

# Trabeculotomy ab interno with Trabectome as surgical management for systemic fluoroquinolone-induced pigmentary glaucoma

## A case report

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### Abstract

**Rationale:** Bilateral acute iris transillumination (BAIT) is a poorly-understood ocular syndrome in which patients present with acute iridocyclitis and pigmentary dispersion with or without ocular hypertension. The etiology of the disease remains unknown, though recent reports suggest an antecedent upper respiratory tract infection or systemic antibiotic administration may trigger the clinical syndrome.

**Patient concerns:** A 55-year-old female was referred for a second opinion regarding her bilateral ocular pain, photophobia, and ocular hypertension. Her medical history was notable for a diagnosis of pneumonia managed with oral moxifloxacin several weeks prior to her initial presentation.

**Diagnoses:** Visual acuity was 20/40 with an intraocular pressure (IOP) of 30 mmHg in the affected eye despite maximal tolerated medical therapy. The patient had severe bilateral iris transillumination defects with posterior synechiae formation and 3+ pigment with rare cell in the anterior chamber. This constellation of findings was consistent with a diagnosis of BAIT.

**Interventions:** A peripheral iridotomy was placed, which mildly relieved the iris bowing, but did not affect the IOP or inflammatory reaction. The patient then underwent cataract extraction with posterior synechiolysis and ab interno trabeculotomy of the left eye with the Trabectome.

**Outcomes:** The patient's IOP on the first post-operative day was 13 mmHg, and anterior chamber inflammation was noted to be significantly reduced at post-operative week 2. The patient was recently seen at a 1-year post-operative visit and her IOP remains in the low teens on a low-dose combination topical agent.

**Lessons:** Ophthalmologists should remain aware of the association between systemic fluoroquinolones and acute pigmentary dispersion that can progress to glaucoma. The Trabectome remains a viable option for management of pigmentary and uveitic glaucoma resistant to medical treatment.

**Abbreviations:** AC = anterior chamber, BAIT = bilateral acute iris transillumination, FDA = Food and Drug Administration, FML = fluorometholone, IOP = intraocular pressure, MIGS = microincision glaucoma surgery, OD = oculus dexter, "right eye," OS = oculus sinister, "left eye," OU = oculus uterque, "both eyes," PDS = pigment dispersion syndrome, TID = transillumination defect, TM = trabecular meshwork.

**Keywords:** iris transillumination, micro-incision glaucoma surgery, MIGS, moxifloxacin, pigment dispersion, trabectome

## 1. Introduction

Recent articles have raised awareness of a uveitic syndrome termed "bilateral acute iris transillumination" (BAIT), characterized by pigmentary dispersion, severe iris transillumination defects (TIDs), and a mydriatic atonic pupil after a yet-unknown

inciting event. Many patients afflicted with the syndrome describe recent systemic antibiotic use or a prior upper respiratory tract infection, though a precise etiology often remains elusive. The diagnosis of BAIT can also be perplexing, as reports have indicated that there is considerable variation in the onset, severity, and time course of the syndrome. Some authors describe a mild, self-limiting condition that resolves over a period of weeks. Others indicate a persistent syndrome refractory to medical management that leaves patients with glaucomatous optic nerve atrophy and permanent ocular complications. We present a challenging case of systemic fluoroquinolone-induced BAIT that was treated with trabeculotomy ab interno using Trabectome, a micro-incision glaucoma surgery. We discuss novel treatment mechanisms that were a successful alternative to traditional trabeculectomy.

## 2. Methods

The Eastern Virginia Medical School Institutional Review Board reviewed this study and deemed it appropriate for publication without further review given its status as a case report. The

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patient signed an informed consent document allowing her clinical history and photographs to be published after all identifying protected health information was removed.

### 3. Case report

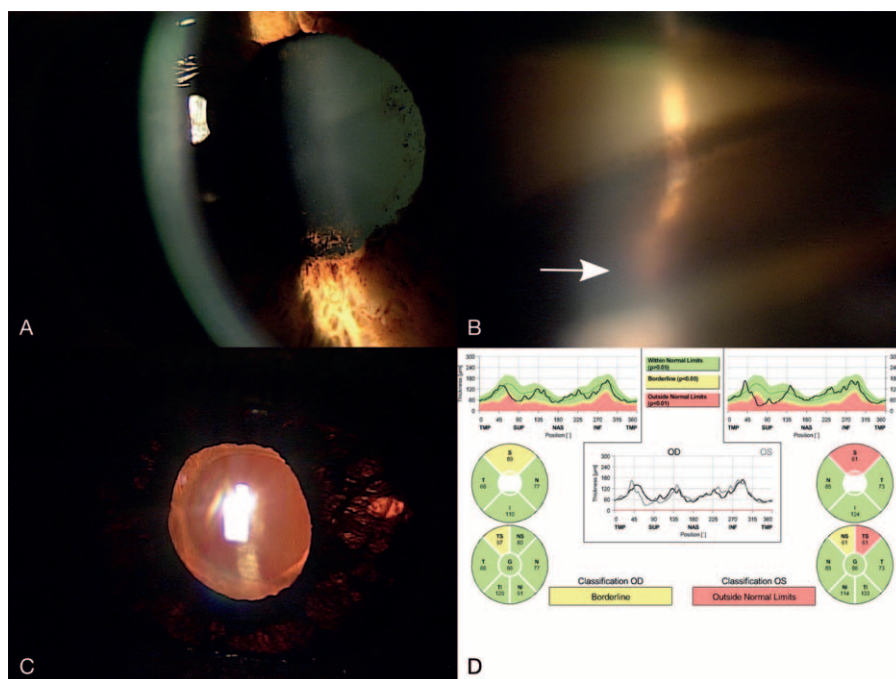
A 55-year-old female was referred to our clinic for a second opinion regarding her bilateral ocular pain, photophobia, and ocular hypertension. She had seen several other providers in the community over a period of 4 months before seeking evaluation with a glaucoma specialist. Her medical history was notable for a diagnosis of pneumonia managed with oral moxifloxacin (Avelox) several weeks before her initial presentation. After seeing her primary ophthalmologist, she was found to have intraocular pressures (IOPs) in the mid-30s and was given a diagnosis of severe iritis with pigment dispersion syndrome (PDS) and started on ocular antihypertensives. Upon referral to our practice, visual acuity was 20/25 and 20/40, with IOPs of 18 and 30 mm Hg. The patient presented to our clinic on latanoprost nightly oculus uterque (OU), fluorometholone (FML) 0.1% twice-daily OU, timolol 0.5% twice-daily OU, dorzolamide 2% 3 times daily OU, and alphagan-P 0.1% 3 times daily OU. The patient had severe bilateral iris TIDs with posterior synechiae formation and 3+ pigment with rare cell in the anterior chamber (Fig. 1A). Cataract severity was graded as 2+ nuclear sclerosis OU. Gonioscopy revealed heavy pigment deposition in the trabecular meshwork (TM) with a significantly concave-bowed appearance of the irides (Fig. 1B). Retinal nerve fiber layer analysis was normal oculus dexter (OD), but showed signs of early loss oculus sinister (OS) (Fig. 1D). These findings corresponded with increased cupping and early visual field loss OS as well. A peripheral iridotomy was placed OS, which mildly relieved the iris bowing, but did not affect the IOP or amount of pigment release in the AC. The patient underwent cataract

extraction with posterior synechiolysis and ab interno trabeculotomy of the left eye with the Trabectome (Fig. 1C). Cataract extraction was completed through phacoemulsification with posterior chamber intraocular lens implantation with an Alcon SN60WF monofocal lens (Alcon Laboratories, Inc., Fort Worth, TX). Her IOP on the first postoperative day was 13 mm Hg, and anterior chamber pigment, cell/flare was noted to be significantly reduced at post-operative week 2. The chamber was noted to be quiet of white cells at the 6-week postoperative visit. A similar procedure was performed on the patient's fellow eye, which we have demonstrated in Fig. 2. The patient was recently seen at a 1-year postoperative visit, and her IOP is 11 mm Hg OD and 13 mm Hg OS on brinzolamide 1%/brimonidine 0.2% (Simbrinza) once daily and FML twice daily.

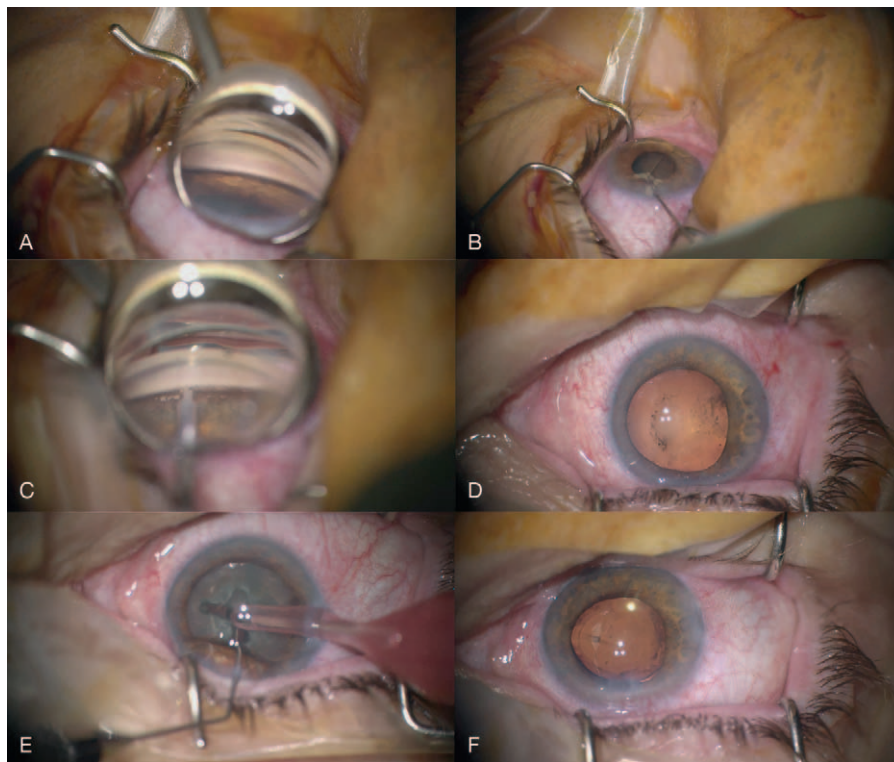
### 4. Discussion

Uveitic glaucoma, representing 5% to 15% of glaucoma cases, can lead to secondary glaucoma requiring surgical treatment, which presents challenges due to the higher risk of postoperative inflammation.<sup>[1]</sup> Drug-induced uveitis is a rare condition, and is often overlooked when evaluating a patient with new-onset intraocular inflammation. Much of our knowledge regarding drug-induced uveitis follows the classification system developed by Naranjo et al,<sup>[2]</sup> in which 7 criteria were proposed to establish causality of adverse events by drugs. Given that most reports are clinical observations without histopathologic confirmation, the definition of drug-induced uveitis is difficult to separate from drug-induced ocular toxicity. There has been little evidence to prove that systemically administered drugs can induce uveitis through direct ocular toxicity or indirect antibody formation and immune complex deposition.<sup>[3]</sup>

Many systemic fluoroquinolones have been associated with uveitis, including ciprofloxacin, ofloxacin, gatifloxacin, levofloxacin,



**Figure 1.** (A) Slit lamp examination demonstrates posterior synechiae formation and significant AC pigment release. (B) Heavy pigment deposition is seen on gonioscopic view of the angle. Note— anterior bowing of the iris (arrow). Iris transillumination defects remain apparent after cataract extraction. (D) Optical coherence tomography demonstrates early superior retinal nerve fiber layer loss OS.



**Figure 2.** (A) Intraoperative gonioprism view of heavily pigmented TM. (B) Posterior synechiolysis. (C) Trabectome-mediated electrolysis of the TM. (D) Pigment deposits visible on the anterior lens capsule before cataract extraction. (E) Cataract extraction through traditional phacoemulsification. (F) Final postoperative view after intraocular lens implantation.

and norfloxacin; however, the most commonly described agent is moxifloxacin.<sup>[4,5]</sup> Bringas Calvo and Iglesias Cortiñas<sup>[6]</sup> provided the first report of an acute bilateral uveitis and PDS secondary to moxifloxacin use in 2004. Since then, a distinct uveitic syndrome termed “Bilateral acute iris transillumination” (BAIT) has been described, characterized by symptomatic pigment release and iris atrophy following a flulike illness or systemic fluoroquinolone use.<sup>[7]</sup> Patients are predominantly middle-aged women who present with ocular pain, severe photophobia, and conjunctival injection 1 to 6 weeks following systemic illness and/or drug administration.<sup>[4]</sup> Clinical findings include bilateral transillumination of the irides, pigment dispersion in the anterior chamber, a mydriatic, poorly responsive pupil, and a relative paucity of anterior chamber inflammatory cells. Gonioscopy typically reveals heavy pigment deposition in the angle, and early IOP rises resistant to treatment are common. In several reported cases, the patient was initially misdiagnosed with acute bilateral iridocyclitis and placed on systemic anti-inflammatory medications. A diagnosis of BAIT is oftentimes only suggestive after an extensive workup for other causes of uveitis remains negative.<sup>[8,9]</sup>

The differential diagnosis of iris transillumination with or without ocular hypertension includes infectious and noninfectious etiologies. PDS is perhaps the most similar to BAIT; however, the clinical course in PDS is silent and slowly progressive, unlike the abrupt and seemingly explosive onset of disease in BAIT. Iris TIDs occur in a symmetric, mid-peripheral pattern in PDS, unlike in BAIT, where they are diffuse bilaterally. Pupillary responses are not affected in PDS, and these patients are typically younger and deny the photophobia and ocular pain that are commonly described in BAIT.<sup>[10]</sup> Pseudoexfoliation syndrome also features iris TIDs, and can be distinguished from

BAIT by the abundant unilateral deposition of fibrillar material. Fuchs’ uveitic syndrome can also be confused with BAIT, though it is typically a unilateral process with chronic, low-grade anterior chamber inflammation with or without heterochromia. Herpetic iridocyclitis can present with patchy iris atrophy, pupillary distortion, and severe IOP elevations secondary to trabeculitis. Acute recurrences in the same eye are common, and both cytomegalovirus and herpes simplex virus have been implicated.<sup>[11,12]</sup>

Treatment options for reported cases of BAIT have included topical steroids and ocular antihypertensives, systemic medications, and laser and incisional procedures. Reported treatment courses have varied from several weeks to over a year to achieve IOP control and resolution of intraocular inflammation. A summary of reported treatment regimens and outcomes is included in Table 1. There have been at least 2 cases of the condition requiring traditional trabeculectomy with anti-metabolite therapy.<sup>[7]</sup> The complications of this procedure are well-known to ophthalmologists, and include hyperfiltration with hypotony, bleb infection, choroidal detachment, corneal decompensation, hyphema, and bleb fibrosis.<sup>[15]</sup> One group reported that laser iridoplasty helped lower IOP in a patient with moxifloxacin-induced BAIT and appositional angle closure.<sup>[16]</sup> We performed a laser peripheral iridotomy early in the patient’s clinical course, which relieved any element of pupillary block, though did not significantly alter the IOP. Dense pigment deposition in the TM was more likely the etiology of our patient’s ocular hypertension rather than an appositional effect. In our case, iridoplasty was not warranted due to a deep AC angle. Definitive treatment required removal of obstructed TM to restore outflow, and removal of the lens-iris interface to eliminate



**Table 1****Comparison of reported cases of BAIT.**

Study	Onset of disease	Presenting IOP	Clinical course	Treatment regimen
Degirmenci et al <sup>[8]</sup>	Unknown etiology	30/32 mm Hg	1 mo to resolution of elevated IOP	Topical and systemic steroid, azathioprine, colchicine, 2 glaucoma medications
Gonul and Bozkurt <sup>[9]</sup>	1-mo post cefazolin	20/18 mm Hg	1 mo	Topical steroid, 2 glaucoma medications
Knape <sup>[13]</sup>	3 d post moxifloxacin	35 mm Hg OU	Patient passed before 2-wk follow-up	Topical steroid, cycloplegic, glaucoma medication
Nascimento <sup>[14]</sup>	3 mo post Avelox	14 mm Hg OU	Not reported	Not reported
Nascimento <sup>[14]</sup>	2 mo post Avelox	16 mm Hg OU	Not reported	Not reported
Nascimento <sup>[14]</sup>	3 mo post moxifloxacin	12 mm Hg OU	Not reported	Topical steroid
Tugal-Tutkun et al <sup>[7]</sup> (52 eyes from 26 patients)	Mean 2.52 wks Range 1–6 wks. 73% presented post flu-like illness and systemic antibiotic course	Mean 16.57/18.80 mm Hg. Range 9–37/8–41 mm Hg	Mean 7.30 mo. Range 1–18 mo.	14 patients developed IOP rises, 10 required glaucoma medications. 7 received diamox, 5 IV mannitol, 2 underwent bilateral trabeculectomy
Willermain et al <sup>[15]</sup>	2 wks post Avelox	46 mm Hg OU	Not reported	Topical, and oral steroids, topical and oral glaucoma medications, laser iridoplasty

BAIT = bilateral iris transillumination, IOP = intraocular pressure.

the continual iris chaffing and pigment release. Given the potential for severe complications of traditional incisional glaucoma surgery, we opted to perform combined cataract phacoemulsification, posterior synechiolysis, and trabeculotomy ab interno with the Trabectome.

The Trabectome, which was FDA-cleared for use in the United States in 2004, was one of the first-described microincision glaucoma surgeries.<sup>[17]</sup> It utilizes a bipolar electrode to create plasma for ab interno ablation of the TM, which is then cleared through constant infusion and aspiration, similar to conventional phacoemulsification fluidics. It carries a favorable risk profile when compared with traditional glaucoma surgeries, and has been shown to achieve favorable IOP decreases in an increasing number of glaucoma types, including exfoliative and pigmentary glaucoma.<sup>[18,19]</sup> A study by Iwao et al<sup>[20]</sup> also demonstrated a similar effect in patients with steroid-induced glaucoma, in which external trabeculectomy success rates were equivocal to trabeculectomy. The results by Dang et al<sup>[21]</sup> were comparable: trabectome-mediated ab interno trabeculectomy achieved nearly a 50% IOP reduction in patients with steroid-induced glaucoma. IOP elevation in steroid-induced glaucoma is thought to be related to increased outflow resistance from the abnormal accumulation of extracellular matrix components in the TM.<sup>[22,23]</sup> Trabectome-mediated extirpation of the damaged TM appears to be particularly effective in controlling IOP in these patients. Cases of secondary open-angle glaucoma have similarly been successfully managed with the Trabectome. van Oterendorp et al<sup>[24]</sup> reported relieving elevated IOP associated with an exacerbation of primary ocular lymphoma through trabeculectomy with the Trabectome. By avoiding incisional glaucoma surgery, they prevented seeding tumor cells to the extraocular tissues, and the trabeculectomy opening and IOP remained stable through 18 months of follow-up.<sup>[24]</sup> Two cases of intractable glaucoma after laser vitreolysis for symptomatic vitreous floaters were also reportedly treated with the Trabectome. The pathogenesis of this rare syndrome is unknown, though may involve increased outflow resistance given the avid response to trabeculectomy.<sup>[25]</sup> The Trabectome, with proper patient selection, represents a powerful tool for managing mild-moderate, and at times, severe cases of glaucoma with impaired aqueous outflow.

## 5. Conclusion

The Trabectome remains a viable option for management of pigmentary and uveitic glaucoma refractory to medical treatment. Ophthalmologists should remain aware of the association between systemic fluoroquinolones and acute pigmentary dispersion that can progress to glaucomatous optic atrophy. Microincision glaucoma surgery with TM removal is an effective treatment methodology in managing this syndrome.

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