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Case Report

Acute Glaucoma and Pupiloplasty: A Surgical Challenge

Pablo Tejada González[1*], Javier Ascaso Puyuelo[1], Juana Martinez Morales[1], Carla Sánchez Remacha[1], Luca Bueno Borghi[1], Javier Ramos Duarte[1], Diana Pérez García[1], Juan Ibáñez Alperte[1]

[1]Hospital Clínico Universitario Lozano Blesa, Spain

***Correspondence author:** Pablo Tejada González, Hospital Clínico Universitario Lozano Blesa, Spain; Email: tejadagonzalezpablo@gmail.com

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Abstract

We report the case of a 75-year-old woman presenting with acute angle-closure glaucoma in the left eye, refractory to maximal medical therapy. Fixed mydriasis prevented laser peripheral iridotomy. One week later, the patient underwent phacoemulsification with intraocular lens implantation combined with a Single-Pass Four-Throw (SFT) pupiloplasty in four quadrants. The procedure restored pupillary anatomy, deepened the anterior chamber and achieved a sustained Intraocular Pressure (IOP) of 10 mmHg without topical medication. At two-week follow-up, best-corrected visual acuity improved to 0.8 (decimal notation; approximately 20/25 Snellen), with an open angle and complete symptom resolution. This case illustrates the role of SFT pupiloplasty as an effective adjunct in the surgical management of complex acute angle-closure glaucoma when laser peripheral iridotomy is not feasible.

Keywords: Acute Angle-Closure Glaucoma; Pupiloplasty; SFT Technique; Phacoemulsification; Fixed Dilated Pupil; Glaucoma Surgery

Introduction

Acute angle-closure glaucoma is typically caused by a pupillary block mechanism, in which resistance to aqueous humor flow from the posterior to the anterior chamber generates a pressure gradient. This leads to anterior bowing of the iris (iris bombé), resulting in appositional closure of the iridocorneal angle and a rapid increase in intraocular pressure.

Peripheral Anterior Synechiae (PAS) frequently develop during the acute episode due to sustained contact between the peripheral iris and the trabecular meshwork. In addition, elevated intraocular pressure may induce iris ischemia, leading to sphincter dysfunction, loss of iris tone and the development of a fixed, nonreactive pupil.

In this setting, laser peripheral iridotomy may become technically unfeasible, requiring alternative surgical strategies aimed not only at relieving the pupillary block but also at restoring normal anterior segment anatomy. The Single-pass Four-Throw (SFT) pupilloplasty technique has emerged as a reliable method for iris reconstruction, particularly in cases of sphincter dysfunction and fixed dilated pupils. In this context, combining early lens extraction with pupillary reconstruction may offer both anatomical and functional benefits. We report a case of acute angle-closure glaucoma with fixed mydriasis successfully managed using phacoemulsification and SFT pupiloplasty [1,2].

Case Report

A 75-year-old woman with no prior ocular history presented to the emergency department with intense ocular pain, redness and nausea. Examination of the left eye revealed a fixed mydriasis, markedly shallow anterior chamber and an Intraocular Pressure (IOP) of 56 mmHg. Preoperative Best-Corrected Visual Acuity (BCVA) was counting fingers due to corneal edema and elevated

intraocular pressure. Both eyes exhibited narrow angles, but only the left eye demonstrated acute decompensation. Gonioscopy showed appositional angle closure in all quadrants in the affected eye. Preoperative slit-lamp findings are shown in Fig. 1.

The fellow eye presented narrow anterior chamber angles without signs of acute attack. Prophylactic laser peripheral iridotomy was planned after stabilization of the acute episode.

Initial medical management included intravenous 20% mannitol, systemic carbonic anhydrase inhibition with acetazolamide, topical timolol and dorzolamide and topical corticosteroids. Despite maximal medical therapy, intraocular pressure remained uncontrolled. Due to the nonreactive, dilated pupil, laser peripheral iridotomy could not be performed. After stabilization, the patient underwent phacoemulsification with posterior chamber IOL implantation one week later [3].

Given the persistent sphincter atony, a Single-Pass Four-Throw (SFT) pupiloplasty was performed in four quadrants to re-establish a functional, round pupil and facilitate angle reopening. The pupiloplasty was performed using a 10-0 polypropylene suture following the single-pass four-throw technique described by Narang. The needle was passed through the iris margins using micro-forceps, creating a loop that was subsequently tightened to approximate the iris tissue and reconstruct a round pupil. The maneuver was repeated in four quadrants to achieve adequate pupillary centration and stability.

The postoperative course was uneventful. At the two-week follow-up, the patient exhibited: IOP of 10 mmHg without ocular hypotensive therapy, an open, deep anterior chamber angle, best-corrected visual acuity of 0.8 (decimal notation; approximately 20/25 Snellen) and complete resolution of symptoms, with no complications. Postoperative anatomical changes were confirmed by anterior segment OCT and ultrasound biomicroscopy (Fig. 2,3) [4,5].

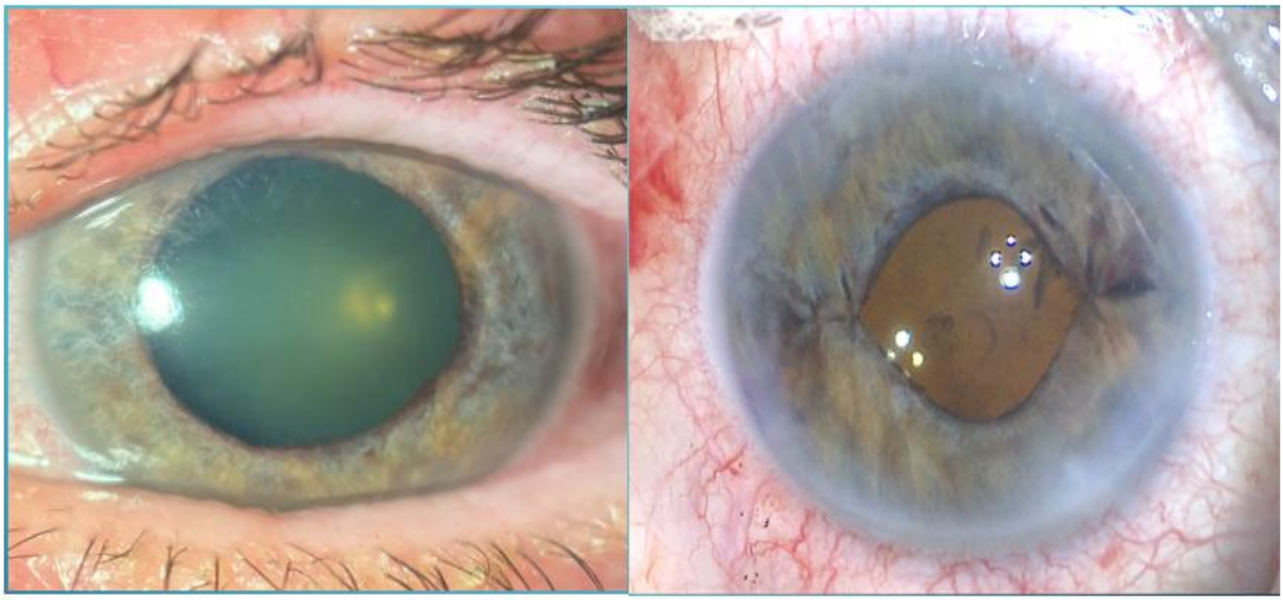

Figure 1: Pre- and postoperative slit-lamp images. Preoperative image showing corneal edema, fixed mydriasis and a shallow anterior chamber consistent with acute angle-closure glaucoma. Postoperative appearance demonstrates a clear cornea, deep anterior chamber and a well-centered pupil following Single-Pass Four-Throw (SFT) pupiloplasty.

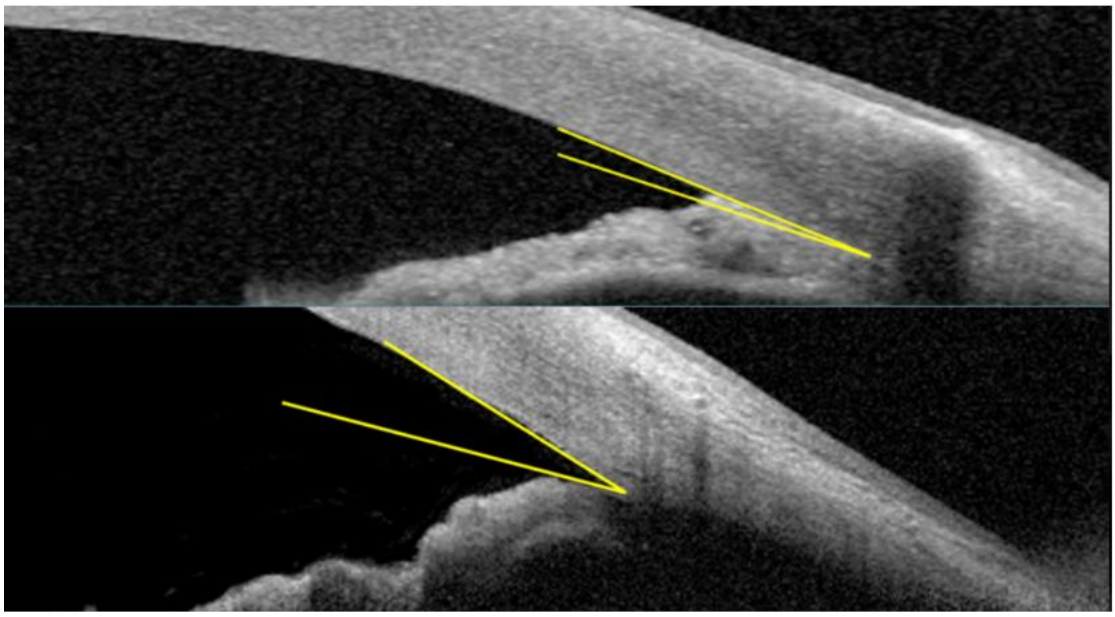

Figure 2: Pre- and postoperative anterior segment OCT. (Top) Preoperative OCT showing complete iridocorneal apposition with pronounced anterior bowing of the iris, consistent with pupillary block in acute angle-closure glaucoma; (Bottom) Postoperative OCT demonstrating a deepened anterior chamber and full angle reopening after phacoemulsification and single-pass four-throw (SFT) pupiloplasty. Yellow markings highlight the change in iris configuration and angle restoration.

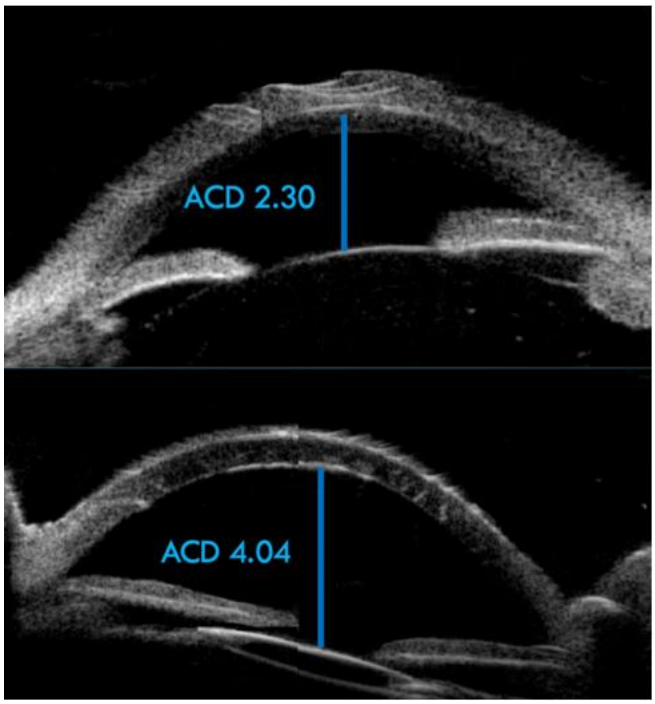

Figure 3: Pre- and postoperative Anterior Chamber Depth (ACD) on Ultrasound Biomicroscopy (UBM). (Top) Preoperative UBM showing a markedly shallow anterior chamber with an ACD of 2.30 mm; (Bottom) Postoperative UBM demonstrating significant deepening of the anterior chamber following phacoemulsification and pupiloplasty, with an ACD of 4.04 mm.

Discussion

Acute angle-closure glaucoma represents one of the most vision-threatening ophthalmic emergencies and its management requires both rapid IOP reduction and definitive resolution of the underlying mechanism of angle obstruction. In the classic pupillary block pathway, the lens-iris diaphragm obstructs aqueous flow from the posterior to the anterior chamber, generating iris bombé and precipitating abrupt angle closure. Laser Peripheral Iridotomy (LPI) is the treatment of choice to eliminate the block; however, when ischemia of the iris sphincter ensues-leading to a fixed, nonreactive pupil-LPI becomes technically

impossible. This subgroup of patients, although less common, presents a major therapeutic challenge, as definitive management must rely on surgical reconstruction rather than laser intervention [6-10]. Although SFT pupiloplasty has been described for the management of traumatic, congenital and postoperative iris defects, its application in the context of acute angle-closure glaucoma with fixed ischemic mydriasis remains rarely reported. In such cases, the inability to perform laser peripheral iridotomy creates a therapeutic challenge. This report highlights the role of SFT pupiloplasty combined with early lens extraction as a strategy to restore iris function, reopen the anterior chamber angle and stabilize intraocular pressure in situations where conventional laser treatment is not feasible. However, its potential role in intraocular pressure control in the context of acute angle-closure glaucoma with fixed mydriasis remains poorly explored. In the present case, the patient exhibited a markedly dilated, atonic pupil that prevented adequate focusing and stabilization for LPI. Prolonged pupillary ischemia likely contributed to sphincter damage, reducing its ability to constrict even after normalization of IOP. Additionally, the coexistence of shallow anterior chambers in both eyes suggested a long-standing anatomical predisposition, with the acute event representing the final decompensation of an already compromised iridocorneal relationship. In such eyes, early lens extraction has been shown to be more effective than iridotomy alone for achieving permanent angle widening, reducing IOP and minimizing recurrence of angle-closure episodes.

Nevertheless, when the pupil remains fixed in a mydriatic configuration, cataract surgery alone may not suffice. A rigid, annuliform pupil hinders capsulorhexis formation, compromises chamber stability and may limit postoperative angle opening. Furthermore, the functional and cosmetic consequences of a fixed dilated pupil-including photophobia, glare, decreased depth of focus and monocular diplopia-can significantly impair postoperative visual performance. Therefore, iris repair becomes not only anatomically beneficial but also visually rehabilitative. The Single-Pass Four-Throw (SFT) pupiloplasty technique is particularly well suited for these scenarios. Its design allows reconstruction of the sphincter with minimal intraocular manipulation: the suture is passed only once through the tissues and the quadruple loop created during the four throws provides strong coaptation of the iris margins without requiring knot tying inside the anterior chamber. This reduces surgical complexity, shortens operating time and lowers the risk of additional trauma to already compromised tissue. Biomechanically, SFT generates consistent tension across the pupil margin, enabling a more physiologic aperture compared with traditional multiple-pass techniques.

In this patient, the decision to perform SFT pupiloplasty in four quadrants aimed to achieve a uniformly round pupil and ensure adequate anterior chamber deepening. By restoring the pupillary contour, iris bombé was eliminated and aqueous dynamics normalized. Postoperatively, IOP stabilized at 10 mmHg without medication-an outcome illustrating that angle reopening was sufficient and sustainable. The improvement in visual acuity and symptom resolution further supports the functional benefit of addressing sphincter incompetence in addition to removing the crystalline lens. Alternative iris-modifying procedures, such as mechanical stretching, sector iridoplasty or suturing using Siepser techniques, could also be considered; however, these methods often require multiple passes, create bulkier knots or provide less predictable centration. Thermal iridoplasty, although useful in some acute settings, is ineffective when the pupil is ischemic or the stroma is rigid, as in this case. Consequently, SFT pupiloplasty represents a balanced option combining structural precision, tissue preservation and reproducibility. Another noteworthy point is the timing of surgery. Surgery was performed one week after the acute episode in order to allow partial resolution of corneal edema and intraocular inflammation, thereby improving intraoperative visualization and surgical safety. Yet the delay was not long enough to permit further glaucomatous damage or progressive synechial closure. This pragmatic window is particularly relevant in cases where immediate phacoemulsification may be unsafe due to corneal edema or extremely shallow chambers.

Overall, this case emphasizes that acute angle-closure glaucoma with fixed mydriasis should be approached with a tailored strategy. When LPI is not feasible, early cataract extraction combined with intelligent reconstruction of the iris architecture offers a robust and definitive solution. SFT pupiloplasty plays a central role in this context by restoring pupillary function, facilitating angle reopening and enhancing visual quality. As surgical management of angle-closure disease continues to evolve, techniques that simultaneously address lens pathology, iris configuration and chamber anatomy are likely to yield the most favourable long-term outcomes. This report has several limitations. It describes a single case with a relatively short follow-up period, which limits the ability to assess long-term intraocular pressure stability and durability of the reconstructed pupil. Larger series with longer follow-up are needed to confirm the role of SFT pupiloplasty in the management of complex angle-closure glaucoma cases.

Conflict of Interest
The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement
Not applicable.

Ethical Statement
The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement
Informed consent was taken for this study.

Authors' Contributions
All authors contributed equally to this paper.

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