Primary Placement of a Motility Coupling Post in Porous Polyethylene Orbital Implants

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The placement of a motility coupling post (MCP) to integrate the prosthesis with a porous orbital implant may enhance prosthetic motility following enucleation. Previously, MCP placement has required a second operation usually at least 6 months following enucleation. We developed a technique to place an MCP reliably and safely into a porous orbital implant at the time of enucleation. Eligibility criteria included high motivation to achieve maximal prosthetic motility, adequate conjunctiva to ensure desirable wound closure, and isolation of the 4 rectus muscles. Enucleation was performed in standard fashion with implantation of a conical porous polyethylene orbital implant. Implanted MCPs protruded anteriorly 2 to 4 mm. The Tenon capsule and conjunctiva were closed in separate layers over the protruding MCP. Thirty-two patients underwent primary placement. Follow-up ranged from 1 to 33 months (mean, 15 months). Nine MCPs spontaneously exposed within the first 4 months. One additional post autoexposed at 12 months. Three patients underwent a secondary procedure to expose the MCP. There were no cases of infection, explantation, or gross MCP malposition. Minor complications included pyogenic granuloma (n=2) and conjunctival overgrowth (n=1). All patients were successfully fit with prostheses. Prosthetic motility was acceptable in all patients. Motility coupling post placement at the time of enucleation surgery in selected patients is an effective, efficient surgical option.

Prosthetic motility can be improved by directly coupling the orbital implant’s movement to the prosthesis. During the past decade, there has been much experience using the hydroxyapatite (HA) implant (BioEye, San Diego, Calif) with a “motility peg” as the most recent iteration of the integrated implant.1 Despite its successes, there are numerous challenges to the HA coupling system that limit its use: a second surgical procedure is needed to place the peg system (anchoring the sleeve and motility post), and it is difficult to place and align the peg precisely on the surface of the spherical implant. Furthermore, the addition of a motility peg in any setting may result in increased complications with the implant (eg, exposure) and with the peg itself (eg, extrusion and pyogenic granuloma formation).2,3 Finally, in this era of greater emphasis on cost containment, the use of the HA implant and, to a lesser degree, the use of any porous implant greatly increase the expense of managing the anophthalmic patient. The direct material expenses (implant and coupling system) are not trivial, and the indirect costs of adjunctive radiological imaging (bone, computed tomographic, or magnetic resonance imaging scan) to confirm implant vascularization, a second surgical procedure to place the coupling device, and postoperative prosthesis modification are also high.

An alternative porous implant that is also widely used is porous polyethylene (Medpor; Porex Surgical, College Park, Georgia).
Tissue growth into porous polyethylene provides decreased migration, the major advantage of a porous implant. In addition, it offers the potential for integration. Although porous polyethylene does not have as favorable a pore structure as HA, it offers several distinct advantages over the HA implant. These include moldability, permitting various customized shapes; easy handling, permitting passage of suture needles through the implant and carving of the implant without crumbling; and decreased expense.

During the past several years, a coupling device has been developed for the porous polyethylene implant. This motility coupling post (MCP) is a custom titanium alloy designed to be anchored directly into the implant. The head of the screw is round and is fit into a hollowed-out portion of the prosthesis (Figure 1). Preclinical rabbit studies demonstrated that this titanium screw placed within a porous polyethylene enucleation implant (8 weeks following placement of an orbital implant) was well tolerated, exhibiting minimal inflammation, no inhibition of vascularization, and no inducement of implant exposure.

Because of the excellent tolerance of this implant in animal studies and our early clinical experience, we sought to extend this model to placement of the MCP at the time of enucleation, covering the post within Tenon capsule, with plans to expose the post 3 to 6 months after surgery.

**PATIENTS AND METHODS**

**PATIENT SELECTION**

All patients who underwent primary placement of the MCP were highly motivated to pursue optimal motility. Preoperative exclusionary criteria included underlying vasculopathy (diabetes, vasculitis, or history of chemotherapy or irradiation) and patients younger than 10 years. Intraoperative requirements included adequate conjunctiva to close the wound without tension and isolation and suturing of the 4 rectus muscles to the implant.

**SURGICAL TECHNIQUE**

The technique for placement of the porous polyethylene conical orbital implants has been previously described. Immediately following a standard enucleation, the posterior Tenon capsule was widely opened with blunt dissection. The implant was prepared by suturing autologous deep fascia of thigh or acellular donor dermis (AlloDerm; Lifecell Corporation, Branchburg, NJ) to the anterior surface of the implant. Before placement in the orbit, the implant was soaked in antibiotic solution (80 mg of gentamicin sulfate in approximately 40 mL of isotonic sodium chloride solution). The double-armed needles of the superior rectus muscle were straightened using 2 needle holders. This maneuver facilitated passing the needles through their corresponding holes in the implant. The implant was slid into position while the anterior conjunctiva or Tenon capsule was retracted using 4 forceps in the oblique quadrants. The 3 remaining rectus muscles were advanced underneath the covering of the implant and sutured 2 to 5 mm from the anterior apex of the implant. The inferior rectus muscle suture was advanced more than the others (approximately 2 mm from the apex) to promote a slight anterior inclination to the superior pole of the implant. After confirming that these 3 muscles were positioned in their corresponding grooves, the sutures were securely tied. Finally, the superior rectus muscle suture, which could not be directly visualized, was tied into position. The central, anterior portion of the implant, noted at the intersection between the horizontal and vertical muscle channels, was marked and the implant’s covering was treated with light bipolar cautery, exposing an approximately 1-mm-diameter surface of the porous polyethylene.

Using a hand drill and screwdriver supplied by the manufacturer, a pilot hole was created followed by anchoring of the MCP (Porex Surgical) (Figure 2, A and B). Care was taken to avoid catching the tissue covering the screw heads and twisting it around the MCP. The head of the MCP was positioned to protrude 2 to 4 mm above the surface of the implant. The Tenon capsule and conjunctiva were meticulously closed with minimal tension using an interrupted buried 5-0 polyglactin suture and a running 6-0 fast-absorbing plain gut suture. The suture line was positioned away from the MCP to avoid pressure at the wound site (Figure 2, C). In all patients, the conjunctival incision line was above the position of the MCP. A polymethyl methacrylate conformer was placed within the conjunctival fornices, antibiotic ointment was applied, and the eyelids were typically closed with a central suture tarsorrhaphy.

**PREPLACEMENT OF THE MCP**

After observing consistent positioning of the implant with the previously described technique, we moved to preplacement of the MCP before positioning the implant within the orbit (Figure 3). Preplacement was performed in the following fashion. After removing the implant from its sterile package and soaking it in an-
tibiotic solution as previously noted, the central anterior surface of the implant (corresponding to the intersection of the anterior extensions of the vertical and horizontal rectus muscle channels) was marked. This site was drilled with the handheld drill, and the MCP was screwed into the implant until the desired height above the implant was achieved (approximately 3½ mm). The anterior portion of the implant was covered with the planned wrapping material (fascia or processed acellular dermis), which was secured with 5 interrupted sutures. The apex of the MCP was exposed by performing a small cut down on the covering, which was then pushed down around the MCP until it was flush with the surface of the implant.

**POSTOPERATIVE MANAGEMENT**

Routine examinations were performed at 1 week, 1 month, and 2 months after surgery. The postoperative course featured close monitoring for evidence of spontaneous exposure of the post (Figure 4 and Figure 5). Patients who did not have spontaneous exposure of the MCP were examined to undergo a conjunctival cut-down procedure over the protruding MCP 2 to 6 months after surgery. Prosthetic fitting was scheduled 2 months after the initial surgery.

**SECONDARY EXPOSURE OF THE MCP**

In patients without spontaneous exposure who elected to proceed with externalization of the MCP, the following technique was used. Topical anesthetic was instilled into the conjunctival cul-de-sac, followed by a cotton pledget soaked in 4% lidocaine. The screw was palpated, and conjunctival cautery was applied to expose the post (Figure 6). The screw was then advanced out to rest 2 to 3 mm above the conjunctival surface. No suturing of the conjunctiva was required. Topical antibiotics were given, and prosthetic modification was scheduled 2 weeks after this procedure. A polymethyl methacrylate conformer was used in place of the prosthesis for 2 weeks after surgery.

**RESULTS**

All 32 patients treated with primary placement of the MCP were undergoing enucleations (ie, no eviscerations or secondary implants). Follow-up ranged from 1 to 33 months (mean, 15 months). Nine titanium posts were found to expose spontaneously between 1 and 4 months after surgery. One additional post was found to autoex-
pose at 12 months. These patients had no complications and did not require conjunctival cut down. The remaining posts did not spontaneously expose. Of these, 3 patients pursued secondary exposure. Of the 32 patients in this study, 8 underwent preplacement of the MCP. Follow-up in this group ranged from 1 to 5 months. In this group, there were no spontaneous exposures and no patient has yet undergone secondary exposure. No complications were seen in this group. All patients were successfully fit with a prosthesis, and motility was acceptable in all patients (Figure 7). In all patients who pursued secondary MCP exposure, the prosthetic motility noticeably improved in all fields of gaze.

**MAJOR COMPLICATIONS**

There were no wound dehiscences, infections, malpositions, or extrusions of the posts. No patient required explantation of the implant or repositioning of the MCP.

**MINOR COMPLICATIONS**

In one case of secondary exposure, there was conjunctival growth over the post. This was addressed by an additional cut-down procedure and by backing out the MCP by half a turn (1 turn of the MCP moves the head approximately 0.75 mm). In 2 cases of spontaneous exposure of the MCP, a pyogenic granuloma developed 1 year after fitting of the prosthesis. The lesions were located at the base of the MCP-conjunctiva interface (Figure 8) and attributed to mechanical trauma at the conjunctiva-peg interface. These patients noted increased discharge from the socket. Each lesion was resected, and this resulted in complete relief of the conjunctival discharge.

**COMMENT**

Our pursuit of this study was based on the observation that the flattened anterior surface of the conical orbital implant does not move significantly from the intraoperative to the final postoperative position. In addition, primary placement of the coupling post is analogous to osseointegrated implants (dental implants and orbital prostheses) in which a titanium implant is buried, then externalized at a later date, following appropriate vascularization of the wound bed. Spontaneous exposure of the MCP was a serendipitous finding.
The early exposure was not associated with any complications, including implant exposure, peg extrusion, or infection. Although not precisely measured, our general observation was that pegs positioned less than 3 mm above the implant did not spontaneously expose, while pegs protruding 4 mm above the implant were much more likely to expose. A subsequent animal study was pursued to help determine the optimal height for placement of the post to allow for appropriately timed exposure of the implant. Ideally, this would be 6 to 8 weeks just before the fitting of the prosthesis. This would allow definitive fabrication of the prosthesis without the need for secondary surgery and prosthetic modification. Animal studies also investigated the effect of primary placement on implant vascularization, infection, and implant mechanical integrity.

Placement of the MCP after positioning the implant in the orbit permitted confirmation of adequate conjunctiva to cover the anterior portion of the implant without tension and of proper centration of the implant. Based on our experience with more than 50 conical orbital implants, we found that there was adequate conjunctiva to cover the implant, the apex of the implant was consistently at the junction of the anterior extension of the implant’s horizontal and vertical channels, and the suture line of the conjunctiva was invariably superior to the central anterior portion of the implant. These predictable findings permitted us to modify the technique in favor of pre-placement of the MCP, which offers several advantages. This method is technically easier since the implant can be held securely on a side table while drilling the implant and advancing the MCP. When placed in situ, it is more awkward to secure the implant while it is “floating” within the orbital fat. The seemingly inevitable twisting and tangling of the covering material while drilling or screwing is avoided if the MCP is placed before covering the implant. If anticipated preoperatively, placement of the MCP can be performed while the anesthesia team is preparing the patient for surgery. Therefore, this method can reduce operating time. In the event that the MCP is found to be malpositioned once the implant is secured within the orbit, it can easily be repositioned or removed.

The MCP offers several advantages over the existing HA system. It is easier to insert, a power drill is not needed, the porous polyethylene implant does not crumble with drilling or screw placement, no migration of the post has been encountered, and the material of the post is made of biocompatible titanium. The newest generation of the HA post system incorporates a titanium coupling post and a manual drilling method. However, the “gripping” properties of HA are not as favorable as those of porous polyethylene. The difference between these 2 leading implants is best understood using a basic carpentry analogy. Placing a screw into HA is similar to anchoring a screw into plaster board, while screwing into porous polyethylene is more similar to placing a screw into wood. Effective anchoring of a coupling device into HA requires a sleeved technique. This results in a larger defect in the implant, whereas the simple screw anchoring system of porous polyethylene results in a smaller defect in the implant. Thus, if the positioning of the MCP is not desirable, it could be easily repositioned or replaced without affecting the integrity of the implant.

Although this series demonstrates the feasibility of primary placement of an MCP, the surgeon should exercise appropriate caution when considering this technique. Migration or rotation of the implant between its intraoperative and final postoperative position may result in decentration or misdirection of the coupling post. The asymmetric anterior surface of the im-

Figure 6. Secondary exposure of the post. A, The conjunctiva is placed on traction overlying the head of the post, and minimal cautery is applied to the conjunctiva. B, The conjunctiva is gently retracted around the post. If necessary, the screw may be backed out to the desired height above the conjunctival surface.
plant permits us to easily monitor its rotational position. Before pursuing primary placement of the MCP, we noted stable positioning of the conical implant from its intraoperative to final postoperative position. Similar stability may occur with placement of spherical implants, but that would be more difficult to assess clinically. Furthermore, in our experience with secondary placement of a motility post on spherical surfaces, the desired centration has been difficult to achieve.

It seems intuitive that the additional surgery of placement of a motility post may increase the potential implant-related complication rate. Conversely, it seems improbable that motility peg placement would cause a decrease in the implant complication rate. Thus, before placing a motility post, the surgeon should have well-developed indications for the placement of such a device.

Criteria for the placement of any motility coupling device should include increasing implant motility and providing support of the prosthesis, which results in decreasing the mechanical burden on the lower eyelid. More quantitative methods documenting the enhanced small-angle conversational movements and larger-angle ductions found with peg placement are needed to provide a more objective assessment of this intervention.12

It is also important to consider other potential non–implant-related complications that may be associated with increased ocular prosthetic motility. Occasionally, as the prosthesis moves, a clicking sound is heard as the coupling post moves in and out of the depression in the back of the prosthesis. Good prosthetic motility requires efficient translation of implant movement to an overlying prosthesis (improved with mechanical coupling) and adequate depth of the conjunctival fornices that must accommodate prosthetic movement. When the coupling of the implant is addressed through placement of a motility peg, fornix depth becomes a more limiting factor. Reduction of the prosthesis size permits enhanced movement but increases the risk of exposure of the anophthalmic socket in more extreme horizontal gaze, while failure to reduce the size of the prosthesis results in a greater risk of prosthetic dislocation. Also, increased prosthetic movement may create more friction between the prosthesis and the conjunctiva, resulting in more conjunctival inflammation and discharge from the anophthalmic socket.

Given these potential limitations, a possible compromise approach would be deep primary placement of a coupling post when surgery proceeds uneventfully. Postoperatively, after the initial fitting of an ocular prosthesis, a thoughtful as-
Assessment of prosthetic motility could guide the clinician to determine the real need for a coupling post. A subconjunctival MCP without exposure may result in sufficient elevation of the conjunctiva to permit enhanced motility in a custom-fit impression prosthesis. Coupling should be considered if there is excellent implant motility, there is adequate depth of the fornices, and a custom fit prosthesis does not efficiently transfer the implant’s movement to the socket implant. In this initial series, few patients (13 [≈40%]) had exposure of the MCP. If MCP coupling is indicated, a small conjunctival cut down over the head of the motility post could be performed and the motility post could then be advanced out to the desirable height above the conjunctival surface. This procedure is technically simpler and more comfortable than secondary drilling of the implant.

Primary placement of an MCP is offered as a potential surgical option, not a mandate. Our series demonstrates the ease and predictability of this procedure with minimal complications. Additional investigation is needed to further measure centration of the MCP and prosthetic motility before and after coupling. In selected patients, primary placement of the coupling post offers several advantages, including greater patient acceptance, technical simplicity, and the potential for definitive primary fitting of an ocular prosthesis. By avoiding the need and expense of postoperative implant imaging (to evaluate vascularization), secondary surgery (coupling post placement), and additional prosthetic fitting, a more rapid and efficient rehabilitation is possible.

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REFERENCES


A look at the past...

The chief advantage of the intracapsular cataract extraction is that the operation is practicable in the immature stage of the cataract. Furthermore, the visual results are surely much better than after capsulotomy. There are not many systematic reports on successive cases to furnish a comparison with the results previously obtained with the extracapsular methods. In my series of 300 successive cases, the visual results were 20/30 or better in 90 per cent, whereas the figures for this visual acuity in the cases of extracapsular extraction ranged from 52-62 per cent.