safely to minimize the unwanted postoperative complications listed above.

## Conclusion

If there is continuous pain, injection, and discharge after porous implant insertion, bacterial infection of the porous implant should be considered immediately. Systemic antibiotics and eye drops should be given without delay. When even appropriate antibiotics cannot control the infection, the implant itself should be considered as the focus of infection. So, if there is no improvement of symptoms despite all of the above treatments, the orbital implant itself should be removed.

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