Chapter 6

Combined Cataract and Trabeculectomy Surgery

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Introduction

When the decision has been made to perform cataract surgery in a glaucoma patient, the options of cataract surgery alone or combined with glaucoma surgery (glaucoma triple procedure) are available to the surgeon. Trabeculectomy is the glaucoma procedure that has been most frequently and for the longest time combined with cataract surgery, to assist in the control of intraocular pressure (IOP). Other combined procedures are discussed in Chapter 14 and elsewhere in the text. As discussed throughout the text, cataract and glaucoma often present in the same patient and are common comorbidities.

The presence of a cataract may drive the decision for combined surgery, and on the other hand, a need for lower intraocular pressure (IOP) may drive the decision for a combined procedure. If the surgeon deems it is likely that the patient will need to return to the operating room for a cataract surgery, following the trabeculectomy, it may be best to perform both surgeries at the same operative session. Progression of cataract is a known complication of trabeculectomy.[1,2] One surgical experience may be the best for a patient, depending on their health status and socioeconomic concerns.

The status of the glaucoma and the target intraocular pressure are the important factors to consider in deciding to pursue a combined cataract extraction and glaucoma procedure versus a cataract procedure alone.[3] The patient is likely to have more IOP lowering with a combined versus a cataract extraction alone.[4,5] This has been shown since the initiation of the combined procedure.

Trabeculectomy was originally combined with extracapsular cataract extraction (ECCE) with a 11-mm wound, as studied by Bobrow in 1999. He was able to follow 35 patients for at least 80 months. He found the eyes with trabeculectomy combined with cataract surgery versus those that underwent cataract surgery alone had an IOP reduction of 8.2 $\pm$ 4.6 mmHg versus 4.4 $\pm$ 3.3 mmHg. Medications were reduced by 1.76 $\pm$ 0.82 versus 1.28 $\pm$ 0.86, respectively.[6]

The surgeon should carefully review the visual field status, level of IOP control and how maximal the therapy is, and the status of the optic disc and/or retinal nerve fiber layer (Figs. 6.1, 6.2, and 6.3). General principles to consider are as follows:

1. A patient with advanced visual field loss and disc damage who is not likely to withstand any elevated postoperative IOP, due to the risk of further damage, is less likely to have elevated IOP following a combined procedure.[7,8]
2. A patient who cannot tolerate medical therapy due to drop allergies, cost, or compliance issues such as dementia or tremor will likely lessen the burden of medical

Fig. 6.1 Fundus photo demonstrating a disc with advanced glaucomatous damage

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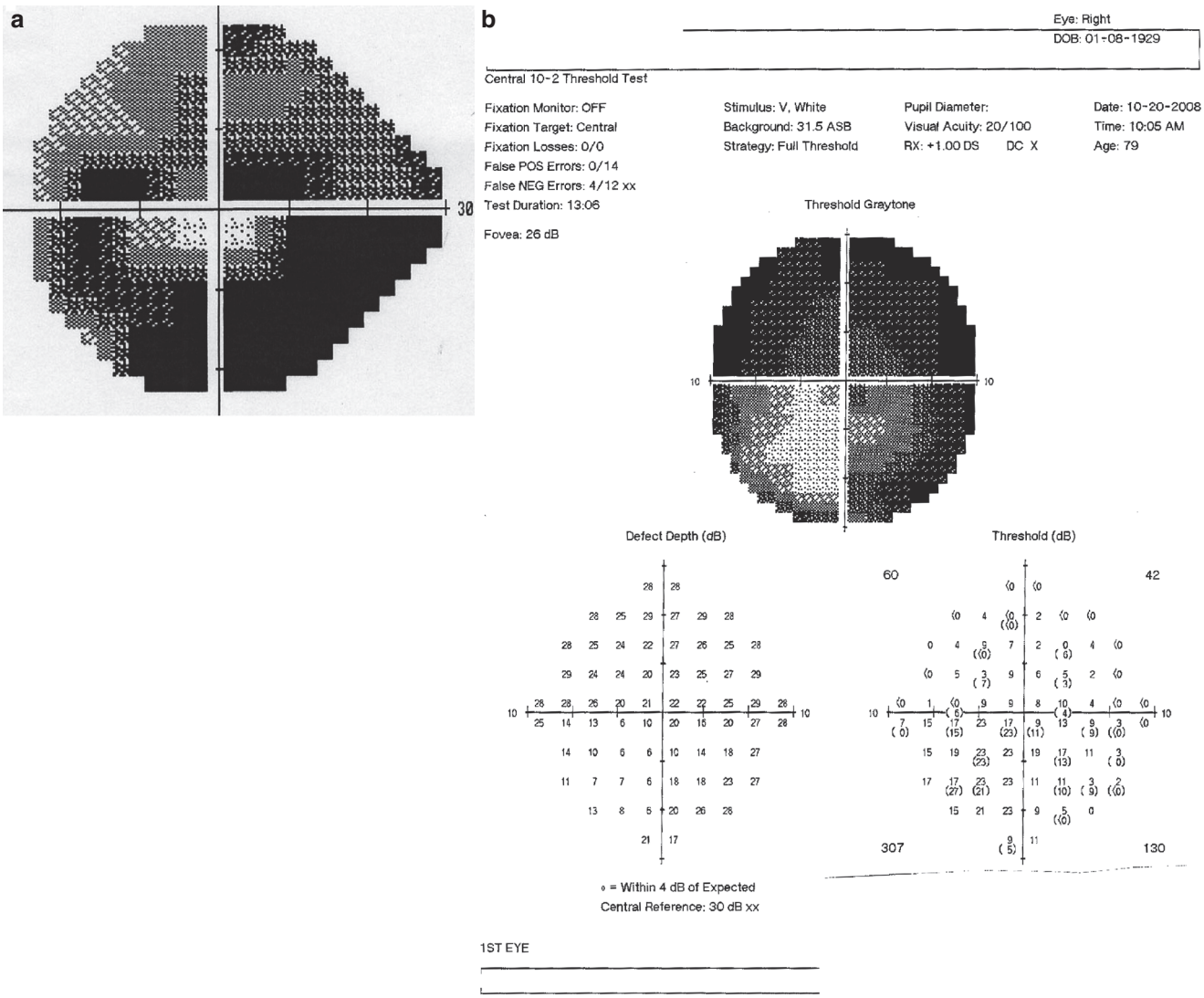

Fig. 6.2 (**a**) Visual field grayscale image of a left eye with a dense inferior nasal step and field loss superior near fixation. (**b**) A 10° visual field demonstrating advanced visual field loss

therapy more so with a combined procedure, although compliance with drops is essential during the postoperative period.

3. A patient who is on maximal medical therapy and has no further options for escalation of therapy for loss of IOP control post cataract surgery may be better served with a combined procedure.
4. A narrow angle patient with poor IOP control and permanent synechial angle closure will be easier to manage postoperatively if the chamber is deepened with concurrent cataract surgery at the time of filtration surgery. There will be the added option of YAG laser capsulotomy and laser to the anterior hyaloid face, should aqueous misdirection present.
5. As noted previously, if a patient is undergoing a trabeculectomy for loss of IOP control and there is a significant or near significant cataract present, then a combined should be considered, as cataracts often progress post trabeculectomy.[9–11] There may be some added lowering of IOP by removing a cataract with pseudoexfoliation (PXF) present.[12–14] or for an angle-closure patient (see Chapters 15 and 18).

A two-staged procedure, with a cataract extraction later, may be pursued if the IOP is very high and the risk of suprachoroidal hemorrhage is elevated, as it may be more likely to occur intraoperative with a more prolonged surgery.[15] In these instances, it is best to gain control of the IOP initially and then pursue visual rehabilitation with a later cataract surgery. See Chapter 16.

Disadvantages of a combined surgery are listed in Table 6.1.

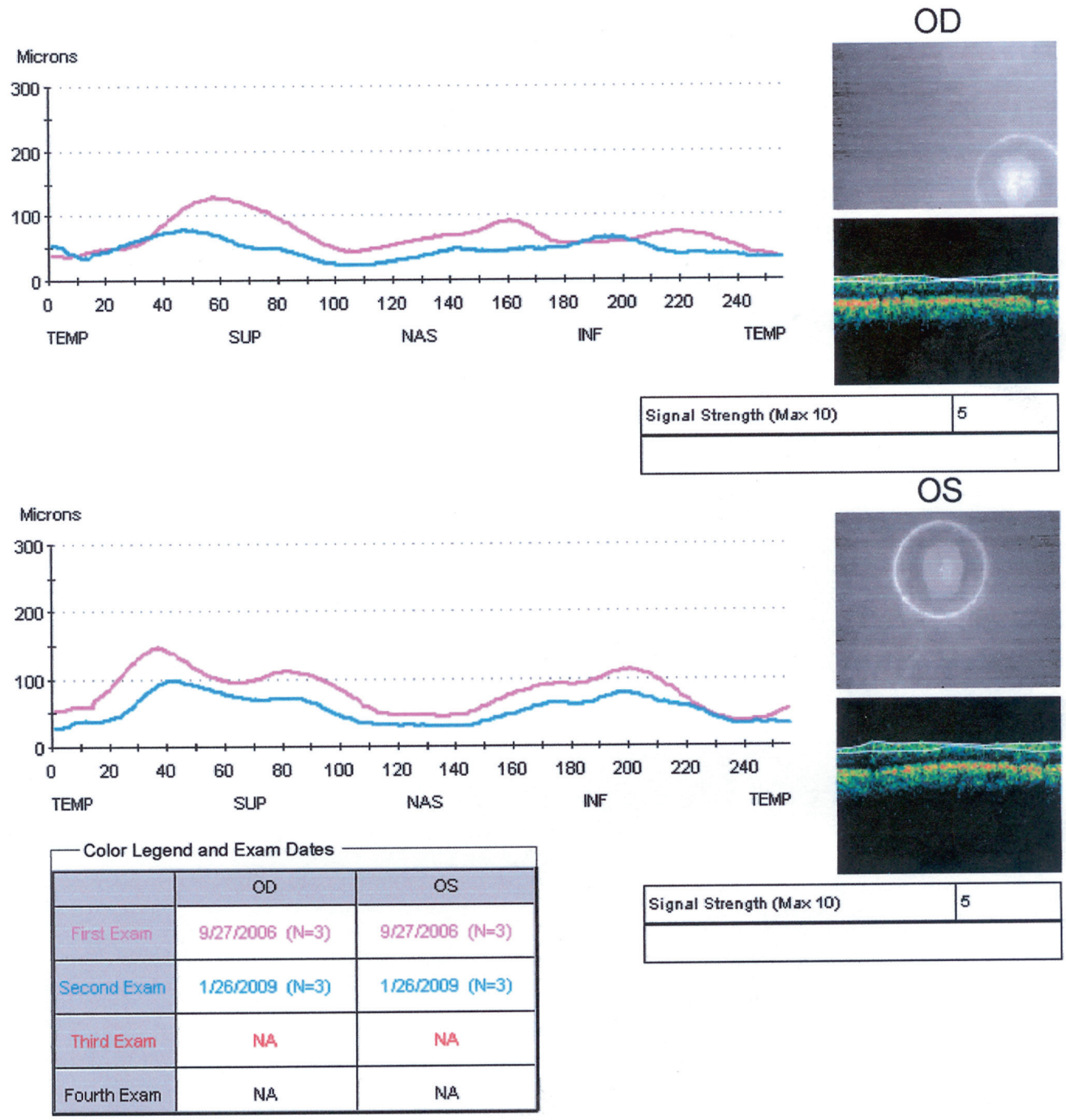

Fig. 6.3 Retinal nerve fiber (RNFL) assessment by ocular coherence tomorgraphy (Zeiss Meditec, Dublin, CA). Note the decreased RNFL in one eye versus the other consistent with a more advanced glaucoma status. Image courtesy of Lloyd Situkali, ophthalmic photography, UVA.

Preoperative Assessment

As for any pre-surgical patient, a history of systemic medications including anticoagulants is essential, and the patient should be current with their surveillance of his/her anticoagulation status if on warfarin. If the patient is hypertensive, blood pressure should be in good control as well as any tachycardia. The current eye medications should be reviewed. As discussed in Chapter 1, the surgeon may want to discontinue prostaglandin analogues if there is a concern for postoperative inflammation. Miotics must be discontinued to allow for maximal pupil dilation. If there is conjunctival inflammation secondary to drops, the surgeon

Table 6.1 Disadvantages of combined surgery versus cataract surgery alone

- Longer operating room time for procedure
- More complex postoperative care
- Slower visual recovery
- Possibly less IOP control versus trabeculectomy alone
- Possibly more astigmatism or myopic shift
- Long-term bleb problems

must decide on whether to discontinue topical medications for a quieter eye and weigh this against performing surgery on an eye with higher intraocular pressure. The patient may need to be instructed on the cessation of oral carbonic anhydrase inhibitors postoperatively. Older patients should be counseled about their increased risk of choroidal effusions.[10,16,17]

A complete eye exam should be done to assess for conditions such as those listed in Table 6.2. This will assist the surgeon in anticipating complications and to prepare adequately.

Table 6.2 Preoperative ocular assessment

- Blepharitis
- Conjunctival inflammation
- Prior conjunctival incisions
- Corneal guttatae
- Pupillary dilation
- Pseudoexfoliation
- Vitreous in the anterior chamber
- Gonioscopy
- Retinal conditions

Surgical Evolution

Incision Size

Simmons et al. and Hurvitz reported similar outcomes in similar case reviews of large-incision ECCE.[18,19] The Simmons report reviewed 75 cases of ECCE combined with trabeculectomy and mean IOP was decreased 3.6 mmHg at 12 months with 1.5 less medications. Shingleton et al. reviewed 35 eyes that underwent a planned extracapsular cataract extraction (ECCE) with an 11-mm incision and 37 that underwent a phacoemulsification procedure with a 6-mm incision. At 1 year, the mean IOP decrease was 5 mmHg for the 6-mm incision group versus 3 mmHg for the ECCE group. The preoperative IOP was slightly higher in the phacoemulsification group, but otherwise the groups were similar.[20] Stewart et al. reported on a group of 18 ECCE cases versus 16 phacoemulsification cases combined with trabeculectomy, and at 1 year the eyes in the phacoemulsification group had a mean lower IOP of 2.3 mmHg and a trend toward less glaucoma medications.[21] Wishart et al. reported similar findings in a comparison of phacoemulsification versus ECCE.[22] The final IOP at 1 year or more was controlled with no medications for 79% of the phacoemulsification patients and 53% of the ECCE patients. There was more astigmatism in the ECCE group and 32% had some pupillary capture of the intraocular lens. Pupillary capture can result from a multiple puncture/can opener style anterior capsulotomy when an anterior chamber shallows with filtration. This type of capsulotomy maintains the intraocular lens position less compared to a continuous curvilinear capsulorhexis that is fashioned to be slightly smaller than the optic of the IOL implanted. In a report by Tous et al., reviewing 475 consecutive cases, there were more complications in the ECCE group (80 eyes) versus the phacoemulsification group (395) with a minimum follow-up of 12 months.[23]

Lyle and Jin studied 216 patients who had undergone combined surgery of which 104 had 3-mm incisions and 112 had a 6-mm incision.[24] Follow-up was for a minimum of 6 months with a mean of 18 months, with longer follow-up for the 6-mm incision group. The smaller incision group had faster visual rehabilitation and less need for any medications at 1 year; 78% versus 68%. At 6 months, the IOP decrease was close to 7 mmHg in the 6-mm incision group and nearly 9 mmHg in the smaller incision group. Several years later, Stewart et al. reported a similar study and found no difference in IOP control at 1 year.[25] A report from Vyas et al. compared 3.5 and 5.2 mm incisions and found no difference in IOP control at 1 year or difference in astigmatism.[26]

Incision sizes have further decreased with the development of the foldable intraocular lens. In one early study of this technology, 49 eyes underwent small incision phacoemulsification with foldable intraocular lens implantation and trabeculectomy. At a mean follow-up of 31.5 months, all patients had IOP control with 80% on no medications and 16% on fewer medications than preoperatively. Mean postoperative IOP was 14.2 ± 3 compared to 22.3 ± 4.3 mmHg preoperative.[27] The literature supports better IOP control with smaller incision cataract surgery; however, there are some reports that do not support this when 6 mm versus 3 mm incisions are compared, and the difference may not be as pronounced as decreasing the incision size from 11 to 6 mm. Six millimeter incisions are still used in countries where there is no access to phacoemulsification and/or foldable IOLs (see Chapter 7).

Antimetabolites

There have been several reports assessing the effect of 5-fluorouracil (5-FU) augmented trabeculectomy combined with phacoemulsification cataract extraction and posterior

chamber intraocular lens (PCIOL). In 1993, O'Grady et al. reported no effect from 5-FU augmentation versus no 5-FU used for glaucoma triple procedure in a randomized study of 74 patients.[28] The 5-FU was delivered subconjunctival for a mean of five 5 mg injections, and the surgery was a single site procedure with a 6-mm incision. On the other hand, in a retrospective study, Cohen reported better IOP control in a group of patients receiving postoperative injections of 5-FU (mean of 4.5 injections/mean 17.3 mg given) as compared to a group that did not receive 5-FU. His surgery was done through a single site with a 6-mm incision and there were 22 eyes in each group. Mean follow-up was short – less than 6 months in the 5-FU group – as compared to over 1 year for the O'Grady groups.[29] Gandolphi, in 1997, reported a greater success of combined surgery utilizing 5-FU injections with a two-site technique in a prospective randomized trial with a 1 year follow-up.[30] Likewise, Donoso and Rodriquez were able to control the IOP in 22 patients who underwent a combined surgery with intraoperative 5-FU and showed survival curves with maintenance of IOP at 20 mmHg or less. The mean preoperative IOP was 19.8 mmHg and postoperative the mean was 12.2 mmHg on no medications. They found similar IOP control with a comparison group of patients undergoing phacoemulsification, following a prior trabeculectomy with intraoperative 5-FU.[31] Chang et al. did a retrospective review of 5-FU trabeculectomy versus the results of 5-FU trabeculectomy combined with phacoemulsification and PC IOL.[32] The study found similar mean IOP levels for both groups with 3 years or more follow-up, although the trabeculectomy group had higher preoperative IOP. The 5-FU was given intraoperatively and then postoperative as needed. More combined procedure eyes required postoperative 5-FU, suture lysis or release, and bleb needling. An evidence-based review published in 2002 concluded that there was not evidence for a benefit from the use of 5-FU for glaucoma triple procedure and that there was a small benefit for the use of MMC.[33]

Mitomycin C (MMC) augmented trabeculectomy has been studied more than 5-FU, likely due to the greater ease of administration. It has improved the outcome of trabeculectomy alone.[34] It has been adopted by many surgeons for use in the glaucoma triple procedure and good outcomes have been reported.[35–40] In a report by Carlson, a randomized study on 29 patients undergoing glaucoma triple procedure with or without MMC was done.[41] The MMC group had an IOP that was 3 mmHg lower on no medications with a mean follow-up of 20 months. The global use of MMC has been questioned by Shin and coauthors who initially found no difference in IOP control in primary triple procedures with and without augmentation with MMC, unless certain factors were present.[42,43] The factors identified as benefiting from the use of MMC were African ancestry, preoperative IOP of 20 mmHg or more, or two or more preoperative medications. In a further study, prior failed trabeculectomy was added to the list of factors.[44] In a later study of 203 eyes that had undergone primary glaucoma triple procedure with 124 receiving MMC, Shin evaluated the results at 36 months. With this review, he concluded that the MMC group had more stable visual fields, less medication use, and lower IOPs.[45] Chapter 8 summarizes and reviews the use of antimetabolites.

Surgical Approach

Various studies have reviewed one-site combined surgery and/or two-site combined surgery. One-site is where both procedures are done superiorly in a quadrant through one incision. Two-site surgery involves two separate surgical procedures on the same day, where a trabeculectomy is done superior and a temporal approach is used for cataract extraction.[36,37] In either approach, there is a choice in how to create the conjunctival incision.[46–48] There have been some reports of greater vitreous loss from a one-site procedure with a limbal-based conjunctival flap.[8,49] There is likely less maneuverability of the instrumentation for cataract surgery working under conjunctiva and a fornix-based flap is the preferred approach for a one-site procedure. In another report, more wound leaks were reported in eyes with a one-site approach that included a limbal-based conjunctival flap versus a fornix-based.[50] The authors hypothesized that the greater manipulation of the conjunctiva led to the wound leaks.

Initially, studies suggested that a two-site approach yields a better IOP result. One of these was a randomized study by Wyse and coauthors who studied 33 patients and their follow-up went beyond 3 months.[51] The two-site group required more medications for the same IOP outcome. The evidence-based review by Jampel in 2002, which assessed effect of technique, concluded that two-site surgery resulted in slightly lower IOPs.[33] However, multiple other studies have shown no difference.[52,53] More recently a randomized, prospective study comparing one-site versus two-site phacotrabeculectomy has shown that the IOP control is similar in both groups.[54] This study randomized 80 eyes and had follow-up for 24 months. In addition, the authors reported that the two-site approach is more time consuming and that although it seems to lead to a more pronounced endothelial cell loss at 3 and 12 months, there is no significant difference in this parameter 24 months after surgery. Endothelial cell loss with two-site versus one-site surgery has also been reported in another study with 12 months follow-up.[55] Cotran has also shown that both surgical approaches were equally effective at lowering IOP over a 3-year follow-up in a randomized study.[56] Again, there was longer operative time

in the two-site procedures and he reported higher post-op day one IOPs. His one-site group had more early leaks with a rate of 6 in 44 eyes.

Intraocular Lens Choice

Tezel and coauthors reviewed the results of glaucoma triple procedure with MMC done with foldable versus rigid intraocular lens placement. The study reviewed 103 eyes with a rigid lens and 112 with a foldable silicone lens. At a minimum follow-up of 12 months, the IOP was less than 20 mmHg without medications in 52% and 67% of eyes in the respective groups.[57] Alzafiri and Harasymowycz reviewed the results of eyes with MMC-augmented glaucoma triple procedure with either a rigid PMMA lens (19 eyes) or a foldable acrylic lens (41 eyes). The IOP control was comparable and the visual rehabilitation was faster in the acrylic foldable lens group.[58]

In another study of glaucoma triple procedure with MMC, the results with foldable silicone lenses were compared with foldable acrylic lenses. The authors reported lower IOP in the first 2 months in the silicone group and more flap suture release in the acrylic group. At the last follow-up over 12 months, the IOPs were not statistically different between the two groups.[59] Another study reported inflammatory membranes on silicone IOLs in 33% of a group of eyes that had undergone phacotrabeculectomy.[60] Serpa compared 124 eyes that had glaucoma triple procedure with a PMMA lens, a silicone foldable, or an acrylic foldable lens. The IOP lowering was the same in all groups. They also reported fibrin deposits in eyes that had silicone IOLs.[61]

Surgical Technique

The author favors a one-site approach. Topical anesthetic, 0.75% preservative-free bupivacaine applied every 15 minutes for 3–4 doses while the patient is preparing for surgery, is used to initiate the case. An inferior traction suture is placed through the inferior peripheral cornea for rotation of the globe downward. A 6-0 Vicryl on an S-29 needle is usually used (Ethicon, Johnson & Johnson, New Brunswick, NJ). Some surgeons employ a similar suture through the superior peripheral cornea, but care should be taken not to abrade the cornea, which would impair visualization during the cataract surgery and cause the patient discomfort postoperative (Fig. 11.11).

A limbal conjunctival peritomy, 5–6 mm, is fashioned with a Westcott scissor and a conjunctival forceps in one superior quadrant (Figs. 6.4 and 6.5a). The conjunctiva and

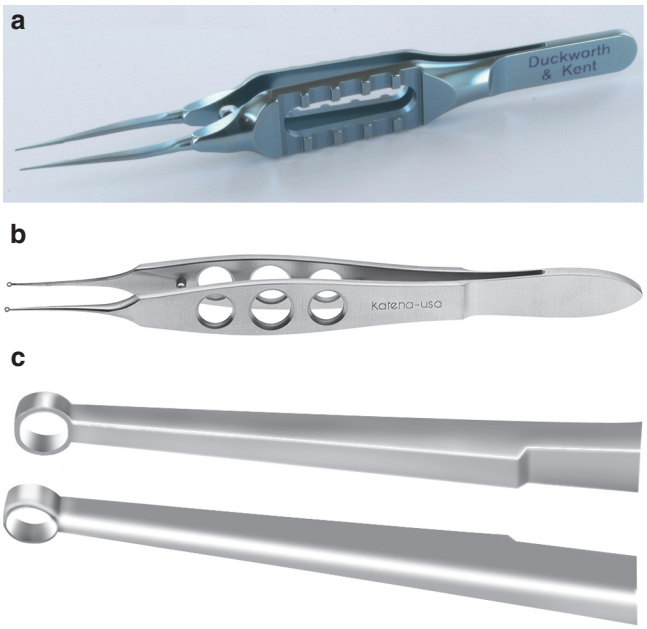

Fig. 6.4 Conjunctival forceps designed not to tear the delicate conjuctival tissue. (**a**) Duckworth and Kent DK 2-100 forceps. Image courtesy of Duckworth and Kent Ltd., Herts, England. (**b**) Fechtner K5-1820 conjunctival forceps with (**c**) close-up of Fechtner forceps. Part figures (**b**) and (**c**) courtesy of Katena Products Inc, Denville, NJ.

Tenon's are undermined in each direction to anticipate the broad application of MMC. This leaves a quadrant for a subsequent filtering procedure if needed in the future. Additional bupivacaine and/or preservative-free 1% lidocaine is injected into the quadrant with a sub-Tenon's cannula, such as the Connor cannula for deeper anesthesia, and this can be supplemented with intracameral 1% preservative-free lidocaine (see Chapter 2). Cautery is used to blanch but not char the episclera.

A scleratome blade is used to fashion a partial thickness scleral flap 3–4 mm at its base, at least ½ thickness of the sclera (Figs. 6.5b and 6.6). To avoid premature entry into the anterior chamber, which would make the use of MMC risky, the author stops before reaching the limbus and applies pieces of (Merocil® or Weckcel®, Medtronics, Minneapolis, MN) cellulose sponges with MMC 0.4 mg/ml under the Tenon's layer, in a broad area for 3 minutes, taking care not to treat the limbus or the conjunctival wound edge (Fig. 6.7). After irrigation of the MMC treated area, with 30 cc of balanced salt solution (BSS), the scleral flap is continued into the peripheral cornea and, if needed for a non-foldable intraocular lens or ECCE, a scleral groove is made to one side (Fig. 6.8). A keratome is used to enter the anterior chamber under the flap creating a two-plane hinged incision for the phacoemulsification (Fig. 6.9). Viscoelastic is injected, taking care not to overly elevate the intraocular pressure, espe-

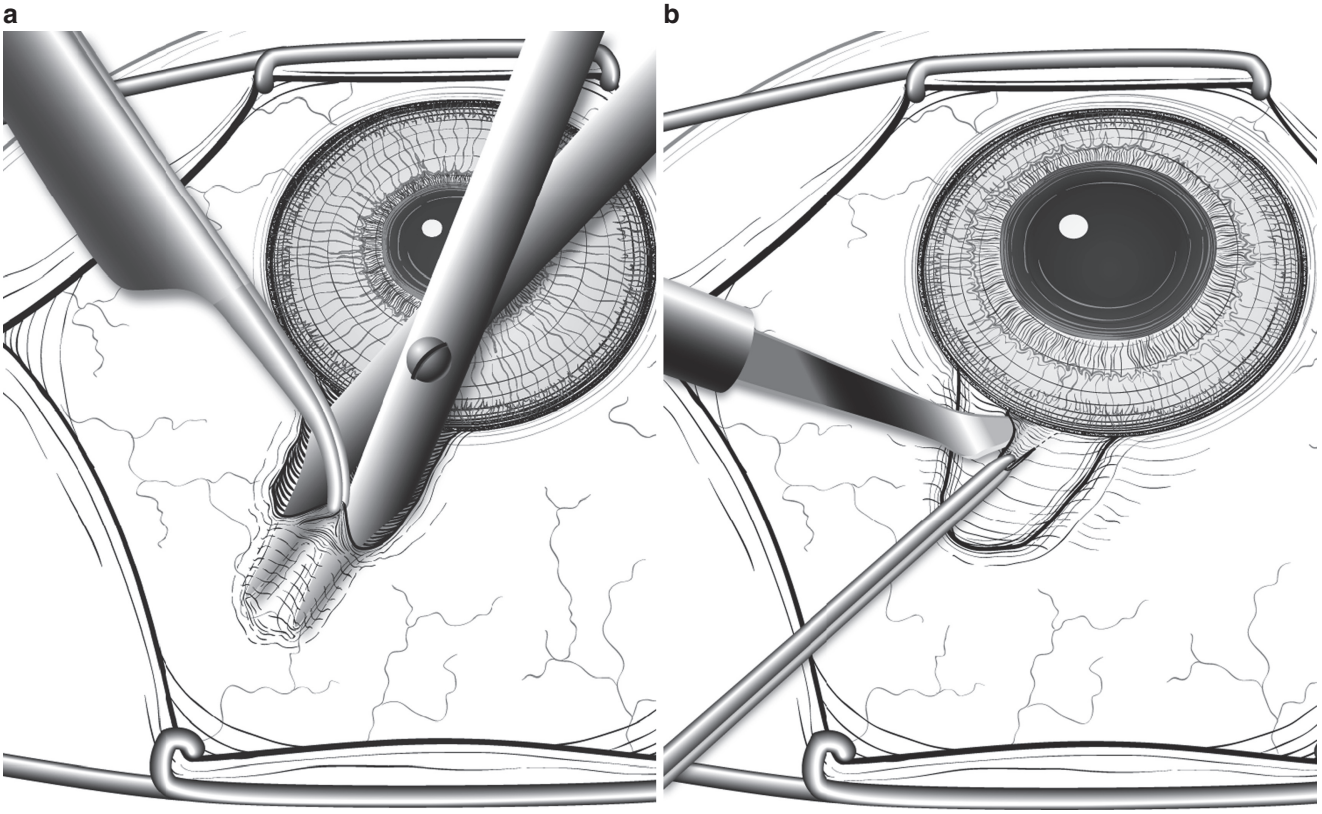

Fig. 6.5 Diagram of the conjunctival incision

cially if there is significant glaucoma damage. A paracentesis is fashioned for the surgeon's use of a second instrument and for injection of BSS as needed.

Once the cataract surgery is complete and the intraocular lens has been placed, the author does not remove residual viscoelastic, to help maintain the globe. The author uses a foldable acrylic IOL. Acetylcholine chloride intraocular solution (Miochol-E, Novartis, East Hanover, NJ) is injected to constrict the pupil. A Kelly punch is used to create a sclerostomy under the scleral flap with a minimum of 1 mm of flap maintained on each side of it (Fig. 6.10). A jeweler's forceps and Vaness scissor are used to create a peripheral iridectomy (Fig. 6.11). The necessity of this has been questioned in a report by Shingleton.[62] A 23-gauge cautery tip is used for any bleeders in the sclerostomy site. Once it is ensured there is no bleeding from the sclerostomy or iridectomy, the scleral flap is closed with two interrupted or releasable 10-0 nylon sutures, near the base of the flap (Fig. 6.12). The anterior chamber is deepened with BSS through the paracentesis and the eye observed to ensure that the anterior chamber is deep, the eye not hard, and that there is some flow of fluid from beneath the flap. Flow toward the 12 o'clock limbus and posterior is preferred over flow toward the palpebral fissure. Additional sutures are placed as needed. Releasables are used if a laser is not readily available postoperative and for patients with conjunctival melanosis that will interfere with laser suture lysis (see Chapter 10).

The limbal epithelium is abraded with a Tooke knife and the conjunctiva brought up to the limbus (Fig. 6.13). It is secured tightly to its original position with interrupted 8-0 Vicryl sutures on a TG 140 or BV 130 needle. Again the anterior chamber is formed and the wound observed for any leaks and need for reinforcement. A Seidel test can be done (Fig. 9.4). Viscoelastic can be left in the anterior chamber as long as the tactile IOP is not too high for the patient. The fixation suture is removed. Subconjunctival injections of a steroid and antibiotic are given in the inferior fornix. The eye is patched with a combination steroid antibiotic ointment for 24 h.

A technique popularized by Khaw is the Moorfield's safe surgery technique, which is described briefly in Chapter 9 and reviewed in Chapter 8. The surgical principals involve the diversion of filtration posterior and over a wide area avoiding filtration along the limbus anterior to the insertion of Tenon's and very localized filtration. These principals help to avoid a focal ischemic bleb prone to

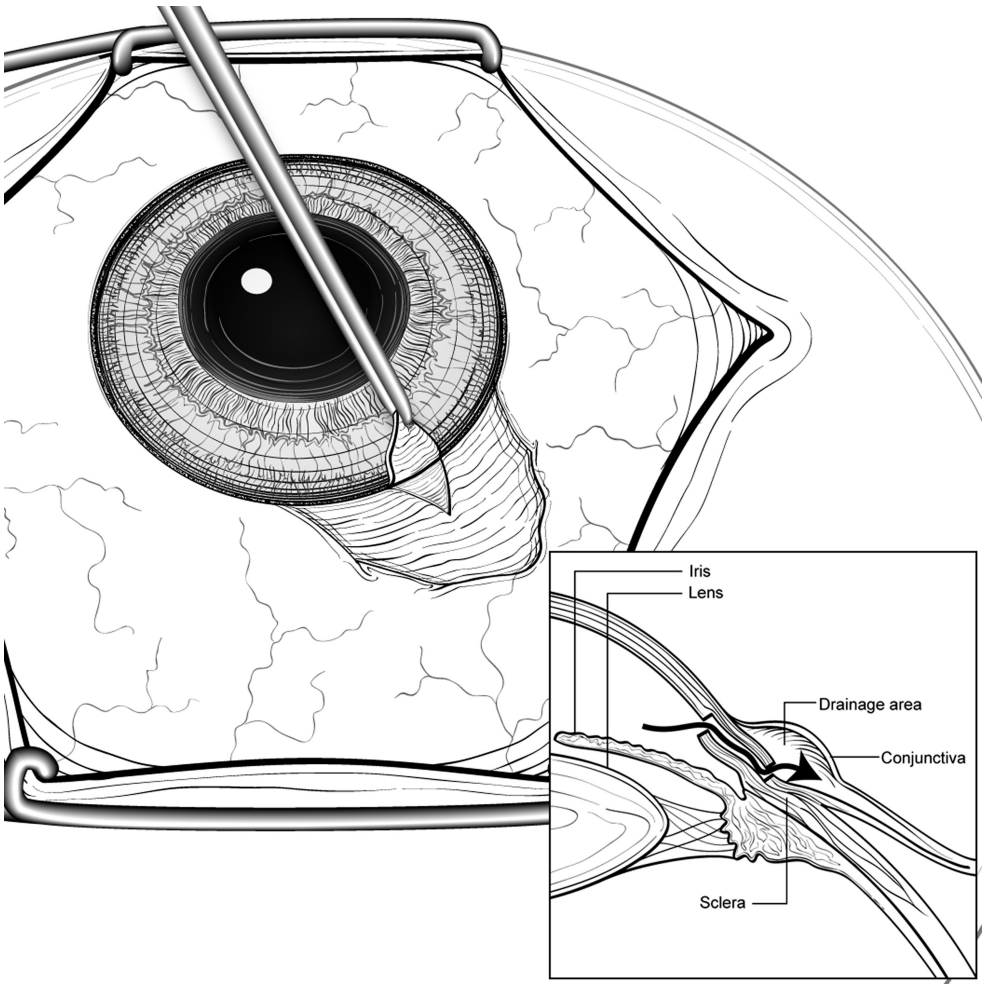

Fig. 6.6 Diagram of the scleral flap fashioned after the conjunctival incision. Profile of the scleral flap dissection

dysfunction years postoperative.[63,64] The technique also discusses alternate closure of the conjunctiva to help avoid leaks. Chapter 14 reviews a conjunctival incision that is several millimeters posterior to the limbus that leaves a skirt of conjunctiva that can be sutured in a running fashion for a tight closure.

Surgeons who are not adept at a superior approach to phacoemulsification or who have a preference for a limbal-based trabeculectomy often prefer a two-site approach. The surgeon's standard phacoemulsification is done, the temporal wound sutured, and viscoelastic left in the eye, taking care not to over pressurize the eye. A standard superior trabeculectomy is then completed. A limbal-based trabeculectomy is likely to have less risk of postoperative wound leak and can endure earlier laser suture lysis due to this.[56] It has been reported to take longer than a fornix-based approach. Typical instruments used in a combined surgery are listed in Table 19.4 and Chapter 19 includes a review of two-site surgery.

Postoperative Care

The patient is seen on postoperative day 1, then about day 5, then 7 days later, then 7–10 days later, and so forth. A broad-spectrum antibiotic such as Vigamox (Alcon, Fort Worth, TX) is used for the first 10–14 days as prophylaxis against infection. The author uses prednisolone acetate 1% drops initially four times a day, then increases this to six times or more at the second visit, to allow some conjunctival healing before the use of aggressive anti-inflammatory drops.

If there is a wound leak on postoperative day 1, it is treated conservatively with a bandage contact lens. Leaks detected or persisting after that are generally sutured closed due to the possible increased risk of bleb failure.[65] Steroids are tapered over 6–8 weeks, as directed by intraocular and bleb inflammation.

Laser suture lysis or release of releasable sutures is done as needed to preserve bleb function, as well as supplemental 5-FU injections. Decision for suture release is usually made

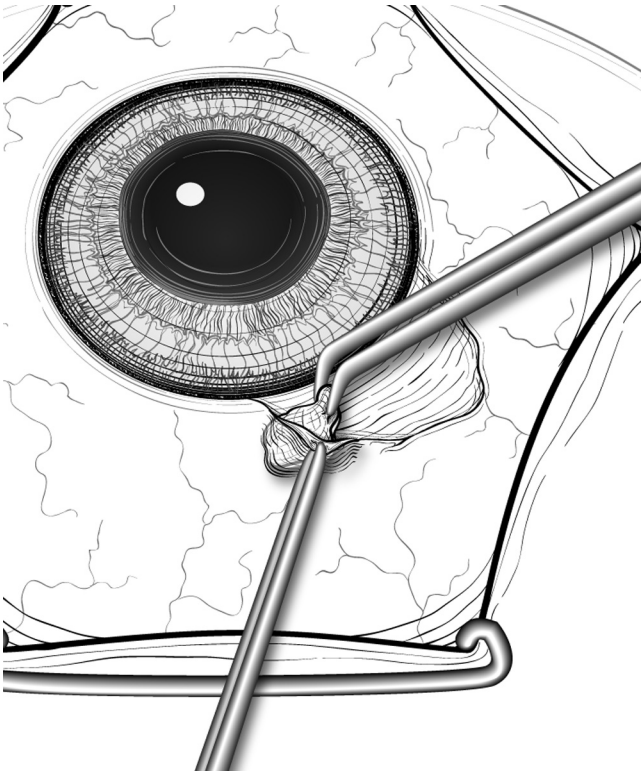

Fig. 6.7 Scleral groove adjacent to scleral flap if needed for IOL insertion

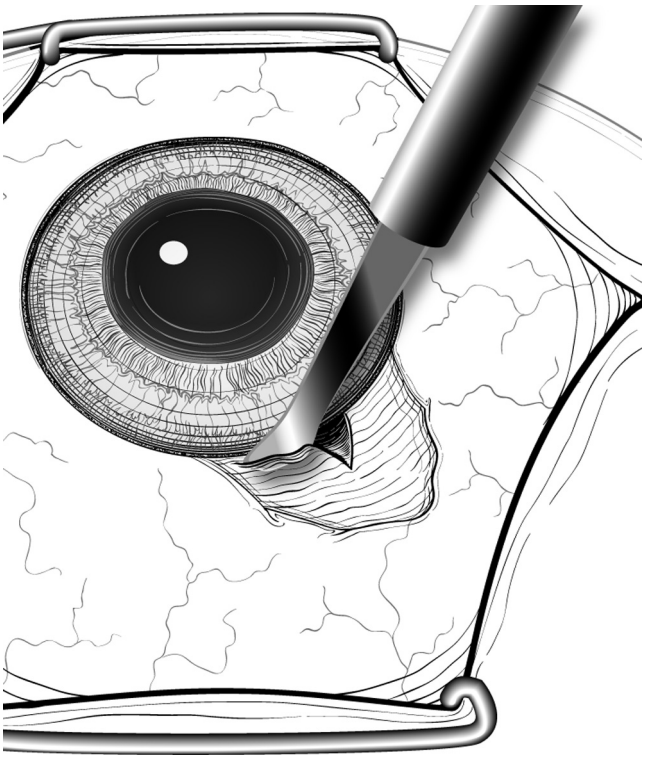

Fig. 6.8 Sponges with MMC placed under the conjunctiva with avoidance of the wound edges

in the second or later postoperative week (see Chapter 10). Predictors of suture release were assessed in one report by Shin et al. African-American ancestry, more than two medications preoperative, and pressure of 14 or over in the first week were found to be predictors of need for suture release.[66] The authors pursued suture release when digital pressure did not result in increased filtration.

Fundus exams are done to ensure that there are no significant choroidal effusions, especially if there is marked shallowing of the anterior chamber or hypotony. They are managed as needed to preserve integrity of the cornea, prevent posterior anterior synechiae (PAS), and to maintain bleb function (see Chapter 12). Results from the Advanced Glaucoma Intervention Study (AGIS) versus the Collaborative Initial Glaucoma Treatment Study (CIGITS) suggest that older patients are more likely to develop choroidal effusions following a filtration procedure.[10,16]

Outcomes

In the report by Buys, the mean preoperative IOP was over 17 mmHg on a mean of three medications. At 2 years follow-up, the mean IOP was between 12 and 13 mmHg and mean

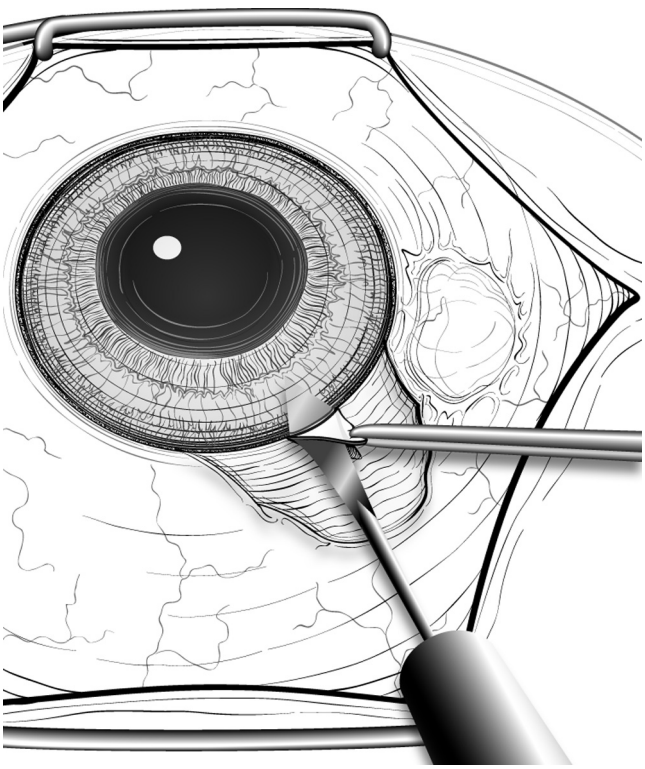

Fig. 6.9 Keratome incision under the scleral flap

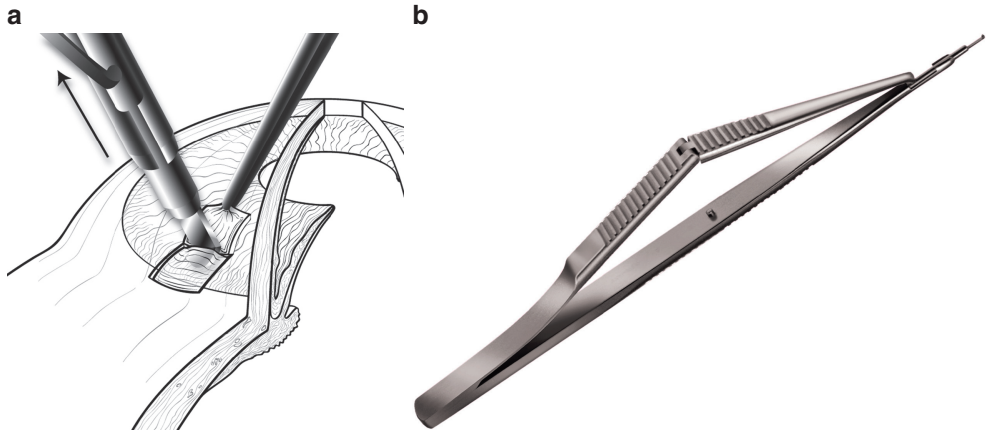

Fig. 6.10 (**a**) Kelly Descemet's Punch. Figure courtesy of Bausch & Lomb, Rochester, NY. (**b**) The punch is used to create the sclerostomy

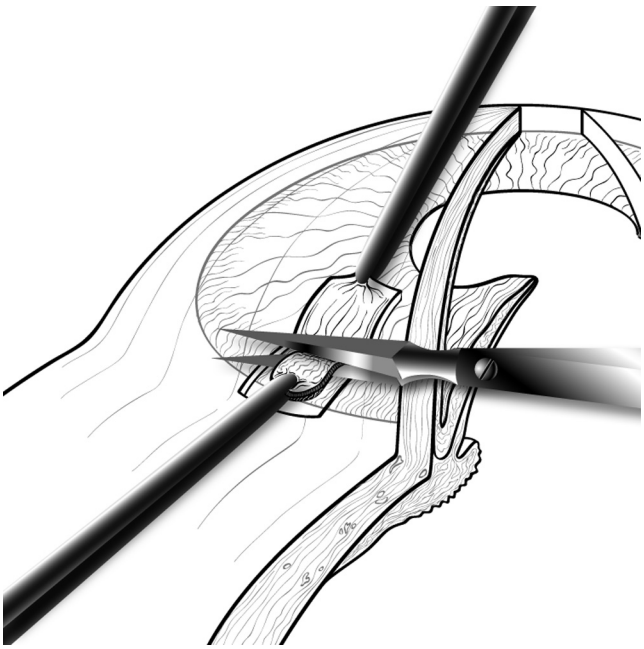

Fig. 6.11 Iridectomy

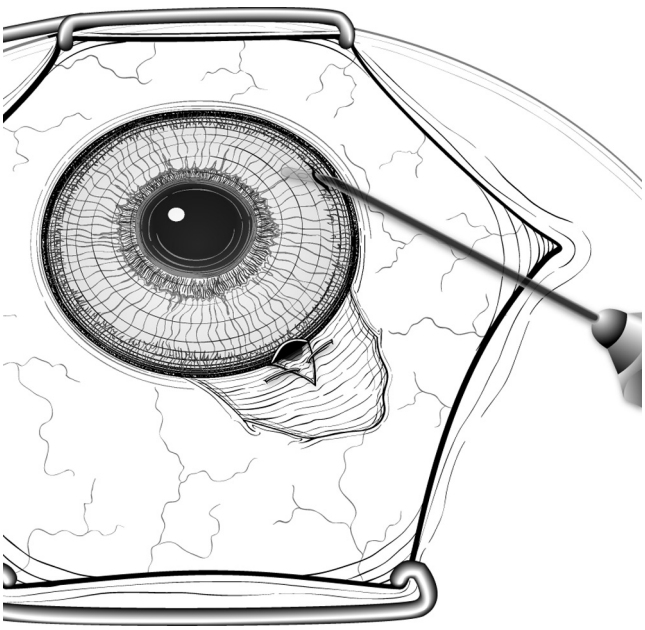

Fig. 6.12 Closure of scleral flap with 10-0 nylon sutures.

medications were under 0.5 for 76 of the 80 patients enrolled in the study.[54] In the study by Cotran, 74 of 90 eyes were studied at 3 years of follow-up. Mean preoperative medications were 2.3 to 2.5 ± 0.9 and less than 0.5 ± 1 at 3 years. Mean preoperative IOP decreased from 20.1 ± 3.8 and 19.5 ± 5.3 to 12.6 ± 4.8 and 11.7 ± 4 mmHg at 3 years for the two groups.[56] Both of these studies used MMC 0.4 mg/ml for 2 minutes. They also used acrylic IOLs.

Figure 6.14a–c illustrates an eye postoperative a one-site combined surgery. Hong reported on a Korean population that included 540 triple procedures followed up to 15 years, with a minimum of 3.[67] The mean preoperative IOP was about 20 ± 12.6 and the mean last mean IOP was 12.5 ± 2.61 mmHg. The IOP mean was quite stable from 1 to 15 year. Less than 3% of patients required a second trabeculectomy procedure. Laser suture lysis was required in 32% of the patients.

Refractive Outcomes

Several studies have reviewed astigmatism associated with glaucoma triple procedure with 6-mm incisions and found that less astigmatism was induced with the cataract procedure done temporal.[51,68,69] In more recent years, biometry has changed from a contact examination to non-contact with the technology of the IOL Master (Zeiss-Humphrey,

Fig. 6.13 Storz EO390 Tooke knife. Courtesy of Bausch & Lomb, Rochester, NY

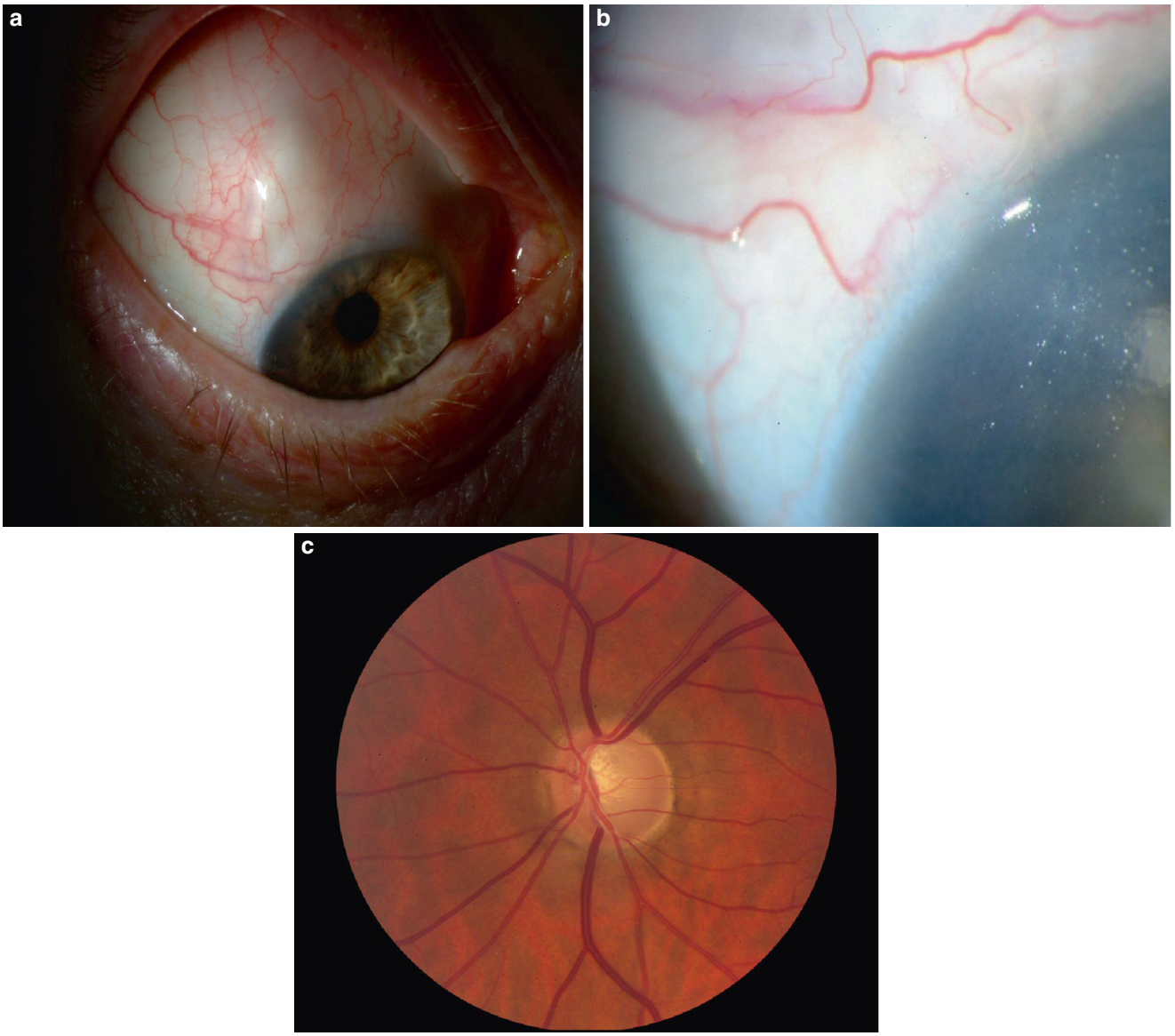

Fig. 6.14 Final appearance of the eye; (**a**) Slit lamp photograph of a diffuse bleb following a combined procedure. At 1 year of follow-up, IOP was remained 10–12 mmHg without medications. (**b**) Close-up of the low lying bleb. Photograph courtesy of Tom Monego, Dartmouth Hitchcock Medical Center (DHMC), Lebanon, NH. (**c**) Fundus photo of the disc of the patient. Photograph courtesy of Tom Monego at DHMC

Dublin, CA). It uses the principal of partial coherence interferometry. Caprioli and authors reviewed the predicted and actual refractive outcomes in 24 eyes that had undergone a glaucoma triple procedure with a comparison group who had undergone phacoemulsification alone. Their measurements confirmed an overall with the rule astigmatism and shortening of the axial length in eyes following glaucoma triple procedure, using a two-site technique. The spherical equivalents of the postoperative refractions did not differ significantly from predicted refraction.[70] Care should be taken in surgery to not induce astigmatism with overly tight sutures and aggressive cautery. The change in axial length can manifest as a myopic shift as reported by Chan and coauthors. They studied 90 consecutive patients, 25 of whom had undergone glaucoma triple procedure. They conclude that the postoperative change in anterior chamber depth is

responsible for the myopic shift in patients who have trabeculectomy at the time of cataract surgery.[71] Interestingly, Shin has noted decreased posterior capsular opacification in eyes status post glaucoma triple procedure with MMC.[43]

Complications

Besides complications related to cataract extraction in general, a glaucoma triple procedure is subject to the same complications as any filtering procedure, as listed in Table 6.3. Most complications are self limited and treated conservatively, but complications requiring invasive intervention may occur. In the Cotran study, there was one case of hypotony maculopathy that required surgery in one group and one patient in the other group developed corneal edema related to shallow anterior chamber and subsequently underwent penetrating keratoplasty. Two late wound leaks developed in the two-site group and one developed blebitis. Both underwent bleb revision.[56] In the Buys study, one patient underwent bleb needling.[54] In the Hong study, there were more bleb leaks, hyphema, and endophthalmitis in the triple-procedure group compared to a trabeculectomy-alone group, which had more hypotony.[67]

Table 6.3 Complications associated with glaucoma triple procedure with MMC[35,36,54,5,6]

- Choroidal detachment and/or hemorrhage
- Hypotony: shallow anterior chamber, maculopathy
- Hyphema
- Wound leaks
- Blocked sclerostomies
- Late endophthalmitis
- Astigmatism

Summary

As cataract incisions have gotten smaller, the results of combined surgery have improved. For incisions of 6 mm and under, the effect of the incision length on IOP outcomes does not appear to be as significant, although the globe remains better formed in surgery with a smaller incision. MMC has assisted in the success of the procedure, even including surgery with larger incisions for ECCE. A capsulorhexis, smaller than the size of the IOL optic, helps to prevent IOL capture should the anterior chamber shallow in the postoperative period. The impact on refractive error has also lessened with the adoption of smaller incision cataract procedures combined with glaucoma surgery.[36,70,71]

Ophthalmologists should consider combined surgery in patients with low target IOP, complex medical regimens, and advanced glaucoma. The surgical approach should be chosen that best suits the surgeon's skills and preferences, taking into consideration the possible adverse effect that a two-site procedure may have on the corneal endothelium and the longer surgical time it entails, and balance this against increased risk of wound leak with a one-site approach. The surgeon should be prepared for the more complex postoperative management dictated by the trabeculectomy (Table 6.4) and counsel the patient regarding a less predictable refractive outcome versus cataract alone. Management of the bleb is discussed in Chapter 9 and choroidal effusions are discussed in Chapter 12.

Table 6.4 Common minor procedures post trabeculectomy

- Anterior chamber injection: viscoelastic,[72] TPA
- Bleb needling
- Postoperative subconjunctival 5-FU injections
- Treatment of wound leaks: sutures or other
- Bandage contact lenses for over filtration or leaks
- Palmberg sutures
- Suture lysis or release
- YAG capsulotomy/anterior hyaloidectomy for malignant glaucoma
- Reversal of blocked sclerostomy
- IOL repositioning for pupil capture

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