

Ab Interno Canaloplasty

A minimally invasive and maximally effective glaucoma treatment.

BY MAHMOUD A. KHAIMI, MD

I performed my first canaloplasty surgery in 2008. My early cases confirmed to me that the procedure offered equivalent IOP-lowering efficacy to traditional filtering surgery but without the bleb-related complications that keep glaucoma surgeons awake at night.¹ Numerous peer-reviewed clinical studies have since confirmed that canaloplasty is as effective as trabeculectomy at lowering IOP and reducing patients' dependence on medication but with a much better safety profile.²⁻⁷

As a surgeon, I believe that excellence is not a destination but a journey. For me, the latest step forward is ab interno canaloplasty (ABiC), a subtle but significant refinement of traditional ab externo canaloplasty that may lower IOP similarly in patients with mild to moderate primary open-angle glaucoma (POAG).

THE PROCEDURE

ABiC offers a comprehensive approach to microinvasive glaucoma surgery (MIGS) by accessing, catheterizing, and viscodilating all aspects of outflow resistance—the trabecular meshwork, Schlemm canal, and the distal outflow system beginning with the collector channels. ABiC is an innovative way of using a proven technique and technology earlier in the disease process, and the procedure can be performed during cataract surgery as well as on pseudophakic patients. (To watch Dr. Khaimi perform ABiC, visit <http://bit.ly/1XZLd5k>.)

The key difference between ABiC and traditional canaloplasty is that, in the former, no tensioning suture is required to maintain the IOP reduction. Although some surgeons, myself included, had anecdotally noted that the lack of a tensioning suture did not compromise IOP

reduction in certain patients after traditional canaloplasty procedures, stronger evidence came from a review of 3-year data by Lewis et al, which indicated that 360° viscodilation alone (ie, canaloplasty without a suture) successfully lowered IOP.² Mapping the results of viscodilation to suture tension also showed that viscodilation was driving the IOP reduction more than the tension of the suture.

PATIENT SELECTION

With ABiC, the surgical treatment algorithm for glaucoma has expanded. Surgeons can now intervene earlier in glaucoma than with conventional filtering procedures, and doctors and patients get the added benefit of simplified postoperative follow-up and fewer side effects and complications compared with trabeculectomy.

Because ABiC is recommended early in the disease process, the primary indication is for patients with mild to moderate glaucoma who are on medical therapy. The procedure may also be considered as a first-line treatment, and it is an option for patients who have undergone laser trabeculoplasty and those for whom adherence to glaucoma medical therapy is problematic. Patients with exfoliative glaucoma and those in whom glaucoma surgery in the fellow eye has failed may also be considered for ABiC. The exclusion criteria are similar to those for traditional canaloplasty, and ABiC should not be performed on patients with neovascular or chronic angle-closure glaucoma.

ABiC is most frequently performed in conjunction with phacoemulsification. It is not limited to a combination procedure, however, but may be performed alone. As an added benefit, ABiC preserves conjunctival tissue for future procedures, if required.

TABLE 1. AB INTERNO CANALOPLASTY ALL EYES

Examination	n	Median IOP (mm Hg) ±SD	Median Medications (n) ±SD
Maximum recorded	106	21.0 ±5.4	2.0 ±1.0
Baseline	106	18.0 ±6.6	2.0 ±1.0
1 month	100	16.0 ±5.2	0.0 ±0.6
3 months	48	15.0 ±4.5	0.0 ±1.0
6 months	20	14.5 ±2.7	0.0 ±1.0

Abbreviation: SD, standard deviation.

TABLE 2. AB INTERNO CANALOPLASTY WITH CATARACT SURGERY

Examination	n	Median IOP (mm Hg) $\pm$ SD	Median Medications (n) $\pm$ SD
Maximum recorded	68	21.0 $\pm$ 5.6	2.0 $\pm$ 1.0
Baseline	68	17.5 $\pm$ 5.1	2.0 $\pm$ 1.0
1 month	63	14.0 $\pm$ 4.1	0.0 $\pm$ 0.3
3 months	30	14.0 $\pm$ 3.7	0.0 $\pm$ 1.0
6 months	13	12.0 $\pm$ 2.6	0.0 $\pm$ 0.0

Abbreviation: SD, standard deviation.

TABLE 3. AB INTERNO CANALOPLASTY WITH OR WITHOUT PRIOR GLAUCOMA SURGERY

Examination	With			Without		
	n	Median IOP (mm Hg) $\pm$ SD	Median Medications (n) $\pm$ SD	n	Median IOP (mm Hg) $\pm$ SD	Median Medications (n) $\pm$ SD
Maximum recorded	46	22.0 $\pm$ 5.3	2.0 $\pm$ 1.0	60	20.0 $\pm$ 5.5	2.0 $\pm$ 1.0
Baseline	46	20.0 $\pm$ 5.5	2.0 $\pm$ 1.0	60	17.5 $\pm$ 7.4	2.0 $\pm$ 1.0
1 month	44	16.5 $\pm$ 5.7	0.0 $\pm$ 0.7	56	15.0 $\pm$ 4.8	0.0 $\pm$ 0.6
3 months	23	16.0 $\pm$ 4.9	0.0 $\pm$ 1.0	25	15.0 $\pm$ 4.1	0.0 $\pm$ 0.0
6 months	10	15.5 $\pm$ 2.9	0.0 $\pm$ 1.0	10	12.0 $\pm$ 2.3	0.0 $\pm$ 1.0

Abbreviation: SD, standard deviation.

MY CLINICAL RESULTS

My own clinical experience with ABiC has been in line with the findings of Lewis et al in terms of the procedure's safety and efficacy.² Of 106 patients treated in a recent case series, there was a total average decrease in IOP of 35% and in glaucoma medications of 100% 6 months postoperatively compared to baseline (M.A.K., unpublished data, 2014-2015). The initial baseline median value maximum recorded IOP for 106 patients was 21 mm Hg ($\pm$ 5.4 standard deviation [SD] on 2 medications $\pm$ 1 SD); at 1 month, 100 patients recorded a median IOP of 16 mm Hg ($\pm$ 5.2 SD on no medications $\pm$ 0.6 SD); at 3 months, 48 patients had a median maximum recorded IOP of 15 mm Hg ($\pm$ 4.5 SD on no medications $\pm$ 1 SD); and at 6 months, 20 patients had a median value maximum IOP of 14.5 mm Hg ($\pm$ 2.7 SD on no medications $\pm$ 1 SD; Table 1).

For patients who underwent combined phacoemulsification and ABiC, the total average decrease in IOP was 38.4% at 6 months (Table 2). For patients who were not using glaucoma medication before surgery, there was a total average decrease of 36.4% in IOP after 6 months. For patients who had no previous glaucoma surgery, the total average decrease in IOP was 38.1% and 100% in medications at 6 months. The total decrease

at 6 months was 33.3% for those who had previously undergone glaucoma surgery (Table 3).

Although longer follow-up is clearly needed to confirm these initial results, I am confident that ABiC will build on canaloplasty's time-tested reputation as a minimally invasive and maximally effective procedure to treat mild to moderate POAG.

OTHER MIGS PROCEDURES

With a variety of different MIGS approaches now available to surgeons or forthcoming, it is worth noting that other techniques are less comprehensive than ABiC in that they address specific—but not all— aspects of the ocular outflow system. The Trabectome (NeoMedix), for instance, uses an electrosurgical pulse to ablate the trabecular meshwork and inner wall of Schlemm canal. The iStent Trabecular Micro-Bypass Stent (Glaukos) allows aqueous humor to flow directly from the anterior chamber into Schlemm canal, thus circumventing the trabecular meshwork.⁸ The Hydrus (Ivantis; not FDA approved) is inserted into Schlemm canal to improve ocular outflow from the anterior chamber to the canal by acting as an intracanalicular scaffold.⁹ The CyPass Micro-Stent (Transcend Medical; not FDA approved) facilitates outflow from the anterior

chamber to the suprachoroidal space. The Xen45 (Allergan; not FDA approved) is placed into the subconjunctival space to create a filtering bleb.⁹

ABiC is also the only currently available procedure that addresses blockages in the collector channels. Studies undertaken in human and bovine POAG eyes by Haiyan Gong, MD, PhD, and colleagues have shown that the collector channels play an important role in obstructing aqueous outflow in POAG eyes. Specifically, when the inner wall tissue of the trabecular meshwork herniates into the collector channels, it blocks aqueous outflow.^{10,11}

CONCLUSION

ABiC effectively lowers IOP. The procedure has an excellent safety profile and can be used to treat a wide variety of glaucomas. Unlike other MIGS procedures, ABiC addresses all potential blockages in the ocular outflow pathway, including distal structures such as the collector channels, which play a key role in obstructing aqueous outflow in POAG eyes.

ABiC may be the answer for which glaucoma surgeons have been waiting—a MIGS option that restores the natural outflow channels without damaging tissue or leaving behind a stent or shunt. ■

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