

Pars Plana Vitrectomy in Nanophthalmos

A small-gauged procedure with a sutureless, self-sealing incision facilitates phacoemulsification and the implantation of a foldable IOL in abnormally small eyes.

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Nanophthalmos is a rare bilateral condition in which the eye is pathologically small but morphologically normal.¹ The combination of a short axial length (15 to 20 mm) and a high ratio of lens-to-eye volume results in severe axial hyperopia, a crowded anterior segment, and angle-closure glaucoma.² These eyes are therefore some of the most challenging on which to perform phacoemulsification and IOL implantation.

A crowded anterior chamber coupled with a positive posterior vitreous pressure complicate sequential surgical steps during phacoemulsification. Ophthalmologists may have difficulty constructing the corneal incision due to peripheral iridocorneal proximity and apposition, and they may find the anterior capsulorhexis hard to control, because the capsule's convexity steers the capsular tears peripherally. Using a forceps in a crowded anterior chamber is tricky. Moreover, the anterior location of the iris leads to its prolapse and contact with instruments, which result in intraoperative pupillary constriction. The close proximity of the phaco tip to the cornea causes endothelial cell loss and corneal edema.³ In addition, it is challenging to place a piggyback IOL due to the anterior chamber's restricted depth. Intraoperative maneuvers to increase the anterior chamber depth using a viscoelastic substance and elevating the bottle's height can help, but not always.^{4,5}

Several strategies have been described for lowering the IOP and shrinking the vitreous prior to cataract surgery in eyes with shallow anterior chambers.⁶⁻⁹ This article describes a technique for decompressing the vitreous prior to cataract surgery with phacoemulsification by means of a sutureless, 25-gauge, high-speed vitrectomy system (1,500 cuts/min). This approach effectively decompresses the vitreous without conjunctival dissection or scleral suturing. Minimal trauma helps to

increase the anterior chamber depth and decrease positive posterior pressure before phacoemulsification.

STEP No. 1: SMALL-GAUGED PARS PLANA VITRECTOMY

First, we perform a vitreous tap using the Millennium Transconjunctival Standard Vitrectomy 25 (TSV25) System (Bausch & Lomb, Rochester, NY) prior to phacoemulsification. We anesthetize the eye with topical tetracaine 0.5% (Novartis Ophthalmics, Inc., Duluth, GA). After pulling the conjunctiva aside, we introduce a 25-gauge trocar and microcannula transconjunctivally, 3.5 to 4.0 mm posterior to the limbus through the pars plana, as measured with a caliper, and angled down toward the optic nerve. This directionality is important to ensure that the trocar does not contact the posterior capsule.

The trocar forms a continuous bevel with the microcannula to ease the entry of the latter instrument. Re-



Figure 1. Pictured are the cannulas used during 25-gauge vitrectomy.



Figure 2. The TSV25 System uses the lightning handpiece with a high-speed electric cutter.

ferred to as an *entry alignment system*, the 25-gauge cannula (Figure 1) aligns the conjunctival and scleral entry sites, which obviates the need for conjunctival dissection. It is helpful to maneuver the system in a circular motion between one's fingers and to counterbalance the applied pressure by having the patient look toward the entry site.

We remove the trocar and introduce the electric cutter (Figure 2) into the vitreous cavity through the microcannula.¹⁰ It is important to note that, on occasion, one may not be able to visualize the cutter within the eye, either due to a small pupil or dense cataract. In such cases, we recommend using a pen to mark off on the cutter the desired distance at which one wants to enter the eye in order to avoid introducing too much of the instrument into a small eye and perhaps traumatizing the retina (Figure 3).

We aspirate a small amount of vitreous (approximately 0.5 to 1.0 mL) and use no infusion. Throughout the vitrectomy, we monitor the IOP by pressing on the eye with a toothless forceps so as not to remove too much vitreous.¹¹ After the chamber has deepened, we remove the microcannula from the pars plana and apply pressure to the area. The sclerotomy site need not be sutured, because it is self-sealing.^{10,12}

STEP No. 2: PHACOEMULSIFICATION

We perform phacoemulsification in our usual fashion. If desired, the surgeon may deepen the anterior chamber further with a superviscoelastic agent such as Healon 5 (Advanced Medical Optics, Inc., Santa Ana, CA), which has both maximally cohesive and highly retentive properties. We create a continuous curvilinear capsulorhexis and then perform hydrodissection and hydrodelineation. After phacoemulsifying the lens with the quick-chop technique, we piggyback foldable IOL implants with one in the capsular bag and the other in the sulcus.

DISCUSSION

True nanophthalmos is an uncommon condition present in only 20% of cases with short eyes, in which

the abnormality is due to short anterior segments.² In the remaining 80% of cases, the abnormality is usually a foreshortened axial length due to a shortened posterior segment.¹³ Shallow, crowded anterior chambers present one of the most technically challenging situations for cataract surgeons. These severely hyperopic eyes are at high risk of complications,¹⁴ including suprachoroidal hemorrhage.¹⁵ In addition, these eyes commonly develop ocular conditions such as chronic angle closure, pseudoexfoliation with zonular loss, spherophakia, and trauma.^{16,17}

As previously described by Chang,⁵ combining preoperative mannitol and ocular compression and then administering an intraoperative injection of a viscoelastic agent is often sufficient for deepening the anterior chamber.^{5,18} Occasionally, however, the anterior chamber is so shallow that the globe will become excessively firm before the ophthalmologist can inject enough viscoelastic to create sufficient space. In such eyes, an automated pars plana vitreous tap may safely expand the anterior segment to permit routine phacoemulsification and IOL implantation.^{5,6,11,19} Another option is a vitreous tap technique that employs a 23- to 26-gauge needle on a 1-mL tuberculin syringe when automated vitrectomy instrumentation is not available.²⁰

We have found the small-gauged technique described in this article to be superior to the traditional pars plana vitrectomy (PPV). The 25-gauge system is less traumatic to the eye, and it provides patients with a speedier recovery. Additionally, patients require fewer postoperative drops.²¹ Of greater significance, however, are the pre- and intraoperative advantages of the 25-gauge versus the 20-gauge system. Vitreous decompression with



Figure 3. The surgeon marks the cutter with a pen to indicate the length entering the eye.

the 25-gauge system involves topical anesthesia. In contrast, traditional vitrectomy requires the administration of a retrobulbar local anesthetic.⁶ Although effective, retrobulbar anesthesia can cause life-threatening and serious ocular complications such as brainstem anesthesia, retrobulbar hemorrhage, perforation of the globe, injury to the optic nerve, ptosis, and an ocular motility defect.^{22,23}

Another disadvantage of the standard 20-gauge system is that the surgeon must perform a conjunctival peritomy. After completing the peritomy, the ophthalmologist must create a 1-mm sclerotomy with a No. 19 microvitrectomy blade, and the sclerotomy site is closed with sutures at the conclusion of the vitrectomy. Numerous complications are associated with traditional sclerotomy sites, including vitreous incarceration, traction on the retina, entry-site retinal tears, injury to the ciliary body, fibrovascular downgrowth, protruding sutures, wound dehiscence, unstable IOP during closure, and postoperative hypotony.²⁴

Because the 25-gauge system reduces the diameter of the incision from approximately 1.0 to 0.5 mm, a conjunctival peritomy is unnecessary. The natural elasticity of the scleral tissues adequately approximates the sclerotomy wound, thus allowing for a completely self-sealing, sutureless procedure. The TSV25 System's microcannula is narrow enough for insertion directly through the conjunctiva and sclera. The small tracts it creates produce self-sealing conjunctival and scleral incisions upon the cannula's removal,¹⁰ thereby avoiding the aforementioned complications associated with traditional sclerotomy sites.^{25,26}

The motor-driven TSV25 System uses a vitrector with a high-speed electric cutter, which eliminates the pulsing associated with pneumatic cutters. By creating minimal traction on the vitreous, the system's high cutting rate improves procedural safety and efficacy.²⁷ The pneumatic cutter causes the duty cycle (ie, the time that the vitrectomy port remains open) to be harder to control as the cutting speed increases. In contrast, the electric cutter allows the ratio to remain 50:50 for successful cutting.²⁶

CONCLUSION

We have experienced no complications of vitrectomy, cataract surgery, or corneal decompensation with small-gauged, sutureless PPV in seven eyes of four patients with nanophthalmos. We believe that the TSV25 System represents a simpler, quicker, and less traumatic alternative to the traditional automated approach. By performing a PPV before phacoemulsification, we minimize the risk of intraoperative complications in nanophthalmic eyes while maintaining the safety and advantages of small-incision cataract surgery. ■

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