Implantation of Glaucoma Drainage Implant Tube Into the Ciliary Sulcus in Patients With Corneal Transplants

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The placement of glaucoma drainage implants may be complicated by tube-corneal touch and endothelial decompensation, particularly after corneal transplantation. We describe an innovative surgical approach to glaucoma drainage implant procedures that may decrease such complications. The approach involves placement of the shunt tube into the ciliary sulcus. This approach may serve as an alternative to anterior chamber angle or pars plana implant placement in pseudophakic or aphakic eyes with refractory glaucoma and a high risk for corneal decompensation.

The surgical outcome of trabeculectomy in secondary glaucoma is poor unless antimetabolites are being used concurrently. Alternatively, the outcome may be improved by anterior chamber placement of a glaucoma shunt tube. This procedure may result in tube-corneal touch and endothelial decompensation resulting in graft failure. Placement of the shunt tube through a pars plana sclerostomy combined with vitrectomy has recently been suggested. This procedure may decrease the risk for corneal complications, but may result in posterior segment complications.

We describe an innovative surgical approach to glaucoma drainage implant in which the shunt tube is introduced into the posterior chamber through a ciliary sulcus sclerostomy.

**SURGICAL PROCEDURE**

Limbal peritomy is performed in the upper nasal or temporal quadrants, exposing the scleral bed. An Ahmed or a Molteno implant is secured to the sclera with 6-0 polyester sutures 8 and 10 mm posterior to the limbus, respectively, between the superior rectus and the horizontal recti muscles. A 3- to 5-mm-long scleral tunnel is made with an angled crescent knife to secure the drainage tube and prevent late exposure. The sclerostomy into the ciliary sulcus is performed under a 3×3-mm, half-thickness, limbal-based scleral flap (Figure 1) with a myringotomy blade, approximately 1 mm posterior to the limbus at the 11- or 1-o'clock position. The blade is inserted with its shaft perpendicular to the limbus and beveled parallel to the iris plane. The position of the ciliary sulcus relative to the limbus was previously described for scleral fixation of posterior chamber intraocular lenses. The position of the blade tip is viewed during the procedure through the dilated pupil to confirm its location and avoid ciliary body separation. Iris retractors may be used to improve the view. The tube is introduced into the posterior chamber through the scleral tunnel and the sclerostomy under the limbal-based scleral flap. The edge of the tube protrudes approximately 3 mm into the posterior chamber. The shunt tube may not exceed the dilated pupillary margin, to avoid interference with vision. It should not be too short, to avoid possible closure by ciliary processes. The shunt tube is thus covered by scleral tissue except for 1 to 2 mm between the drainage implant and the posterior entrance of the scleral tunnel and 1 to 2 mm between the anterior opening of the scleral tunnel and the posterior lip of the limbal-based scleral flap (Figure 2). The fornix-based conjunctival flap is se-
cured to the limbus with 7-0 polyglactin sutures.

At the conclusion of the procedure, betamethasone acetate (3 mg) and gentamicin sulfate (20 mg) are injected subconjunctivally 180° away from the implant site. Postoperative topical treatment includes 0.3% gentamicin sulfate, 4 times a day, 1% cyclopentolate hydrochloride, three times a day, and 0.1% dexamethasone sodium phosphate, 4 times a day and tapered gradually to once a day.

**PATIENTS AND RESULTS**

This procedure was performed in 3 patients. The personal data, indications, preoperative treatments, and preoperative and postoperative visual acuities and intraocular pressures are summarized in the Table.

The patients for this procedure were selected carefully. All had refractory glaucoma and a high risk of corneal decompensation; all had undergone other surgical procedures that failed to control their intraocular pressure; and there was potential to improve the vision in all cases. The insertion of the tube through the ciliary sulcus was selected as the procedure of choice, owing to the combination of pseudophakia or aphakia, corneal graft, and moderate shallowing of the anterior chamber. Ocular pain was alleviated following the procedure in all 3 patients.

The mean preoperative intraocular pressure was 36.2 mm Hg (range, 32-41 mm Hg) with full antiglaucoma medical treatment. The pressure decreased by approximately 25 mm Hg to 11.3 mm Hg (range, 8-14 mm Hg) postoperatively without any antiglaucoma medication. Visual acuity remained stable during a mean follow-up of 18 months (range, 16-20 months). The corneal grafts remained unchanged without complications. Figure 3 demonstrates the tube in the posterior chamber 13 months after surgery in patient 3.

**COMMENT**

A glaucoma drainage implant is an alternative to increase the success rate of filtration surgery in certain secondary glaucomas after failure of trabeculectomy with adjunctive antimetabolites. Introducing the shunt tube into the anterior chamber may be complicated by tube-corneal touch in 8% to 20% of patients and endothelial decompensation in 17% to 19% of patients. The risk of endothelial decompensation due to tube-corneal touch is further increased to 42% in eyes with corneal transplants.

Glaucoma develops in up to 53% of patients who have had penetrating keratoplasty. It is usually managed by cyclodestruction, which is associated with postoperative inflammation and may result in decreased visual acuity and phthisis bulbi. Improved surgical results have been reported after placement of the glaucoma drainage implant through the pars plana. However, this procedure requires pars plana vitrectomy to allow free access of aqueous humor into the tube. Our approach combines several potential advantages, namely, avoidance of pars plana vitrectomy and posterior segment complications, and a decreased risk for corneal decompensation. In the presence of a posterior chamber intraocular lens and intact posterior capsule, the optic of the intraocular lens may prevent incarceration of the capsule into the tube and vitrectomy may...
be avoided. In aphakia, anterior vitrectomy may be sufficient. This procedure is simple and easy to perform by the anterior segment surgeon and, potentially, it may be used as an alternative for cyclodestruction, which has a less predictable result.

Ciliary sulcus placement of a shunt tube may be indicated in pseudophakic or aphakic eyes for refractory glaucoma in primary corneal diseases such as Fuchs endothelial dystrophy, in corneal transplantation, in shallow anterior chamber, or in extensive synechial angle closure. The procedure may be particularly advantageous in the presence of an anterior intraocular lens, since the tube would not disturb the lens. It is contraindicated in phakic eyes, since it may endanger the integrity of the crystalline lens.

We did not encounter major potential intraoperative complications such as ciliary body separation or suprachoroidal hemorrhage in these procedures. We operated on a limited number of patients owing to strict enrollment criteria. A larger series and a longer follow-up are required to establish the efficacy and safety of this procedure and to support its use as an alternative to other techniques.

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REFERENCES