

# Trabeculectomy with an implantable biodegradable collagen matrix (Ologen) for the management of glaucoma associated with cavernous sinus arteriovenous fistula

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## Abstract

A 58-year-old gentleman presented with open angle glaucoma secondary in the right eye secondary to a cavernous sinus arteriovenous fistula. Since the intraocular pressure control was refractory to medical management, an augmented filtration surgery was planned. Trabeculectomy in eyes with raised episcleral venous pressure is associated with a substantially greater risk of intraoperative or post-operative choroidal effusion and suprachoroidal haemorrhage. This patient was successfully managed by performing trabeculectomy with an implantable biodegradable collagen, type 1 atelocollagen, matrix (Ologen), without any sight threatening complications.

## Introduction

Secondary glaucoma occurs in nearly half of the patients who have ophthalmic manifestations of cavernous sinus arteriovenous fistulae.<sup>1</sup> Elevated intraocular pressure (IOP) is secondary to increased episcleral venous pressure. Glaucoma is the most common cause of loss of vision in these eyes and is often challenging to treat. With trabeculectomy, there is a high risk of potentially vision-threatening intraoperative or post-operative complications such as suprachoroidal hemorrhage or choroidal effusion.<sup>2</sup>

The adjunctive use of anti-fibrotics to prevent post-operative scarring enhances the long-term success rate of trabeculectomy; however, it may be associated with a greater incidence of post-operative hypotony which is detrimental in eyes with raised episcleral venous pressure.<sup>3</sup> An implantable biodegradable collagen matrix designed for sub-conjunctival placement to enhance the long term success of trabeculectomy may be a safer alternative in these eyes. It not only modulates post-operative sub-conjunctival fibrosis, but it may keep the scleral flap mechanically well apposed, preventing over filtration and hypotony. The Ologen collagen matrix (Aeon Astron Europe BV, Leiden, Netherlands) is a porous scaffold of 90% or more porcine type 1 atelocollagen and 10% or less glycosaminoglycans. This report demonstrates the successful management with trabeculectomy and Ologen implant of a patient with refractory open angle glaucoma secondary to a cavernous sinus arteriovenous fistula.

## Case Report

A 58-year-old gentleman presented with a chief complaint of decreased vision associated with pain and redness in the right eye over the two years prior to his presentation. One year prior to presentation, he

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was diagnosed elsewhere with open angle glaucoma in the right eye and was started on the following treatment regimen: topical 2% dorzolamide one drop three times per day, topical combination 0.5% timolol maleate with 4% pilocarpine one drop two times per day, and topical 0.005% latanoprost one drop once at bedtime. He has a medical history of well-controlled diabetes and hypertension. He has history of head trauma with a wooden stick 18 years prior to presentation.

Best corrected visual acuity was 20/40 in the right eye and 20/20 in the left eye. On clinical examination, extraocular movements were full, orthophoric, and painless in all directions of gaze. A right-sided subtle axial proptosis was present (Figure 1). Anterior



**Figure 1**  
*Axial proptosis of the right side was present.*

segment examination revealed dilated, tortuous corkscrew shaped episcleral vessels in the right eye (Figure 2). The anterior segment was unremarkable in the left eye.



**Figure 2**  
*Dilated and tortuous episcleral vessels were present in all quadrants.*

IOP was 26 mmHg and 14 mmHg in the right and left eyes, respectively. The central corneal thickness was 523 and 542 microns in the right and left eyes, respectively. The anterior chamber angle was open up to scleral spur in both eyes. There was no evidence of angle recession or blood in the Schlemm's canal in either eye. Orbital bruit and signs of thyroid eye disease were absent.

Dilated fundus examination revealed an average sized disc, with a vertical cup-to-disc ratio of 0.9 in the right eye, with bipolar notching. The disc was within normal limits in the left eye. Formal visual field testing (Humphrey Visual Field Analyzer 10-2 SITA-Standard) demonstrated a biarcuate scotoma threatening fixation in the right eye. Perimetry was within normal limits in the left eye.

Orbital imaging revealed a dilated superior ophthalmic vein in the right orbit as well as thickening of the right medial rectus muscle. In view of history of trauma, a clinical diagnosis of a cavernous sinus arteriovenous fistula was made. The patient's open angle glaucoma of a right eye was posited to be secondary to the cavernous sinus fistula.

Since the IOP was uncontrolled despite maximally tolerated medical therapy, surgical intervention was planned. Trabeculectomy with an Ologen collagen matrix was performed.

To reduce IOP and prevent sudden hypotony, pre-operative injection of intravenous 20% mannitol was administered to the patient. A standard fornix based trabeculectomy with wide area dissection and triangular scleral flap was performed. The flap was sutured at the apex using a single 10-0 nylon suture. The suture was normotensive and just apposed the flap to the scleral bed. A 6 mm Ologen disc was positioned subconjunctivally, allowing it to partly cover the apex of the triangular scleral flap. Watertight conjunctival closure was achieved using interrupted 8-0 polyglactin sutures. Cycloplegics were initiated at the conclusion of the surgery to deepen the anterior chamber. There were no intraoperative complications.

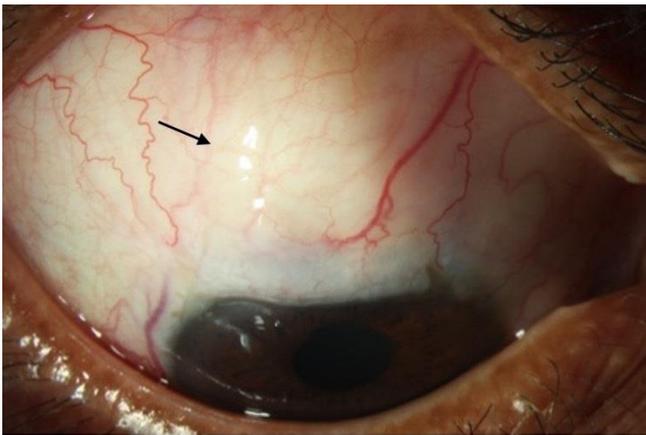
On post-operative day one, the patient's visual acuity was 20/60. IOP was 16 mmHg. Anterior

segment examination disclosed a diffuse bleb and deep and well-formed anterior chamber. The patient was started on topical 1% prednisolone acetate one drop eight times per day, topical 0.5% moxifloxacin one drop four times per day, and topical 1% cyclopentolate one drop three times per day.

However, one week post-operatively, examination disclosed a formed but mildly uniformly shallow anterior chamber, in the presence of a diffuse bleb. Seidel's test was negative and the IOP was noted to be 14 mmHg. Fundus examination revealed peripheral shallow choroidal detachment, confirmed B-scan ultrasonography. In addition to the intensive topical steroids, the additional cycloplegic and mydriatic agents were added.

By one month post-operatively, the choroidal detachment resolved and the anterior chamber deepened to normal. The patient's visual acuity improved to 20/20 and IOP was 16 mmHg.

Two years post-operatively, the IOP has been well maintained with a well-functioning, diffuse bleb (Figure 3) without any topical intraocular pressure lowering agents. Visual acuity and perimetry have also remained stable over two years.



**Figure 3**  
*Anterior segment examination one year post-operative revealed a diffuse, well-functioning bleb in the right eye.*

## Discussion

Cavernous sinus fistulae are characterized by an arteriovenous communication between the cavernous

sinus and the internal or external carotid artery, or both. These may occur insidiously in the setting of systemic disease such as hypertension or atherosclerosis, or they may occur abruptly following trauma. Most fistulae, which are traumatic in origin, have high rates of arterial blood flow, though some have low flow rates. Presenting features may include decreased vision, diplopia from ophthalmoparesis, proptosis, including pulsatile proptosis, conjunctival chemosis, and dilated and tortuous conjunctival vessels. However, the presenting features are often subtle and easy to overlook. Often times, patients are misdiagnosed with blepharitis, conjunctivitis, or even thyroid eye disease. In this case, the patient was initially misdiagnosed as having primary open angle glaucoma, even though he had open angle glaucoma secondary to the cavernous sinus fistula.

The incidence of secondary glaucoma in patients with cavernous sinus arteriovenous fistulae ranges from 41% - 64.3% in various studies.<sup>1</sup> Intractable secondary glaucoma in these eyes is the major cause of ocular morbidity and requires prompt treatment. While closure of the fistula is often the definitive treatment, if the fistula does not spontaneously close, surgical treatment of the glaucoma is an option. However, surgical management of these eyes is extremely challenging, as these patients usually have an aggressive course of disease and need long-term substantially lowered post-operative IOP. In addition, the sudden lowering of IOP in eyes with raised episcleral venous pressure may lead to serous or haemorrhagic transudation into the suprachoroidal space due to unopposed venous backpressure. Thus, these patients are at a higher risk of intraoperative and post-operative complications such as choroidal effusion, suprachoroidal haemorrhage, and hypotony maculopathy, all of which may be potentially vision threatening.<sup>2</sup>

In view of long standing disease, increased conjunctival vascularity, and use of multiple topical medications, the probability of post trabeculectomy fibrosis was very high in this patient. Adjuvant use of anti-metabolites is an option in these patients, as it has been demonstrated to significantly improve the

long term success of trabeculectomy. However, the incidence of hypotony related complications is increased with the use of anti-metabolites.<sup>3</sup> Other options in these situations include the use of releasable sutures with trabeculectomy.

Trabeculectomy with Ologen implant was chosen as it not only modulates post-operative sub-conjunctival fibrosis, but also mechanically keeps the scleral flap well apposed to decrease the risk of post-operative hypotony. Ologen is a biodegradable implant consisting primarily of atelocollagen, designed for sub-conjunctival placement. It acts as a mechanical separator and prevents conjunctival fibrosis with the episcleral tissue. It also helps in tissue remodeling and organized wound healing post-operatively.<sup>4</sup> A meta-analysis of 6 studies including 224 participants concluded that trabeculectomy with an Ologen implant is comparable to the use of the anti-metabolite mitomycin C, with a similar long-term success rates.<sup>5</sup>

Based on our experience, we believe that the 6 mm Ologen disc should be positioned at the apex of the triangular flap or over the posterior edge of the rectangular flap. We believe that care should be taken to avoid placing the Ologen disc closer the base of the scleral flap, which may result in increased mechanical resistance, sub-scleral adhesions and eventually bleb failure. We believe that placement of the disc should be followed by meticulous conjunctival closure with 8-0 polyglactin suture.

## Conclusion

Refractory secondary glaucoma in eyes with raised episcleral venous pressure may be challenging

to manage. Trabeculectomy in these eyes is associated with increased risk of intraoperative and post-operative complications. Use of collagen implants that not only modulate post-operative wound healing but also prevent post-operative hypotony may be beneficial. A biodegradable collagen matrix implant may mechanically keep the scleral flap well apposed, thus preventing over filtration and hypotony. We believe that the Ologen implant may be a safe alternative in this subset of high risk patients, including high myopes, juvenile open angle glaucomas, and glaucomas associated with raised episcleral venous pressure.

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