

Aurolab aqueous drainage implant in the vitreous cavity: Our modifications over the conventional technique of glaucoma implant surgery

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Glaucoma drainage devices (GDDs) are used for managing refractory glaucoma due to failed trabeculectomy, neovascular glaucoma, traumatic glaucoma, and secondary glaucoma post keratoplasty. Aurolab aqueous drainage implant (AADI) is a nonvalved drainage implant conventionally implanted with the tube placed in the anterior chamber. Studies about the outcome of the various aqueous drainage devices implanted in the anterior chamber have reported complications such as tube extrusion, migration, blockage, erosion, and corneal decompensation. We propose modifying the conventional GDD implantation technique by placing the tube in the vitreous cavity, thereby negating the risk of anterior segment complications in patients with refractory glaucoma whose anterior segment is already compromised. Another novel approach implemented in this technique was making a scleral tunnel instead of using a scleral or corneal patch graft to cover the tube to prevent its migration. This article describes the surgical steps of this technique and its advantages, along with a surgical video.

Key words: Refractory glaucoma, aurolab aqueous drainage device, vitreous cavity, anterior chamber, surgical technique, intraocular pressure

Diagnosis and glaucoma management has seen a paradigm shift in the past decade with many innovations in investigative modalities, medical and surgical management. Despite all the advances, it remains a chronically progressive irreversible cause of blindness worldwide, and the prevalence of glaucoma in India ranges from 2.2% to 5.8%.^[1,2] Intraocular pressure (IOP) control has improved with newer anti-glaucoma medications, but all have their pros and cons. When glaucoma is not controlled, even with maximum medical management, filtering surgery is the gold standard approach. Many modifications, such as using antimetabolites and ologen implants, have been used with trabeculectomy to improve the success rates and increase the bleb's longevity.^[3]

In cases refractory to the above-mentioned conventional treatment, a glaucoma drainage device (GDD) is used. The indications for GDD are failed trabeculectomy, neovascular glaucoma, malignant glaucoma, secondary glaucoma post penetrating keratoplasty, uveitic glaucoma, traumatic glaucoma, and congenital glaucoma. Recently published data suggest that primary surgery for glaucoma by tube has the same outcomes compared to filtering surgery with antimetabolites in terms of safety and IOP control.^[4] We describe a modification of the conventional GDD implantation technique, which we follow in the above-mentioned refractory cases.

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Surgical Technique

Conjunctival dissection

The first step is to make an inferior 120 degrees fornix-based conjunctival peritomy from 4 o'clock to 8 o'clock, and the underlying tenon's capsule is also dissected meticulously. Care should be taken to undermine conjunctiva and tenons properly, so there is no risk of conjunctival tearing. A fornix-based peritomy gives better exposure than a limbal-based peritomy for proper implant insertion and minimizing tissue damage [Fig. 1a].

Rectus muscle bridling

After peritomy, the medial rectus and inferior rectus muscles are first hooked and then bridled using a 4-0 silk suture. The bridle suture also acts as a tractional suture to facilitate implantation and manipulation of the aurolab aqueous drainage implant (AADI) during surgery [Fig. 1b].

Scleral tunnel

A distance of 3 mm, 3.5 mm, or 4 mm is marked from the limbus using calipers depending upon the lens status, whether aphakic,

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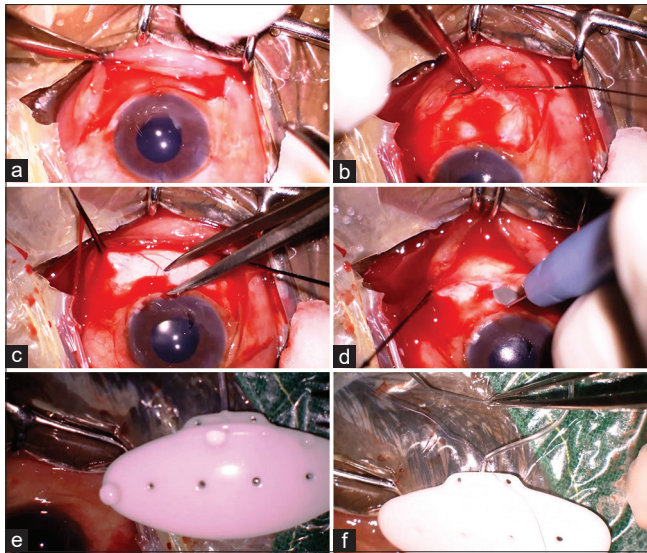


Figure 1: (a) Fornix-based Conjunctival dissection. (b) Rectus muscle bridling. (c) 3.5 mm from the limbus is marked for a scleral tunnel. (d) Scleral tunnel is fashioned 4 mm in length and 2 mm in breadth. (e) Checking patency of tube. (f) Ligation of tube with CHQ knot and checking for complete tube blockage

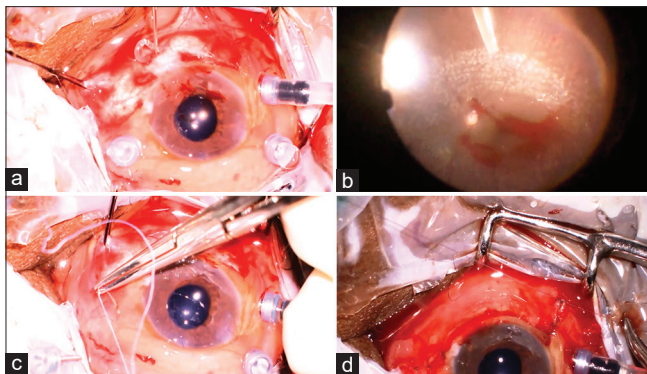


Figure 3: (a) Introducing the tube in Vitreous cavity. (b) Tube in Vitreous Cavity. (c) Port closure. (d) Closure of peritomy

pseudophakic or phakic, respectively, at a location between the two rectus muscles. A partial-thickness scleral tunnel is fashioned in the inferonasal quadrant using the crescent blade, approximately 4 mm in length and 2 mm in breadth. We have avoided using any scleral or corneal patch grafts and instead used the patient's sclera to cover the tube [Fig. 1c and d].

Patency of the implant

We first check the tube patency by injecting a balanced salt solution (BSS), and one should also look for any manufacturing defect at this step. Then, the AADI tube's proximal end is ligated with a clove-hitch knot using a 7-0 vicryl suture and checked for complete tube blockage. If BSS oozes at the implant base, it suggests incomplete blockage and should be tightened further. Complete tube occlusion is essential to prevent sudden postoperative hypotony [Fig. 1e and f].

Scleral fixation of implant

Good conjunctival exposure and bridling the rectus muscle helps in easy insertion and avoids damage to the rectus muscle when done blindly. The implant plate is placed beneath the

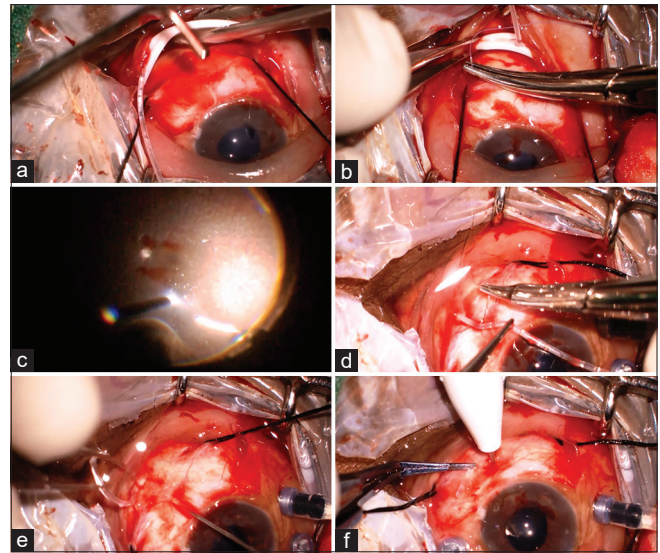


Figure 2: (a) Passing the implant plate beneath the rectus muscle. (b) Scleral fixation of the implant with 7-0 vicryl sutures. (c) Complete vitrectomy with Base dissection and scleral indentation. (d) Fenestration of the tube. (e) Passing of tube through the scleral tunnel. (f) Pars plana entry at the proximal end of the tunnel

rectus muscles behind the spiral of tillaux as posteriorly as possible. Anchoring sutures are passed through the sclera, and the fixation holes provided at the implant's footplate on either side of the tube with 7-0 vicryl suture, and the knot is buried inside the fixation hole. We found a lesser incidence of suture-related complications such as irritation, suture exposure, and granuloma using vicryl suture compared to nylon suture [Fig. 2a and 2b].

Pars plana vitrectomy

We perform a standard three-port pars plana vitrectomy, either 23 or 25 gauge. First core vitrectomy is done, and posterior vitreous detachment is induced if not present, and complete vitrectomy with a through base dissection is performed. We use intravitreal triamcinolone acetate for better visualization of the vitreous. Any additional retinal procedure, if required, can be completed during this step [Fig. 2c].

Tube implantation in vitreous cavity

We prefer to do fenestration of the tube using the needle of 7-0 vicryl at this step if an early reduction of IOP is desired. Fenestration is done after judging tube location in the tunnel to avoid anterior bleb formation [Fig. 2d]. A max grip forceps is then passed through the tunnel, and the tube of the implant is docked and then pulled through the tunnel using the forceps. Tube length of 2 mm is measured beyond the limbus, and the extra tube is trimmed with a scissor in a bevel-up fashion. We make a pars plana entry at 3.5 mm away from the limbus at the scleral tunnel's proximal end with a 23 G trocar. The tube's trimmed end is held by the max grip forceps and inserted into the vitreous cavity. The scleral tunnel area is gently massaged with an indenter to ensure no kinking of the tube. If the tube gets stuck in the port for some reason, it can be internalized using the same forceps through the vitreous cavity. Any remaining vitreous at the base around the tube should be removed to prevent future tube blockage. In this technique, there is no need for additional sutures to secure the tube as there is no exposed part of the tube subconjunctivally [Figs. 2e and f and 3a and b].

Closure of the ports & peritomy

The bridle sutures are first released, and the scleral ports are closed with 7-0 vicryl suture. The dominant and non-dominant ports are closed first. Conjunctiva is mobilized and then secured to its original position with 7-0 vicryl suture taking care that the closures should be watertight. The infusion port is closed last as it helps maintain the globe until the end of the surgery, thereby preventing sudden IOP changes in the glaucomatous eye. If hypotony is noted, intravitreal BSS can be injected in the end to form the globe [Fig. 3c and d].

Videos 1-3 (online content) show the surgical technique in detail.

Discussion

Aurolab aqueous drainage device (AADI) is a non-valved glaucoma shunt made of permanent implantable grade silicone polymer. The design of this implant is similar to the original Baerveldt glaucoma implant 350. The endplate's surface area is 350 mm², and the silicon plate and tube length are 32 and 35 mm, respectively. It has two fixation holes in the silicone plate, which can be anchored to the sclera using 8-0 or 9-0 nylon sutures. The plate's unique fenestration design allows fibrous tissue growth to control bleb height and volume, secure the plate in place, and minimize ocular motility disturbance.

Rathi *et al.*, in their study, found the AADI group had similar IOP control compared to Ahmed glaucoma valve with lesser need for anti-glaucoma medications at six months follow-up, leading to a higher complete success rate compared to Ahmed glaucoma valve group at six months follow-up.^[5]

Conventionally all the GDD implantation technique has been described for placing the tube in the anterior chamber (AC). However, placing the tube in the AC can cause tube migration, tube erosion, tube extrusion, and tube blockage by either iris or vitreous. The more dreaded complication is the corneal endothelial touch resulting in corneal decompensation, especially in young patients. AC insertion of the drainage tube is contraindicated in some instances such as shallow or disorganized AC, vitreous in AC, presence of peripheral anterior synechiae, or in cases of preexisting corneal diseases.^[6]

Pars plana implantation of the GDD tube was first proposed in 1991 but was not widely accepted due to posterior segment complications due to the non-availability of good vitrectomy machines.^[7] Placing the GDD tube in the vitreous cavity negates all the anterior segment complications, and with the modern vitrectomy machines, the risk of posterior segment complication is minimal. Pars plana tube insertion is preferred in coexisting retinal disorders such as retained lens fragments, proliferative diabetic retinopathy, epiretinal membrane, and neovascular glaucoma, which requires simultaneous vitrectomy.^[5]

In this technique's modification, a long partial-thickness scleral tunnel is made starting from pars plana going posterior beyond the spiral of tillaux with a crescent blade. Also, we do not need a scleral or corneal patch graft being used conventionally to cover the tube, which avoids crowding of implants and tissues and prevents tube-related complications. It is a relatively easier technique and cost-effective, and more importantly, it saves donor tissue for corneal procedures. During COVID-19 times, the donor tissue availability has become scarce and should only be reserved for corneal indications. The ligation suture gets absorbed and opens the

tube around 5-7 weeks post-surgery, and the patient is asked to continue the anti-glaucoma medication for that period. Further titration of topical glaucoma medication can be done after measuring the IOP once the tube opens and forms a bleb.

If the initial IOP is very high, the tube's fenestration can be performed before passing the tube through the tunnel, which will help in a faster lowering of the IOP. It can be either done after ligating the tube initially or later after anchoring the implant. We prefer after fixing the plate, as we want the fenestration to lie beneath the tunnel, so there are fewer chances of the fenestration being exposed subconjunctivally, leading to anterior bleb formation.

Bin Wang and Wenwei Li, in their meta-analysis comparing pars plana (PP) with AC GDD, showed that both the PP GDD and AC GDD procedures had similar efficacy of reduction in the IOP and number of medications with fewer complications in the pars plana group.^[8] Maheswari *et al.*, in their study, showed similar outcomes in both the groups with a 74% success rate in controlling IOP.^[6]

Conclusion

Our experience with this technique has yielded excellent outcomes with minimal complications in cases of refractory glaucoma and glaucoma associated with retinal pathologies that require vitrectomy. This procedure has been beneficial in cases with traumatic lens subluxation with secondary glaucoma, where this procedure can be combined with lens removal and scleral fixation of Intra Ocular Lens in a single procedure preventing multiple surgeries.

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Conflicts of interest

There are no conflicts of interest.

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