Combined phacovitrectomy with capsular tension ring and gas tamponade for chronic cyclodialysis cleft unresponsive to conventional closure

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Abstract:
Traumatic cyclodialysis clefts, a rare diagnosis after blunt injury to the eye, are typically amenable to closure with either medical therapy or direct surgical cyclopexy. However, when cyclodialysis clefts cannot be closed through these methods, unorthodox techniques may be required. We describe a method to close a traumatic cyclodialysis cleft involving simultaneous vitrectomy, capsular tension ring placement, and insertion of an intraocular lens.

Keywords:
Capsular tension ring, choroidal folds, cyclodialysis cleft, hypotony, phacovitrectomy

Introduction
Traumatic cyclodialysis clefts are a rare diagnosis after blunt injury to the eye.[1] If diagnosed in a timely manner, most are amenable to closure with either medical therapy or direct cyclopexy. For clefts unamenable to primary closure, there are numerous techniques to attempt cleft repair. We describe a technique in which an intraocular lens (IOL) is placed at the same time as cleft repair without the need for iris cerclage.

Case Report
A 38-year-old male was initially seen by the ophthalmology service due to blunt trauma to the right eye secondary to assault with a metal pipe. On initial consultation in the hospital, he was diagnosed with a right-sided closed orbital wall fracture, traumatic iritis with microhyphema, and a choroidal rupture in the right eye. Vision at that time was hand motion, and intraocular pressure (IOP) was 44 mmHg through rebound tonometry. After initial treatment with topical steroids, his visual acuity improved from hand motion to 20/60 over the course of 2 months. During his recovery, the patient was noted to have persistent hypotony and macular folds [Figure 1a]. No cyclodialysis cleft was initially seen, although he was persistently dilated on cycloplegia for the iritis during initial gonioscopy. In addition, his IOP was noted to be consistently lower than the left eye, with at least a 5 mmHg difference each visit, and ranged between 6 and 11 mmHg. A month after his initial injury, choroidal folds were noted on examination and on optical coherence tomography. Although his IOP at this time was 9 mmHg, the IOP in his left eye was 20 mmHg.

Three months after his initial injury, he was referred to the retina service for the...
evaluation. Best-corrected visual acuity (BCVA) was 20/60 in the right eye, IOP was 11 mmHg in the right eye, and 20 mmHg in the left eye. Examination of the anterior segment revealed a shallow anterior chamber, and undilated gonioscopy revealed a 5-clock-hours cyclodialysis cleft located temporally. The patient was then referred to the glaucoma service for cyclodialysis cleft closure. Initial surgical repair was performed by direct cyclopectomy through scleral flaps with 10–0 prolene suture. Afterward, a small area (<1 clock h) of open cleft was still noted superotemporally, which did not close after application of argon laser. A repeat direct cyclopectomy was performed a month after initial surgery with 9–0 prolene suture, but was unsuccessful in relieving his hypotony.

Given his refractory course, he was referred to another glaucoma specialist for evaluation and treatment. Ultrasound biomicroscopy (UBM) examination revealed shallow choroidal serous detachments with an atrophic, detached ciliary body processes corresponding to the location of the cyclodialysis cleft. Gonioscopic examination showed an area concerning for residual cleft opening between 7 and 8 o’clock, but closure of the cleft was confirmed with pressure on the globe during UBM [Figure 2]. His hypotony was thought to be secondary to infarcted ciliary body processes secondary to detachment. Due to the cause of hypotony, the glaucoma specialist suggested phacoemulsification with capsular tension ring (CTR) insertion with the IOL, and pars plana vitrectomy with gas tamponade to bolster and reattach the ciliary body as a more heroic measure.

A month afterward (over 3 months since the initial injury), a combined phaco-vitrectomy with IOL, CTR implantation, and gas tamponade with 22% sulfur hexafluoride (SF6) was then performed. During phacoemulsification, zonular instability was noted in areas associated with the cyclodialysis cleft. A MORCHER® Type 14C CTR (FCI Ophthalmics, Pembroke, MA, USA) was inserted into the capsular bag to provide capsular support, and an +22.50D SN60WF acrylic monofocal IOL (Alcon, Fort Worth, TX, USA) was placed in the capsular bag without complication. The diopter was chosen based on the calculations and axial length of the normal contralateral eye. A complete vitrectomy was performed, with induction of a posterior vitreous detachment and vitreous skirt shaving. After air-fluid exchange, the air was exchanged with 22% SF6 in the vitreous cavity. He was then instructed to remain supine for a week. Postoperatively, the patient had short-term ocular hypertension above 30 mmHg that was well controlled with topical therapy and oral acetazolamide. A little over 1 month after the surgery, the hypotony resolved in the right eye, with normalization of the anterior chamber and ocular hypertension at 28 mmHg on topical steroids. His topical steroids were tapered off over the next 2 weeks, and his pressure decreased to 14 mmHg without any topical aqueous suppressants. Three months after the surgery, his BCVA improved to 20/25 (requiring +0.50 D correction) and his IOP was 14 mmHg without any medications, with some resolution of his choroidal folds. His cyclodialysis cleft was noted to be closed on gonioscopy at this visit. A year after his last surgery, BCVA remained 20/25 without any complications, with a measured IOP of 18 mmHg off all drops. No lens decentration or dislocation was noted at present. His choroidal folds were noted to have improved significantly, though not completely resolved [Figure 1b].

**Discussion**

There are many sequelae that can occur after blunt trauma to the eye, but cyclodialysis cleft formation appears to be relatively rare compared to other conditions.[1] Cyclodialysis clefts unamenable to closure by medical therapy through cycloplegia or laser treatment require surgical management for long-term successful closure and resolution of hypotony. Direct cyclopectomy through scleral resection to access the ciliary body with subsequent suturing of the cyclodialysis cleft (with various suture techniques) have been the most studied and are typically very successful.[2,3] Overall success rate by direct cyclopectomy is high; closure is often successful within two attempts.[3,4]

Other techniques to close cyclodialysis clefts have been described, though they have not been analyzed as much in the literature compared to direct cyclopectomy. These techniques include direct cryotherapy,[2,3,5] temporary anterior segmental scleral buckling with sponge elements and cryotherapy,[6] gas tamponade with 20% SF6 with cryotherapy,[7] pars plana vitrectomy with cryotherapy and gas tamponade,[8] suturing a CTR to sclera with iris cerclage,[9] and supporting the sulcus with either the haptics of a three-piece IOL or CTR.[10-13] Although case reports have described their successes, the rareness of this diagnosis after an injury makes it difficult to determine the overall effectiveness of these techniques. Failure of the initial attempts with direct cyclopectomy was likely due to a combination of detached ciliary bodies as well as ciliary body infarction, rather than surgical technique given the high success rate described in the literature.

Gross et al. has described a fairly recent surgical technique to close large cyclodialysis clefts.[14] In this technique, phacoemulsification with the placement of a CTR, subsequent pars plana vitrectomy, gas tamponade, and light cryotherapy, was used to repair large cyclodialysis clefts >180° successfully. In their case of four eyes, hypotony was relieved in all patients with improvement in the visual acuity. Of these four patients, three were
left aphakic. We performed a similar technique to close this patient’s chronic cyclodialysis cleft successfully, with simultaneous IOL implantation in the capsule at the time of phacoemulsification and CTR placement. Given the axial length of the affected eye was 3 mm shorter than the contralateral eye, the contralateral eye was used to calculate the diopter of the lens implanted, with −0.50 diopters of error as the target. Other than his short postoperative ocular hypertension, no significant long‑term complications were noted after surgical repair. We believe this technique closed the cleft by helping oppose the ciliary body to the scleral spur by two means; with direct bolstering of the ciliary body to the spur through the CTR, and posterior pressure through short‑acting gas tamponade when lying supine. The flatter, more pliable diaphragm provided by a CTR‑supported capsule works synergistically with posterior pressure while supine through gas tamponade for better apposition. Thorough pars plana vitrectomy, with removal of the posterior hyaloid and vitreous skirt shaving, was performed to maximize surface area for gas tamponade posterior to the capsule and to ensure enough gas at a week of tamponade. Complete vitrectomy also lessens the risk of retinal detachment and possible subsequent proliferative vitreoretinopathy (due to his age) from residual peripheral vitreous that would have been otherwise left with anterior vitrectomy.

This technique provides some advantages over other previously described techniques; given that traumatic cataracts with zonular instability may be present, treatment of both a traumatic cataract and hypotony from a cyclodialysis cleft can be done simultaneously with this technique without the need for CTR suturing with iris cerclage,[9] or placing a CTR or three‑piece IOL in the sulcus. Such techniques, while effective, are also very complex to perform and may have long‑term complications, such as uveitis‑hyphema‑glaucoma findings from iris chafing of haptics, potential future malignant glaucoma, and vitreous prolapse. Plus, treatment of a traumatic visually significant cataract and a cyclodialysis cleft may potentially be done simultaneously, instead of leaving the patient aphakic,[14] with this technique. Finally, the less complex anterior segment techniques required may make this technique more approachable by the ophthalmology community. One potential weakness of this technique is that while it appears to have been successful for a refractory cyclodialysis cleft <180°, its effectiveness is unknown for cyclodialysis clefts >180° with significant zonular instability.

In this case, hypotony improved with a corresponding improvement in vision. The choroidal folds, although not completely resolved, did improve significantly. Persistent hypotony may eventually result in irreversibility of the choroidal folds due to fibrotic changes in the retina, choroid, or sclera.[15] Thus, while optimal timing of cyclodialysis clefts repairing is within 3 months after injury, this case showed that it may still be worthwhile to attempt repairing even after 3 months.[16] Reproducible results with additional surgeries would help validate this technique as a way to close chronic cyclodialysis clefts with ciliary body detachment while inserting
an IOL simultaneously. More cases are necessary to help determine the best algorithms in determining IOL power, but using the contralateral eye if no previous measurements are available may be an acceptable alternative. However, a large case series may be difficult owing to the fairly rare incidence of this diagnosis. This surgical technique may serve as a flexible way to close more complex cyclodialysis clefts not amenable to direct cyclopegy, especially for clefts that are chronic.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consents for the patients images and other clinical information to be reported in the journal. The patient understands that his names and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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Conflicts of interest
The authors declare that there are no conflicts of interests of this paper.

References
1. Ding C, Zeng J. Clinical study on Hypotony following blunt ocular trauma. Int J Ophthalmol 2012;5:771-3.
2. Ioannidis AS, Bunce C, Barton K. The evaluation and surgical management of cyclodialysis clefts that have failed to respond to conservative management. Br J Ophthalmol 2014;98:544-9.
3. Agrawal P, Shah P. Long-term outcomes following the surgical repair of traumatic cyclodialysis clefts. Eye (Lond) 2013;27:1347-52.
4. Küchle M, Naumann GO. Direct cyclopegy for traumatic cyclodialysis with persisting hypotony. Report in 29 consecutive patients. Ophthalmology 1995;102:322-33.
5. Trika S, Turnbull A, Agrawal S, Amerasinghe N, Kirwan J. Management challenges arising from a traumatic 360 degree cyclodialysis cleft. Clin Ophthalmol 2012;6:257-60.
6. Mandava N, Kahook MY, Mackenzie DL, Olson JL. Anterior scleral buckling procedure for cyclodialysis cleft with chronic hypotony. Ophthalmic Surg Lasers Imaging 2006;37:151-3.
7. Ceruti P, Tosi R, Marchini G. Gas tamponade and cyclocryotherapy of a chronic cyclodialysis cleft. Br J Ophthalmol 2009;93:414-6.
8. Hoerauf H, Roiser J, Laqua H. Treatment of traumatic cyclodialysis with vitrectomy, cryotherapy, and gas endotamponade. J Cataract Refract Surg 1999;25:1299-301.
9. Klus A, Kosatka M, Kozer M, Rekas M. Surgical reconstruction of traumatic ciliary body dialysis: A case report. J Med Case Rep 2017;11:22.
10. Mardelli PG. Closure of persistent cyclodialysis cleft using the haptics of the intraocular lens. Am J Ophthalmol 2006;142:676-8.
11. Malandrini A, Balestrazzi A, Martone G, Tosi GM, Caporossi A. Diagnosis and management of traumatic cyclodialysis cleft. J Cataract Refract Surg 2008;34:1213-6.
12. Yuen NS, Hui SP, Woo DC. New method of surgical repair for 360-degree cyclodialysis. J Cataract Refract Surg 2006;32:13-7.
13. Gupta S, Sagar P, Gogia V, Khokhar S, Dada T. Dual endotamponade for extensive long-standing cyclodialysis using sulcus-fixated Cionni ring and PCIOL. J Glaucoma 2016;25:e284-7.
14. Gross JB, Davis GH, Bell NP, Feldman RM, Blieden LS. Surgical repair of large cyclodialysis clefts. Eur J Ophthalmol 2017;27:382-5.
15. Jampel HD, Pasquale LR, Dibernardo C. Hypotony maculopathy following trabeculectomy with mitomycin C. Arch Ophthalmol 1992;110:1049-50.
16. Cohen SM, Flynn HW Jr., Palmberg PF, Gass JD, Grajewski AL, Parrish RK 2nd. Treatment of hypotony maculopathy after trabeculectomy. Ophthalmic Surg Lasers 1995;26:435-41.