



Extension of a Severed Paul Glaucoma Implant Tube Using the Crawford Lacrimal Tube: A Novel Surgical Technique

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Dear Editor,

Glaucoma drainage devices (GDDs) are essential tools in the management of refractory glaucoma, particularly in patients with complex or secondary disease where traditional techniques are likely to fail. Among these devices, the Paul Glaucoma Implant (PGI; Advanced Ophthalmic Innovations, Singapore) has emerged as a promising alternative, especially in eyes at high risk of hypotony or surgical failure. Its low-profile, non-valved design has demonstrated efficacy and safety in multiple studies, offering favorable intraocular pressure (IOP) control with a low rate of complications.^{1,2}

As with any GDD, intraoperative or postoperative complications may occur with the PGI. Although tube transection is rare, it is a particularly challenging

complication that can compromise the function of an otherwise well-positioned implant. Tube transection may be identified during routine postoperative follow-up visits or during revision surgery, although it can also be inadvertently overlooked during exploration. When tube discontinuity occurs, options for salvage are limited. Complete device replacement is possible but increases surgical time, complexity, and cost. Therefore, several techniques have been described to re-establish tube continuity.

Methods for addressing tube discontinuity include the use of 22-gauge angiocatheter segments,³ silastic sleeves,⁴ and dedicated tube extenders,⁵ although many commercial extenders have been discontinued and may no longer be readily available. An alternative is the “tube-in-tube” technique, which involves inserting one tube inside another to create a continuous lumen. This method has been applied by reusing sterilized surplus tube segments from previous GDD surgeries⁶ or extending an Ahmed valve using a segment of Paul tube.⁷

Despite these options, there remains a need for low-cost, readily available, and biocompatible materials that ensure a secure, watertight connection between tube segments. Previous reports have described the use of Crawford lacrimal tubing to extend the tube of a GDD as a cost-effective alternative during revision surgery.⁸

The Crawford Lacrimal Intubation System (France Chirurgie Instrumentation S.A.S., Paris, France) is a commonly available instrument in ophthalmic surgery. The tubing component of the system is made of sterile medical-grade silicone—the same material as the Paul tube—and therefore provides smoothness, rigidity, and biocompatibility suitable for bridging severed tube ends.

Keywords: Paul glaucoma implant, Crawford tube, glaucoma drainage device, tube extension

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To the best of our knowledge, this is the first report describing the use of a Crawford lacrimal tube segment specifically to extend a severed tube of a PGI. The technique is simple, reproducible, and cost-effective and may serve as a practical alternative when conventional solutions are unavailable.

This method was successfully applied in a 76-year-old male patient who had undergone implantation of a PGI in the right eye two months earlier due to uncontrolled IOP despite maximal medical therapy. The patient presented for routine follow-up with signs of ocular inflammation, and slit-lamp examination revealed tube extrusion with transection of the drainage tube (Figure 1). Because the implant plate remained functional, the decision was made to extend the tube with a section of Crawford tube.

Under peribulbar anesthesia, a conjunctival peritomy was performed over the superotemporal quadrant. Blunt and sharp dissection exposed both the proximal (plate-attached) and distal (posterior chamber-directed) tube segments. The lumens were irrigated to ensure patency.

A 5- to 7-mm segment of Crawford tube was prepared. The tube's silicone composition and its lumen—practically identical to that of the Ahmed valve tube (Figure 2)—make it compatible with GDD tubing. However, its internal diameter (304 μm) is smaller than the external diameter of the Paul tube (467 μm), requiring gentle mechanical dilation to accommodate the tube.

A tube-in-tube configuration was created by dilating one end of the Crawford segment with forceps and introducing the proximal Paul tube into it, ensuring at least 3-4 mm of overlap to prevent dislocation. No sutures were used, relying on friction for stability.

The extended tube was reinserted into the posterior chamber by enlarging the existing communication tract with a 23-gauge needle. A fascia lata patch graft was placed for protection, and the conjunctiva was closed with 8-0 polyglactin sutures (Figure 3).

Postoperatively, the patient received topical antibiotics and corticosteroids. Follow-up assessments monitored IOP, tube stability, and inflammation.

The procedure was completed without complications. The reconstructed tube demonstrated a watertight, stable connection without kinking. The tube remained well-positioned in the posterior chamber, with good graft coverage. On postoperative day one, the anterior segment was quiet, with an IOP of 15 mmHg and no need for hypotensive medications. Subsequent follow-ups showed stable IOP and correct tube positioning.

These findings suggest that using Crawford tubing to extend a severed PGI tube is a safe and effective method that provides favorable short-term outcomes.

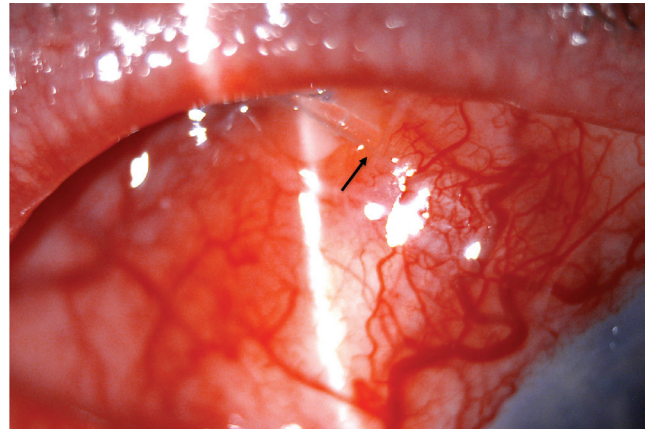


Figure 1. Slit-lamp photograph showing a severed tube of the Paul glaucoma implant (black arrow). The disconnection between the proximal and distal segments is visible in the superotemporal quadrant

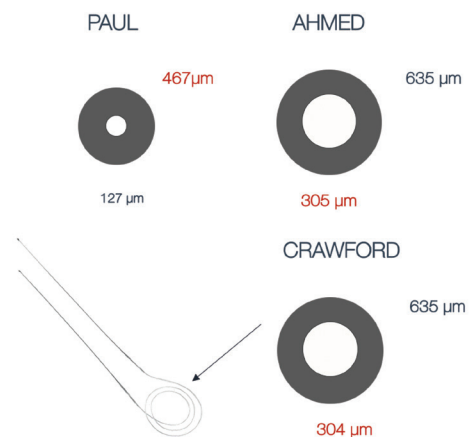


Figure 2. Comparative schematic representation of the external and internal diameters of the Paul and Ahmed glaucoma drainage device tubes and of Crawford lacrimal tube (black arrow indicates the silicone tubing component of the Crawford Lacrimal Intubation System). Note the similar lumen size between the Crawford and Ahmed tubes and the need to dilate the Crawford lumen to accommodate the external diameter of the Paul tube

Smith and Doyle³ proposed angiocatheter-based extension as a cost-effective option that avoids explantation and replacement of the entire implant. However, the Crawford tube is more commonly used in ophthalmology and is generally more accessible. The same applies to the silastic sleeves described by Kooner.⁴ The progressive discontinuation of dedicated extenders further limits alternatives, making readily available materials advantageous.

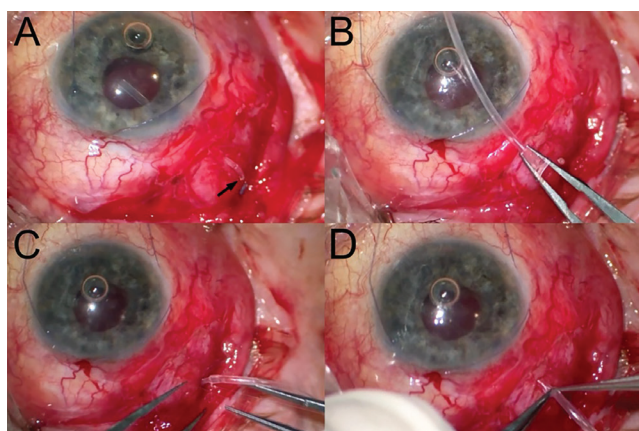


Figure 3. Intraoperative images illustrating the tube extension technique using a Crawford lacrimal tube segment. A) In situ view of the severed Paul glaucoma implant tube following extrusion (black arrow). B) Mechanical dilation of a short Crawford lacrimal tube segment using forceps to accommodate the Paul tube. C) Tube-in-tube configuration, with the proximal Paul tube inserted into the Crawford tube segment, ensuring adequate overlap for stability. D) Reintroduction of the extended tube into the posterior chamber through the existing sclerotomy

Regarding tube-in-tube techniques, using a segment of PGI tube to extend an Ahmed valve has been described.⁷ However, this solution cannot be applied when the remaining PGI tube is insufficient, and it increases cost by sacrificing part of a functioning implant. The technique proposed by Pandav et al.⁶ relied on leftover GDD tube segments from previous surgeries, but GDD tubing materials are not designed for resterilization. Additionally, their technique placed the extension in the anterior chamber, whereas our approach utilizes the benefits of posterior chamber placement.

Posterior chamber positioning is associated with better endothelial outcomes compared to anterior chamber placement. Godinho et al.⁹ observed significant endothelial cell loss over time in eyes with anterior chamber tubes, whereas ciliary sulcus or posterior chamber placement showed no significant endothelial cell density changes. Zhang et al.¹⁰ reported a significantly greater monthly endothelial loss in anterior chamber placement compared with ciliary sulcus positioning.

The Crawford tube provides a practical, biocompatible, and widely available solution for reconstructing severed tubes in PGIs. The technique is safe, reproducible, and cost-effective, offering a viable alternative to full device replacement while preserving implant function and maintaining stable short-term anatomical and IOP outcomes.

Ethics

Informed Consent: Informed consent was obtained from the patient, including consent for the use of relevant clinical information and images for scientific and educational purposes.

Declarations

Authorship Contributions

Surgical and Medical Practices: A.L.A., Concept: Á.C.V., E.A.G., Design: Á.C.V., Data Collection or Processing: E.A.G., M.B.C., M.R.C., J.V.P.L., Analysis or Interpretation: Á.C.V., G.R.F., M.B.C., Literature Search: Á.C.V., G.R.F., E.A.G., Writing: Á.C.V., G.R.F., E.A.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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