Indirect Cyclopexy for Repair of Cyclodialysis Clefts

A cyclodialysis cleft is a rare condition caused by disinsertion of the longitudinal fibers of the ciliary muscle from the scleral spur. In most cases, this occurs as a result of severe blunt ocular trauma or as a complication of intraocular surgery that involves iris manipulation.[1–4] Cyclodialysis results in a direct communication between the anterior chamber and suprachoroidal space and this permits unrestricted outflow of aqueous, often leading to hypotony.[4,5] Persistent hypotony can lead to severe permanent vision loss from hypotony maculopathy. Hypotony maculopathy is characterized by chorioretinal folds, optic nerve head edema, and vascular tortuosity. A variety of techniques for repair of cyclodialysis have been described anecdotally in the literature (Figure 1).[3] Smaller cyclodialysis clefts may be treated successfully with topical cycloplegics,[6] photocoagulation,[7,8] or cryotherapy;[2,9] however, larger clefts often require surgical closure.[1,8,10] Methods of surgical closure include direct[10] and indirect[11] cyclopexy, placement of a capsular tension ring,[12] scleral buckling,[13] and vitrectomy with endotamponade.[14] The most commonly reported method is direct cyclopexy, which involves suturing the ciliary muscle to scleral spur with visualization through a dissected scleral window.[10] Although this technique can be time consuming and technically challenging, especially in hypotonous eyes, its efficacy has been demonstrated in multiple large case series.[2,10,14,15] Indirect cyclopexy is a less time consuming, less invasive alternative that involves placement of sutures radially along the limbus without direct visualization of the ciliary body.[16–18] We describe our technique for indirect cyclopexy and the results of treating patients with cyclodialysis clefts.

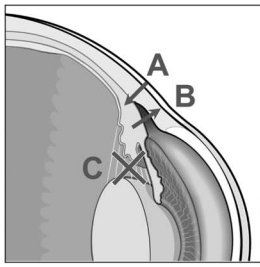
Methods

Institutional review board approval was obtained from the Cleveland Clinic Foundation before undertaking a retrospective, observational study of a consecutive case series of patients treated with indirect cyclopexy for traumatic cyclodialysis clefts with hypotony. The study adhered to the tenets of the Declaration of Helsinki.

Patients were included in the review if they underwent indirect cyclopexy for the treatment of hypotony due to a cyclodialysis cleft between March 2005 and February 2017. Cyclodialysis cleft was diagnosed using gonioscopy and confirmed with ultrasound biomicroscopy (UBM 50 mHz; Quantel Medical USA, Bozeman, MT). Patients were excluded if cyclopexy was performed in conjunction with pars plana vitrectomy with endotamponade, capsular tension ring, or scleral buckle. It was determined that these additional procedures would confound the results and raise question as to which surgical procedure resulted in cyclodialysis cleft closure. Ocular history, visual acuity, intraocular pressure (IOP), complications, and examination data were recorded. The surgeries were performed by two surgeons (A.V. R. and J.E.S.). Paired *t*-test was used for all statistical analyses using SAS software (version 9.3; Cary, NC). A significance level of 0.05 was assumed for all tests.

Surgical Technique

The indirect cyclopexy procedure involved conjunctival dissection followed by demarcation of the extent of the cyclodialysis cleft as previously established using UBM. Using 9-0 Prolene (Ethicon,



1. Mechanical Apposition	Technique
A. Appose sclera to ciliary body	Scleral Buckle
B. Appose ciliary body to sclera	Vitrectomy with endotamponade Direct cyclopexy Indirect cyclopexy
C. Relieve tension on ciliary body	Capsular tension ring Cycloplegia
2. Induced Localized Inflammation	Cryotherapy Argon or Diode cyclophotocoagulation

Fig. 1. Summary of techniques for repair of cyclodialysis clefts.

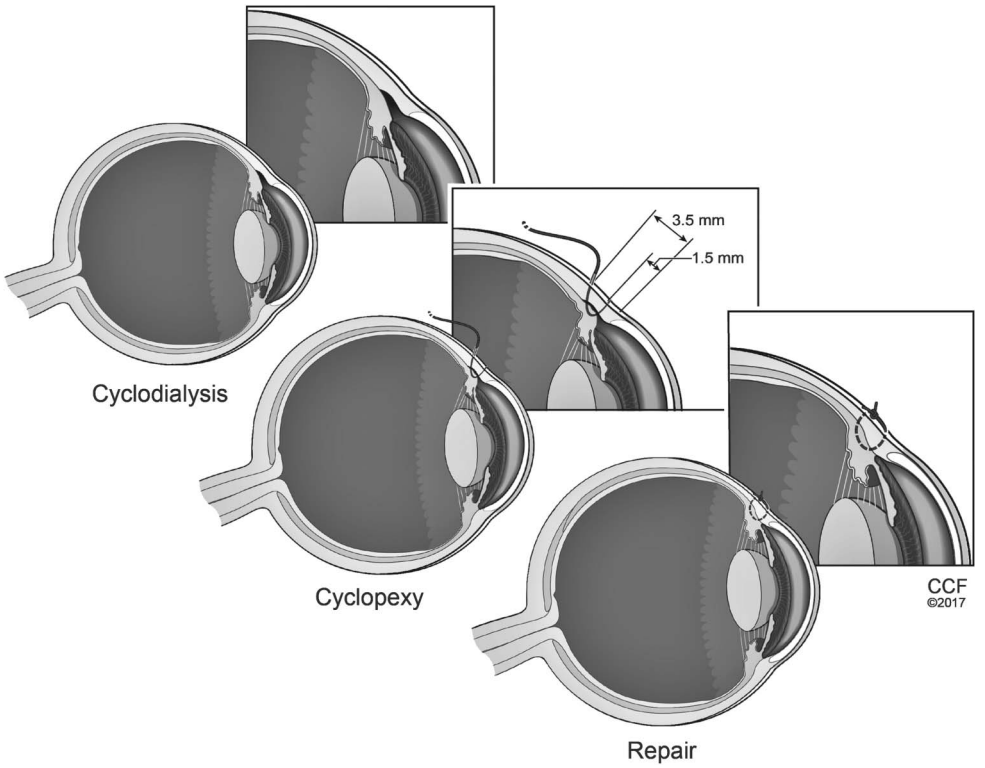


Fig. 2. Schematic representation of indirect cyclopexy technique demonstrating needle path through sclera 3.5 mm posterior to surgical limbus, ciliary body, and out through sclera 1.5 mm posterior to surgical limbus.

Inc, Somerville, NJ) suture on a spatulated, 3/8 circle needle, full-thickness bites were taken that spanned from 3.0 mm to 1.5 mm (radially) from the limbus through the ciliary body (Figure 2). These passes were performed anterior-to-posterior or posterior-to-anterior based on surgeon preference. Multiple interrupted bites were placed approximately 0.5 mm apart to incorporate the extent of the cyclodialysis cleft. Suture knots were buried through sclera and conjunctiva was closed with 6 to 0 plain gut suture (see **Video, Supplemental Digital Content 1**, http://links.lww.com/IAE/A834, which demonstrates the indirect cyclopexy surgical technique).

Results

A total of nine patients were identified as having undergone treatment with indirect cyclopexy for cyclodialysis cleft with hypotony. Four were excluded due to concomitant pars plana vitrectomy with endotamponade. Table 1 lists demographic information, ocular history, preoperative and postoperative visual acuities, and IOP measurements for the five patients included in the study. Of these five patients, four were men and one was a woman. Their mean age was 53 ± 6 years (range, 39–70). The mean follow-up time after indirect cyclopexy was 24 ± 8 weeks (range, 9–52). Cyclodialysis was caused by blunt ocular trauma in three patients and intraocular surgery in two patients (pars plana vitrectomy in both cases). Mean duration of hypotony before treatment with cyclopexy was 27 ± 12 weeks (range, 5–70). Preoperative UBM was used for diagnostic confirmation and surgical planning, whereas postoperative UBM confirmed cyclodialysis closure (Figure 3). Preoperatively, mean IOP was 3.6 ± 1.2 mmHg (range, 1–8), and all eyes demonstrated signs of hypotony (Figure 4). Postoperative IOP increased in all patients and the change was statistically significant at final follow-up with a mean of 16.9 ± 3.1 mmHg (range, 8–27) and a mean increase of 13.4 ± 3.1 (range, 7–24) ($P = 0.01$). Logarithm of the minimum angle of resolution visual acuity improved significantly by a mean of 0.47 ± 0.17 (23.5 letters) (range, 15–32 letters) ($P = 0.04$) with a preoperative mean logarithm of the minimum angle of resolution visual acuity of 1.04 ± 0.20 (20/219) (range, 20/138–20/348) and postoperative mean

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.retinajournal.com).

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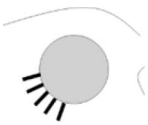
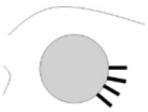
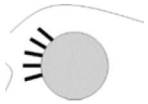
Table 1. Patient Demographics, Ocular History, and Preoperative and Postoperative Data

Case#	Age	Eye	Ocular History	Surgical Figure	Preoperative IOP (mmHg)	Preoperative VA	Postoperative IOP (mmHg)	Postoperative VA	Follow-up (weeks)
1	40	OD	Blunt trauma		3	20/100	27	20/60	26
2	63	OS	PPV for epiretinal membrane		3	20/70	15	20/20	52
3	39	OS	Blunt trauma		8	20/300	16	20/70	13
4	70	OS	PPV for retinal detachment and macular hole		1	CF	8	CF	9
5	55	OD	Blunt trauma		3	20/250	19	20/25	22

OD, right eye; OS, left eye; PPV, pars plana vitrectomy; VA, visual acuity.

logarithm of the minimum angle of resolution visual acuity of 0.56 ± 0.30 (20/72) (range, 20/36–20/145). The lack of improvement in visual acuity after cyclopexy in one patient with very poor preoperative visual acuity (Case #4) was attributed to their history of a longstanding macular hole and severe band keratopathy. No intraoperative or postoperative complications were observed.

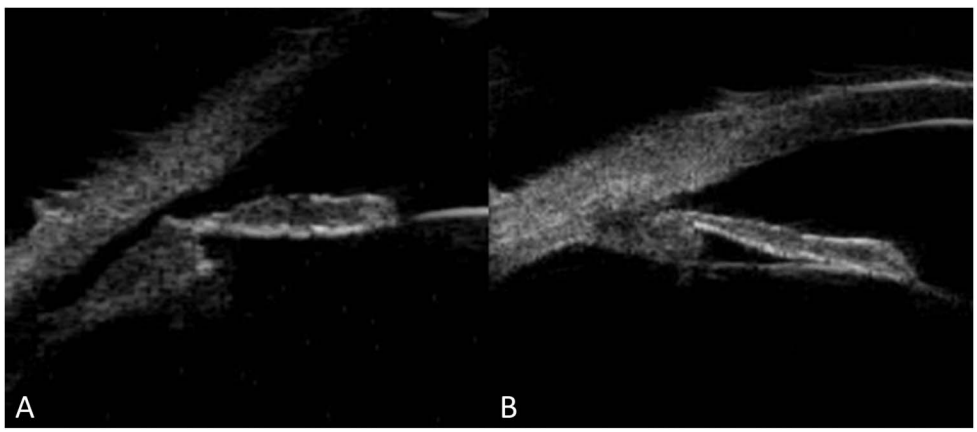


Fig. 3. Preoperative UBM (**A**) and postoperative UBM (**B**) 1 month after indirect cyclopexy demonstrating resolution of cyclodialysis cleft.

Fig. 4. Widefield photograph of hypotony maculopathy associated with cyclodialysis cleft demonstrating chorioretinal folds, optic nerve head edema, and vascular tortuosity (**A**) and postoperative photograph with resolution of these findings (**B**) after indirect cyclopexy.

Discussion

Cyclodialysis clefts with hypotony can lead to severe vision loss if left untreated. Surgical repair is often necessary to resolve hypotony maculopathy and improve visual acuity. Several techniques for repair of cyclodialysis clefts have been reported (Figure 1) including various methods of cyclopexy involving suturing the ciliary body to sclera.[3] Direct cyclopexy is the most widely reported with closure rates ranging from 67% to 93%.[2,10,14]

The most popular method involves a limbal-based scleral flap with direct visualization of the cyclodialysis cleft and suturing of the ciliary muscle to the scleral spur.[15] Although this method offers good success rates,[10,14] it can be very challenging in a hypotonous eye and requires extensive surgical skill and experience. We report our experience treating adult patients with hypotony maculopathy due to cyclodialysis cleft with indirect cyclopexy. Indirect cyclopexy has previously been reported by Tate and Lynn[11] and Metrikin et al[17] as a method of cyclodialysis repair without direct visualization of the ciliary body. The techniques they described involved variations of passing McCannel[19] retrievable sutures radially through cornea, ciliary body, and perilimbal sclera. More recently, a case report by Chadha et al[18] described successful cyclopexy with a simplification of the McCannel retrievable suture technique by placing radial sutures through peripheral cornea, iris root, and ciliary body without any intraocular manipulation or stab incisions. Although anecdotally, these techniques have described success, the McCannel suture can be technically challenging, and it has been suggested that the involvement of iris root in both methods induces broad peripheral anterior synechiae and may cause severe pupil distortion.[5,20] The technique described in the current report avoids these potential complications by directing suture passes more posteriorly to avoid cornea, lens, and iris root while still maintaining efficacy. We report resolution of hypotony in all the patients treated with the current technique with significant increase in IOP and visual acuity.

The method of indirect cyclopexy described in this report has several advantages when compared with alternative surgical techniques. It is a relatively simple technique that avoids the risk of performing a scleral flap in a hypotonous eye, does not require identification or manipulation of highly vascularized intraocular structures, and avoids the complications associated with placing a suture through the iris root as described previously.[5,20] Although there are potential risks inherent in passing a suture blindly into the sclera, that is, intraocular hemorrhage, peripheral anterior synechiae, retinal detachment, or cataract, none of these complications were observed in the current series.

One patient who developed a cyclodialysis cleft after trauma (Case #1) in this study did have an IOP of 27 mmHg 6 months after indirect cyclopexy; however, the multifactorial nature of traumatic glaucoma makes it difficult to ascertain whether this high IOP is a direct result of surgery or from traumatic damage to the patient's trabecular meshwork at the time of the initial injury.

The limitations of this study include the retrospective design, uncontrolled methodology, relatively short follow-up, and limited number of patients. Despite these limitations, these results suggest that this method of indirect cyclopexy may be a successful, safe, and less-challenging method of repair of cyclodialysis clefts warranting larger definitive studies.

Key words: cyclodialysis cleft, cyclopexy, hypotony, hypotony maculopathy, indirect cyclopexy, trauma, UBM, ultrasound biomicroscopy.

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References

1. Ioannidis AS, Barton K. Cyclodialysis cleft: causes and repair. Curr Opin Ophthalmol 2010;21:150–154.
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;98:544–549.
3. González-Martín-Moro J, Contreras-Martín I, Muñoz-Negrete FJ, Gómez-Sanz F, Zarallo-Gallardo J. Cyclodialysis: an update. Int Ophthalmol 2017;37:441–457.
4. Ikeda N, Ikeda T, Nagata M, Mimura O. Pathogenesis of transient high myopia after blunt eye trauma. Ophthalmology 2002;109:501–507.
5. Ormerod LD, Baerveldt G, Sunalp MA, Riekhof FT. Management of the hypotonous cyclodialysis cleft. Ophthalmology 1991;98:1384–1393.
6. Shah VA, Majji AB. Ultrasound biomicroscopic documentation of traumatic cyclodialysis cleft closure with hypotony by medical therapy. Eye (Lond) 2004;18:857–858.
7. Aminlari A, Callahan CE. Medical, laser, and surgical management of inadvertent cyclodialysis cleft with hypotony. Arch Ophthalmol 2004;122:399–404.
8. Han JC, Kwun YK, Cho SH, Kee C. Long-term outcomes of argon laser photocoagulation in small size cyclodialysis cleft. BMC Ophthalmol 2015;15:123.
9. Krohn J. Cryotherapy in the treatment of cyclodialysis cleft induced hypotony. Acta Ophthalmol Scand 1997;75:96–98.
10. Küchle M, Naumann GOH. Direct cyclopexy for traumatic cyclodialysis with persisting hypotony. Ophthalmology 1995; 102:322–333.
11. Tate GW, Lynn JR. A new technique for the surgical repair of cyclodialysis induced hypotony. Ann Ophthalmol 1978;10: 1261–1268.
12. Yuen NSY, Hui SP, Woo DCF. New method of surgical repair for 360-degree cyclodialysis. J Cataract Refract Surg 2006;32: 13–17.
13. Mandava N, Kahook MY, Mackenzie DL, Olson JL. Anterior scleral buckling procedure for cyclodialysis cleft with chronic hypotony. Ophthalmic Surg Lasers Imaging 2006;37:151–153.
14. Xu WW, Huang YF, Wang LQ, Zhang MN. Cyclopexy versus vitrectomy combined with intraocular tamponade for treatment of cyclodialysis. Int J Ophthalmol 2013;6:187–192.
15. Agrawal P, Shah P. Long-term outcomes following the surgical repair of traumatic cyclodialysis clefts. Eye (Lond) 2013;27: 1347–1352.
16. Taban M, Sonnie C, Hayden BC, Sears JE. Ultrasound biomicroscopy-guided surgical intervention for cyclodialysis clefts. Retin Today 2011;6:38–41.
17. Metrikin DC, Allinson RW, Snyder RW. Transscleral repair of recalcitrant, inadvertent, postoperative cyclodialysis cleft. Ophthalmic Surg 1994;25:406–408.
18. Chadha N, Lamba T, Belyea DA, Merchant KY. Indirect cyclopexy for treatment of a chronic traumatic cyclodialysis cleft with hypotony. Clin Ophthalmol 2014;8:591–594.
19. McCannel MA. A retrievable suture idea for anterior uveal problems. Ophthalmic Surg 1976;7:98–103.
20. Nichols JC, Lee DH, Feman SS, Shields SR. Severe pupil distortion following transchamber repair of a cyclodialysis cleft. Ophthalmic Surg Lasers 2002;33:426–429.