

Case Report

The Road Less Traveled: Ciliary Sulcus Implantation of the Preserflo MicroShunt

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Keywords

Preserflo MicroShunt · Sulcus · Glaucoma surgery · Minimally invasive glaucoma surgery

Abstract

Introduction: Herein, we report on the option and clinical advantage of the Preserflo MicroShunt insertion into the posterior chamber ciliary sulcus in a patient with advanced pseudoexfoliation glaucoma at a high risk of corneal decompensation. **Case Presentation:** We describe a 64-year-old advanced pseudoexfoliation glaucoma patient who despite maximal tolerated medical therapy and two failed glaucoma surgeries, still suffered from uncontrolled intraocular pressure (IOP) of 36 mm Hg in his left eye. The patient underwent the implantation of the Preserflo MicroShunt. The shunt was placed nasally into an area of unscarred conjunctiva, with the anterior part of the shunt inserted into the ciliary sulcus. Postoperatively, the patient's IOP dropped to 6 mm Hg on the first day and stabilized at 11 mm Hg at the 6-month mark. An elevated, posteriorly located bleb was observed, and the patient no longer required additional topical medications. Endothelial cell (EC) count remained stable with no signs of corneal edema. The patient did not experience any serious postoperative complications. **Conclusion:** Implantation of the Preserflo MicroShunt into the ciliary sulcus appears to be a viable option for patients at high risk of corneal decompensation, hence, offering effective IOP control while minimizing EC loss. Further studies with larger patient groups are warranted to better evaluate the safety and efficacy of this technique.

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Introduction

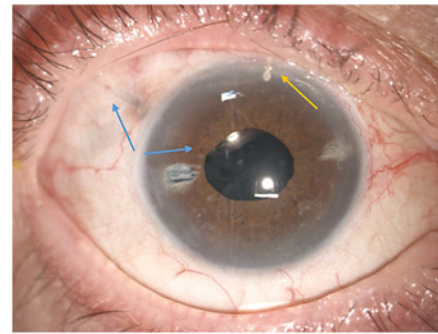
Glaucoma drainage devices (GDDs) provide a flow of aqueous humor from the anterior chamber to the subconjunctival space [1]. In recent years, the advent of minimally invasive glaucoma surgery (MIGS) [2] has introduced a range of innovative techniques and devices. These methods enhance aqueous humor outflow through various pathways, including the trabecular meshwork, suprachoroidal space, and subconjunctival route. One of these new techniques is the insertion of the Preserflo MicroShunt (Santen, Osaka, Japan), an ab-externo microshunt, which decreases intraocular pressure (IOP) through subconjunctival drainage of the aqueous humor from the anterior chamber [3].

A significant concern with traditional tubes has been the potential for endothelial cell (EC) damage and corneal decompensation. Tube-endothelial contact which may occur during eye rubbing, movement, and blinking, has been implicated in corneal endothelial decompensation when tubes are inserted through the anterior chamber angle [4, 5]. Studies have reported EC loss rates ranging from 7% to 27% [6, 7]. In recent years, Alcon voluntarily withdrew the CyPass Micro-Stent from the global market due to concerns over EC loss observed in a 5-year post-surgery analysis [8]. Tube implantation into the pars plana or ciliary sulcus has been investigated as a possible route to reduce contact in cases with a risk of corneal decompensation or peripheral anterior synechiae [9]. Tube insertion into the ciliary sulcus has been proposed as a more advantageous option because insertion into the pars plana is thought to be associated with a higher incidence of posterior segment complications, such as, retinal detachment and vitreous hemorrhage. This procedure is recommended only in eyes that have undergone a pars plana vitrectomy [10]. Ciliary sulcus implantation has been shown to reduce EC loss at a rate of <50% of placement in the anterior chamber [11]. Although the Preserflo MicroShunt is considered less invasive than drainage devices such as the Ahmed glaucoma valve (AGV), some studies have demonstrated that the implant is associated with EC loss from the immediate postoperative period that continues over time (7.4% per year) although tubes located >600 µm from the endothelium showed EC loss close to zero [12]. Other studies have shown no significant change after 2 years of follow-up [13]. A previously published case describes preserflo implantation in the posterior chamber, with the bevel oriented downwards to prevent iris incarceration [14]. Herein, we describe the clinical outcome and complications of the Preserflo MicroShunt tube insertion into the posterior chamber via the ciliary sulcus, in a bevel up fashion, in a patient at risk of corneal decompensation.

Case Presentation

We present the case of a 64-year-old patient with advanced pseudoexfoliation glaucoma and uncontrolled IOP in the left eye (36 mm Hg), despite maximal tolerated medical therapy. The patient had previously undergone two glaucoma surgeries in this eye: a superiorly placed trabeculectomy with an EX-PRESS Glaucoma Filtration Device and a temporally placed AGV with a sulcus located tube. Both surgeries eventually failed due to conjunctival fibrosis. Moreover, the patient had a history of complicated cataract surgery in this eye, which required an anterior vitrectomy and the implantation of an scleral-fixated intraocular lens (Fig. 1). His EC count (ECC) was 1,024 cells/mm², placing him at a high risk for corneal decompensation. After an in-depth discussion with the patient, it was decided to implant a nasally located Preserflo MicroShunt into an area of unscarred conjunctiva. To mitigate the risk of EC loss, the anterior part of the shunt was implanted via the ciliary sulcus into the posterior chamber.

Fig. 1. Patient's left eye. At 10 o'clock, blue arrow the tube of a previous failed Ahmed glaucoma valve is observed, in addition to its tip picking behind the iris and at 12 o'clock, yellow arrow, the EX-PRESS glaucoma filtration device shunt can be seen.



Surgical Technique

A fornix-based conjunctival flap was created in the superior-nasal quadrant of the left eye. The episclera and sclera were treated with three sponges soaked in 0.4 mg/mL mitomycin C for 3 min, placed away from the corneal limbus, and then meticulously rinsed with a balanced salt solution. A scleral tunnel was created starting 3 mm posterior to the limbus. As in “standard Preserflo implantation,” the initial part of the scleral tunnel is created superficially and extends up to 1 mm from the limbus. For the second part of the tunnel, in this case, a 25 G angled needle is inserted from that point, directed toward the ciliary sulcus at a steeper angle compared to the usual anterior chamber implantation, aiming below the iris plain.

The location of the tunnel exit via the ciliary sulcus was verified by elevating the tip of the needle and observing the needle's imprint on the iris. The implant was subsequently inserted into the scleral tunnel with the device's “fins” fitting tightly into the tunnel's ostium. The insertion was performed with the bevel up, following the standard technique used for implanting the device in the anterior chamber.

Patency was confirmed by the visible fistulation of the aqueous humor at the end of the shunt. The posterior part of the Preserflo MicroShunt was then sutured to the sclera with a single 10-0 nylon suture. The Tenon's capsule and conjunctiva were reapproximated to the limbus and secured with two 10-0 nylon sutures and one 10-0 nylon mattress suture, with the knots buried in the tissue. Upon completion of the surgery, an injection of Sub tenon 0.1 mL of Healaflow (Swiss Aptissen) was added at the bleb location in addition to an inferior injection of subconjunctival steroids and antibiotics.

Outcomes

On the first postoperative day, the IOP significantly dropped to 6 mm Hg. By the 6-month postoperative mark, the IOP had stabilized at 11 mm Hg, and the patient no longer required additional topical medications. An elevated posteriorly placed nasal bleb was observed. ECC was 977 cells/mm² with no signs of corneal edema. Ultrasound biomicroscopy was used to verify the tube's location (Fig. 2).

Discussion

Placement of a GDD tube into the anterior chamber may increase corneal endothelial damage, leading to corneal decompensation, and in cases of patients after corneal transplant surgeries, graft rejection, especially, in eyes with a shallow anterior chamber [15]. A reduction in the number of ECs by 20%–35% 2–3 years after tube implantation in the anterior chamber has been reported [10]. When placing the tube into the ciliary sulcus, the end of the tube is



Fig. 2. Ultrasound biomicroscopy demonstrating the Preserflo MicroShunt's (orange arrow) location in the ciliary sulcus.

positioned as far from the cornea as possible, thereby, avoiding contact with the cornea [10], and decreasing EC loss.

New devices and techniques in glaucoma surgery have emerged, offering less invasive options with improved safety profiles. However, these minimally invasive glaucoma surgery (MIGS) devices that include anterior chamber tubes, such as the Xen 45 (XEN45 μ m, Allergan Plc., USA) or the Preserflo MicroShunt, still result in EC loss, albeit, at a relatively lower rate [12]. In the case of Preserflo implantation, EC loss begins shortly after surgery and continues over time, following a similar pattern of ongoing EC loss previously described for long-tube shunts [11–13].

In the present case, the patient had experienced two failed filtration surgeries; hence, we opted for a minimally invasive approach. Given the high risk of corneal decompensation, we believed that placing a tube into the ciliary sulcus would lower the risk of corneal EC loss while maintaining controlled IOP. We chose to use the Preserflo MicroShunt for this procedure, as there was a small area of viable conjunctiva in the superior-nasal part of the eye.

The internal part of the Preserflo tube is shorter compared to other GDDs, i.e., the AGV. The distal part of the Preserflo tube, extending from the “fins,” measures 4.5 mm, leaving approximately 3 mm of the tube inside the eye, posterior to the iris. This can present a technical challenge in seeing and verifying the location of the tube after insertion, especially, when the tube is not inserted as part of a combined procedure. After implantation of the tube, we verified that it was in place and working, by visually verifying flow through the tube. The latter would likely have resulted in tube occlusion by vitreous with no observable flow. Healaflo was injected under the conjunctiva at the tube entrance location. This absorbable spacer, known for its anti-inflammatory properties, also aids in reducing postoperative scarring after glaucoma surgery [16]. Ultrasound biomicroscopy, subsequently performed, confirmed the tube's location (Fig. 2).

Implantation of the Preserflo MicroShunt tube into the anterior chamber could induce corneal decompensation due to postsurgical tube malposition and potential iris injury. Implantation through the pars plana into the vitreous can reduce injury to the cornea, iris, and the anterior chamber angle. However, this method is feasible only in eyes that have previously undergone a vitrectomy. Furthermore, the tube tip may become occluded by vitreous unless the vitreous base has been completely removed.

The advantage of implanting the Preserflo MicroShunt into the posterior chamber via the ciliary sulcus, as demonstrated in this case, rests on the fact that injury to the cornea, iris, and anterior chamber angle is avoided. This technique can be performed even in eyes where a prior vitrectomy was not performed, making it particularly beneficial for eyes with corneal transplants or a low EC count. Therefore, it is crucial to perform an ECC before surgery, especially after multiple procedures, to tailor the most suitable approach for each patient.

A few serious posterior segment complications have been reported in studies examining tube implantation into the ciliary sulcus [15]. These complications include bleb encapsulation, hyphema, tube blockage, choroidal detachment, and corneal decompensation. In our case, the patient did not experience any of these complications.

A major limitation of this case report is its short follow-up period. However, this is the first report describing the implantation of the Preserflo MicroShunt into the ciliary sulcus in this fashion, providing insights despite the limited duration. Since there are only a few descriptions of the implantation of the Preserflo MicroShunt into the ciliary sulcus, in order to better evaluate the safety and efficacy of this implantation, further studies with more patients and a longer follow-up are warranted.

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Statement of Ethics

This study protocol was reviewed and approved by the Local Institutional Review Board and Ethics Committee of the Hillel Yaffe Medical Center, Israel (HYMC 010924). Written informed consent was obtained from the patient for publication of the details of their medical case and any accompanying images. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see <https://doi.org/10.1159/000543219>).

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

E.B., M.M., A.S., and B.T. conceptualized the study, performed the methodology. M.M. and E.B. performed the formal analysis and investigation and prepared the original draft. M.M. and A.S. prepared the resources. B.T. and E.B. supervised the study. E.B. and A.S. acquired the data. All authors reviewed and have approved the manuscript for submission.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its online supplementary material files. Further inquiries can be directed to the corresponding author.

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