Occlusion of Aquaporin Flow in a Case of Toxic Anterior Segment Syndrome Following Implantable Collamer Lens Surgery Causing Severe Pupillary Block

Short Title: TASS with Pupillary Block following ICL

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ABSTRACT

A V4c toric implantable collamer lens (ICL) was implanted in the left eye of a 32-year-old female. After one week the lens was 15° off axis and uneventful lens alignment correction was performed. At postoperative day 1 (POD#1) an intraocular pressure (IOP) of 11mmHg and mild corneal edema were observed. At POD#7 there was a UDVA of 20/800, an IOP of 44 mmHg, diffuse corneal edema and fibrin strands in the anterior chamber. Toxic anterior segment syndrome (TASS) was diagnosed and topical steroids, cycloplegia, anti-glaucoma drops and oral acetazolamide were prescribed. At POD#9 dispersed endothelial pigment with a fixed mid-dilated pupil were identified. Anterior segment optical coherence tomography showed strands of fibrin blocking the central ICL hole and angle closure. Pupillary block related to the fibrin occluded Aquaport hole consecutive to TASS was diagnosed. The patient underwent ICL removal, but continued with an atonic, hyporeflexic pupil as a complication.

INTRODUCTION

Refractive error is a leading cause of reversible visual impairment worldwide, and corrective refractive surgery is one of the most frequently used ocular surgeries globally. For a young phakic patient with refractive error, several possible methods of surgical correction exist including surface ablation, laser-assisted in-situ keratomileusis (LASIK), small incision lenticule extraction (SMILE) and phakic intraocular lenses (IOLs). For those with high refractive errors or with corneas at risk for ectasia, a phakic IOL may be a more suitable option. Phakic IOLs can generally either be placed in the anterior chamber (iris-fixated) or in the sulcus. The advantage of the former is the greater distance from the lens, and of the latter is the greater distance from the corneal endothelium. Implantable collamer lenses (ICL) (STAAR Surgical, Monrovia, CA, USA) are FDA approved and are the most popular phakic IOL worldwide because of the ease of implantation and safety profile. The latest ICL model (V4c, not FDA approved) has a tiny central hole (AquaPORT) allowing for increased flow of aqueous preserving the nutrient supply to the lens and preventing pupillary block without the need to perform a peripheral iridotomy.

In the current case report we present a case where following ICL implantation the patient developed toxic anterior segment syndrome (TASS) with a subsequent pupillary block as a consequence of the occlusion of the Aquaport flow hole related to the presence of fibrin confirmed with anterior segment optical coherence tomography (AS-OCT). To the best of our knowledge, this is the first case of pupillary block secondary to TASS in a patient with an AquaPORT containing ICL V4c. This case demonstrate that Aquaport may not prevent pupillary occlusion in cases with anterior chamber inflammation as in TASS.

CASE PRESENTATION

A 32-year-old female keratoconus patient first presented to our center (Department of Cornea and Refractive Surgery, Vissum Instituto Oftalmologico, Alicante, Spain) complaining of deterioration in vision in her left eye following implantation of intracorneal ring segments (ICRS) for the treatment of progressive keratoconus in another center. Upon examination she presented with an uncorrected distance visual acuity (UDVA) of 20/63 and a topography demonstrating that the ICRS was the cause of refractive error and irregular astigmatism as they were improperly placed. The patient subsequently underwent removal of ICRS combined with
epithelium-off corneal crosslinking (3mW/cm² for 30 minutes) in her left eye without any adverse events.

After a period of six months of stable manifest refraction of -1.0 -3.25 x 165° correcting the patient to 20/20, the patient elected to undergo toric ICL implantation in her left eye. At the one-week post ICL visit the UDVA was 20/25 and the lens was noted to have good vault (Figure 1A) but was however 15 degrees off axis. The patient elected to undergo lens rotation that same day without any intraoperative adverse events.

At the postoperative day 1 (POD#1) following ICL rotation the patient complained of blurry vision and had a UDVA of 20/63 with a normal IOP of 11mH and some corneal edema limited to the midperiphery with a few cells in the anterior chamber (Figure 1B). The patient continued to receive prednisolone acetate 1% and moxifloxacin 0.5% QID each.

At POD#7 following ICL rotation the patient complained of further deterioration in vision and presented with a UDVA of 20/800, an IOP of 44mmHg, limbus to limbus corneal edema and fibrin strands in the anterior chamber without a hypopyon level (Figure 1C). Under the working diagnosis of TASS the patient was treated with topical prednisolone acetate 1% (Q2H), cycloplegia and received both topical antiglaucoma medication and oral acetazolamide with potassium supplementation to control the IOP.

At POD#9 following ICL rotation the patient demonstrated dispersed pigment on the endothelium as well as a fixed mid-dilated pupil (Figure 2). On AS-OCT, strands of fibrin blocking the central AquaPORT hole of the ICL were clearly documented as well as angle closure (Figure 1D). Under the working diagnosis of pupillary block secondary to TASS the patient underwent removal of the toric ICL and was left with an unreactive pupil and corneal edema that resolved within a period of one month and a final corrected distance visual acuity (CDVA) of 20/32. However, a fixed mydriatic pupil was left as a consequence of the high IOP levels (Urrets Zavalia Syndrome) caused by the pupillary block.

**DISCUSSION**

This case report demonstrates a case of TASS with pupillary block developed in a patient with an ICL V4c implant. The serial pictures of AS-OCT taken clearly demonstrate the formation of corneal edema, fibrin strands, closure of the central hole of the ICL and development of angle closure. To the best of our knowledge, this is the first case of pupillary block secondary to TASS in a patient with an AquaPORT containing ICL V4c.

Often, the exact etiology of TASS is unknown. It can occur after any intraocular anterior segment intervention and is the result of a sterile inflammatory reaction to a toxic substance such as extremes of pH or osmolarity and/or the presence of preservative or detergent residue. Typically, TASS develops within 48 hours following surgery with the most common finding being diffuse corneal edema involving the periphery and it is often accompanied by fibrin strands and trabeculitis manifesting as increased IOP. In the current case the patient had normal IOP and mild corneal edema at POD#1 which was attributed to the procedure itself although in retrospect it may have been disproportionate to the intervention itself (uneventful ICL rotation). At POD#7 when fibrin strands and increased IOP were noted, the diagnosis of TASS was evident.
There is a paucity of data regarding the development of TASS following ICL implants. Sridhar et al. reported the first case of TASS following the use of an older model of the ICL in 2013. In 2016 Eissa et al. reported that one out of 54 eyes receiving the Aquaport ICL developed TASS. Recently, Singh et al. reported one case of TASS following Aquaport ICL with no increased IOP. In none of the aforementioned cases (n=3) of TASS was pupillary block evident. In the current case, the TASS related fibrin strands blocked the AquaPORT hole preventing flow of aqueous humor and leading to subsequent pupillary block as clearly demonstrated on serial AS-OCT photos.

To the best of our knowledge, occlusion of the Aquaport has yet to be reported as a complication of ICL implantation. The resulting pupillary block secondary to TASS due to occlusion of the Aquaport following ICL V4c implantation was clearly demonstrated by serial AS-OCT images. This case demonstrate that an Aquaport hole may not be enough to prevent pupillary block in cases with postoperative intraocular inflammation, causing severe postoperative complications such as Urrets Zavalia Syndrome. Clinicians should consider this diagnosis in cases with corneal edema in the early postoperative period following AquaPORT ICL insertion. Raised awareness and a fast, timely intervention may improve patient outcomes.

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REFERENCES


FIGURE LEGENDS

**Figure 1.** Serial anterior segment optical coherence tomography pictures demonstrating (A) implantable collamer lens (ICL) with good vault (~1 x corneal thickness) prior to lens alignment correction. (B) Postoperative day 1 following lens alignment correction corneal edema can be seen with an open angle and no fibrin strands. (C) Postoperative day 7 following (ICL) alignment demonstrating pupillary strands forming and (D) by postoperative day 9 fulminant pupillary block has developed.

![Figure 1A](image1.png)

![Figure 1B](image2.png)

**Figure 2.** Postoperative day 9 following ICL alignment demonstrating diffused pigment dispersion on the corneal endothelium with a fixed mid-dilated pupil resulting from the pupillary block secondary to toxic anterior segment syndrome.

![Figure 2](image3.png)