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A Modified Technique in Applying Sponge Soaked with Mitomycin C in Trabeculectomy

Xiulan Zhang, MD, PhD, Yunhe Song, MD*, Jeffery Liebmann, MD†, and Robert N. Weinreb, MD‡*

Abstract: Trabeculectomy with adjunctive use of Mitomycin C (MMC) has been a benchmark for glaucoma filtration surgery for decades. However, there are many variations in the ways that the sponges soaked with MMC are applied during the trabeculectomy surgery. We herein describe our way of placing the MMC-soaked sponges to improve the safety and efficacy of the trabeculectomy. The sponges are placed vertically and posteriorly with the long side of the sponge perpendicular to the limbus, not parallel. This will reduce the size of the conjunctival wound at the limbus to preserve more virgin conjunctiva that can be used for repeated trabeculectomy when needed. This will also facilitate a more posteriorly directed flow of aqueous drainage that, in turn, may increase the success rate of the trabeculectomy. We have obtained encouraging results in our practice, and further large-scale randomized studies seem warranted.

Key Words: bleb-related complication, glaucoma, mitomycin C, mitomycin trabeculectomy, trabeculectomy

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Despite the advent of many new technologies in aiding the diagnosis and treatment of glaucoma, glaucoma remains an important cause of world blindness.[1–3] Although minimally invasive glaucoma surgeries are becoming more popular, trabeculectomy remains the most effective incisional surgical method for lowering intraocular pressure.[4–6] According to *Primary Open-angle Glaucoma Preferred Practice Pattern* published in 2020[7] and the third edition of the *Asia Pacific Glaucoma Guidelines*,[8] trabeculectomy can also be considered in suitable cases as first-line surgical therapy.

The effectiveness of trabeculectomy depends on the formation of a functional filtering bleb. Mitomycin C (MMC) was first introduced for intraoperative use in trabeculectomy by Chen et al[9] in 1983. With an antifibrotic effect, it reduces subconjunctival scarring, and is recognized to significantly improve the likelihood of functional bleb formation.[10] At present, it is a widely used adjunct to trabeculectomy.[11]

Application of MMC is mostly by direct application to the scleral bed by MMC-soaked sponge, although subconjunctival injection has also been used, to a much less extent. Although some studies showed that there was no significant difference regarding safety between the two methods,[12–14] the direct sponge method is well accepted in clinical practice and considered as the conventional and benchmark method. The conventional method of MMC-soaked sponge placement may lead to bleb-related complications.[15] The using of large and irregular sponges, and their improper positioning, as well as high concentrations of MMC,[16] can cause complications, including: hypotony, bleb leakage,[17] and blebitis;[18] limited reoperation area due to thin avascular conjunctiva and surrounding scarring from exposure to MMC; or limbus or corneal degeneration (Figs. 1–3). Although Peng Khaw et al have proposed a recommended method of MMC application in which the sponge should cover the largest possible area to create a more diffused bleb and prevent the development of a posterior limiting scar (ring of steel) or cystic bleb,[19] this method might cause excessive conjunctival trauma and make it difficult to reoperate on the area. More bleb-related complications might be related to oversized conjunctival incision and the largest area of MMC application in the long run. Here, a modified, practical method of using MMC-soaked sponge is proposed to improve the surgical outcomes. In brief, a sponge with a dimension of 3.5 mm × 10 mm soaked with MMC is placed vertically and posteriorly with the long side of the sponge perpendicular to the limbus, not parallel (Figs. 4C1 and 5). The exact MMC concentration and duration of application will be decided by the operating surgeon. The detailed surgical techniques are shown in Figure 5 and the attached Supplementary Digital Content, http://links.lww.com/APJO/A107 and http://links.lww.com/APJO/A108)

With this method of application of the MMC-soaked sponge, we have the following observations:

(1) the drainage direction of aqueous humor changed from sequestrated at the limbus to the posterior fornix, forming a posteriorly directed filtering tunnel;
(2) the conjunctival incision was limited and the opportunity of secondary operation can be achieved;
(3) the chance of corneal and limbal involvement is reduced. The postoperative effect is shown in Figure 6.

This modified method has several potential advantages. First of all, this method causes minimal damage to the conjunctiva with limited surgical trauma within the incision field. Secondly, the more posterior positioning of the sponge may make the filtering bleb diffuse and reduces the risk of bleb-related complications to

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From the *State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou 510060, China; †Bernard and Shirlee Brown Glaucoma Research Laboratory, Edward S. Harkness Eye Institute, Department of Ophthalmology, Columbia University Medical Center, New York, NY, USA; and ‡Shiley Eye Institute, Hamilton Glaucoma Center and Viterbi Family Department of Ophthalmology, University of California San Diego, La Jolla, CA, USA.
The authors have no conflicts of interest to declare.
Address correspondence and reprint requests to: Xiulan Zhang, State Key Laboratory of Ophthalmology, Zhongshan Ophthalmic Center, Sun Yat-sen University, Guangzhou 510060, China. E-mail: zhangxl2@mail.sysu.edu.cn

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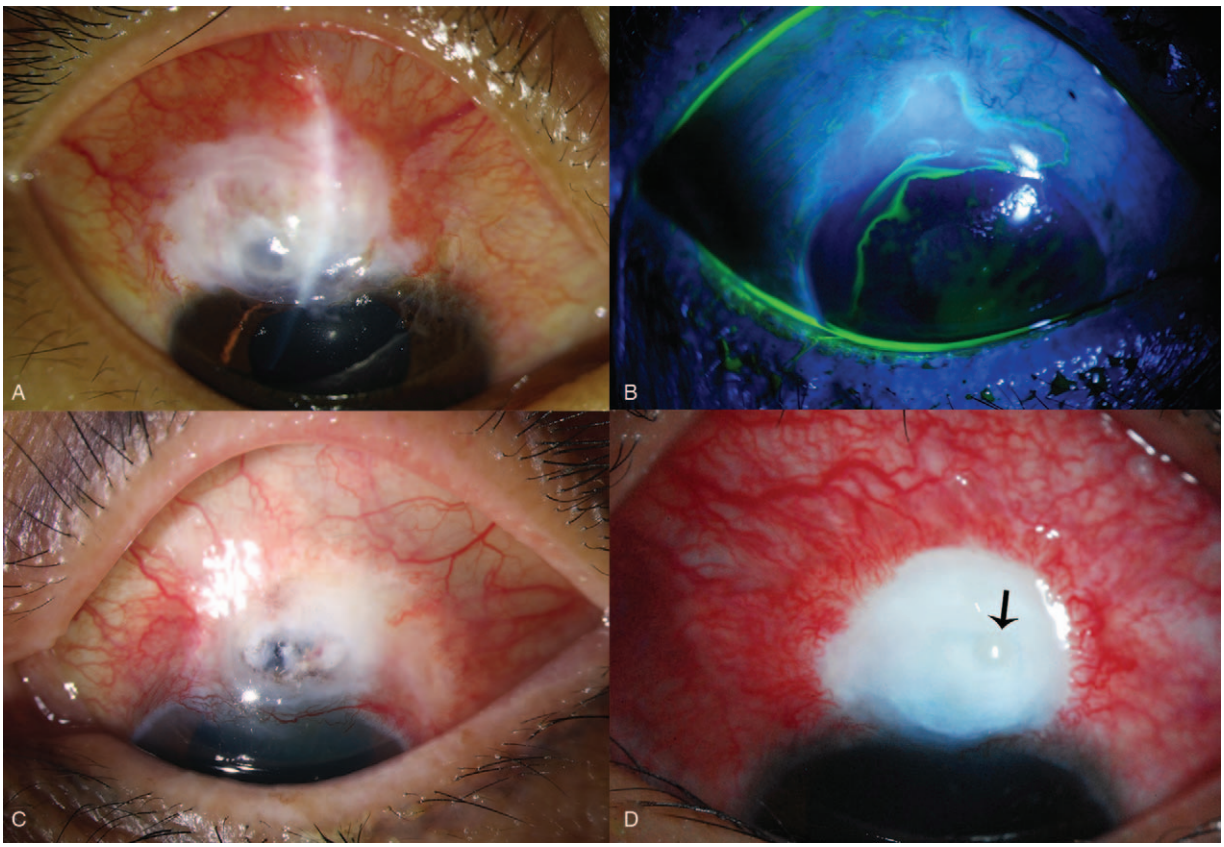

FIGURE 1. Slitlamp photos showing bleb-related complications after trabeculectomy with adjunctive Mitomycin C. A, Formation of thin-walled and localized filtering bleb with densely scarred ''ring of steel'' area of fibrosis, which is surrounded by moderate amount of vascular congestion. B, Leakage of the filtering bleb was well shown with a positive seidel test using the sodium fluorescein stain. C, Perforation of the filtering bleb will increase the risk of bleb infection and even endophthalmitis. D, The blebitis with a pale and localized avascular bleb. Severe congestion of the bulbar conjunctiva was shown. The black arrow indicated a purulent lesion protruding on the surface of the bleb.

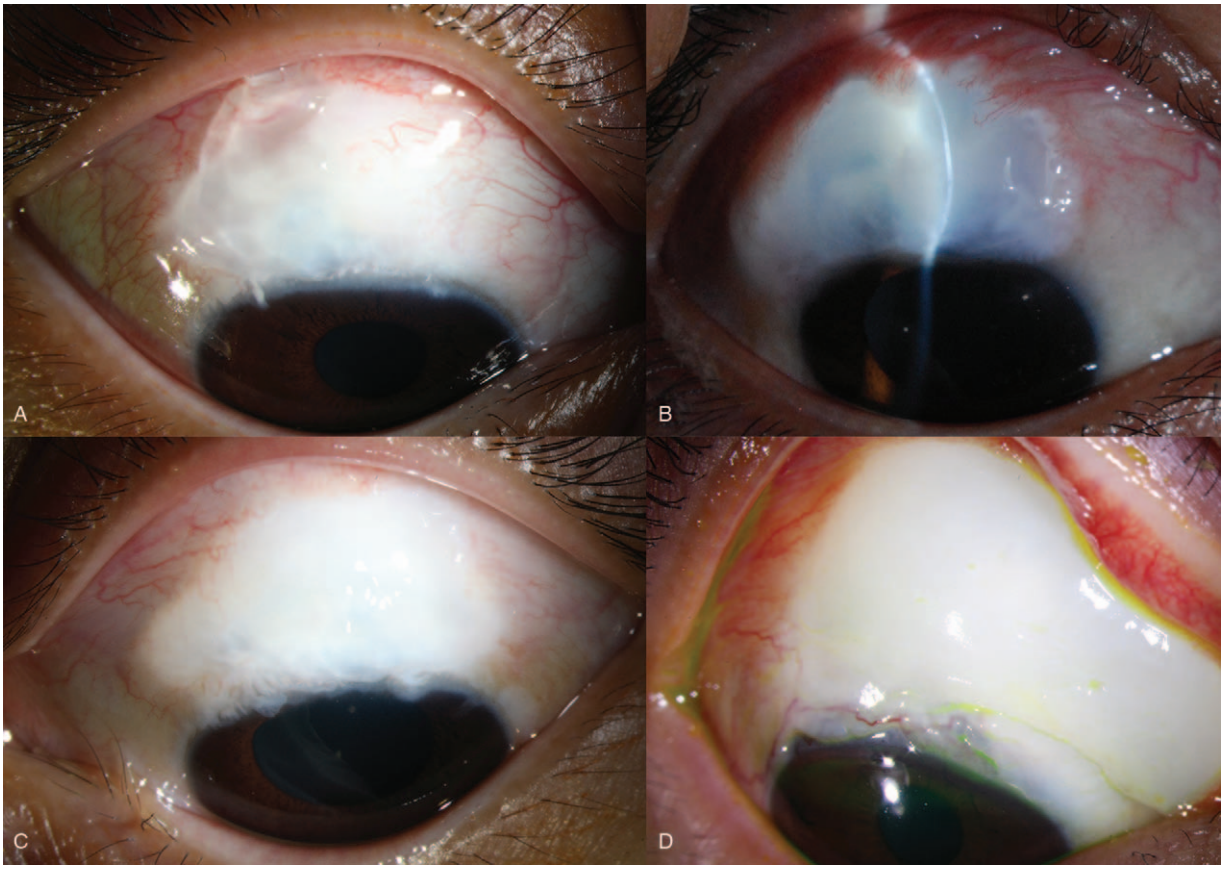

FIGURE 2. Slitlamp photos (A–D) showing post-trabeculectomy with excessive conjunctival injury that will limit the availability of conjunctiva for reoperation.

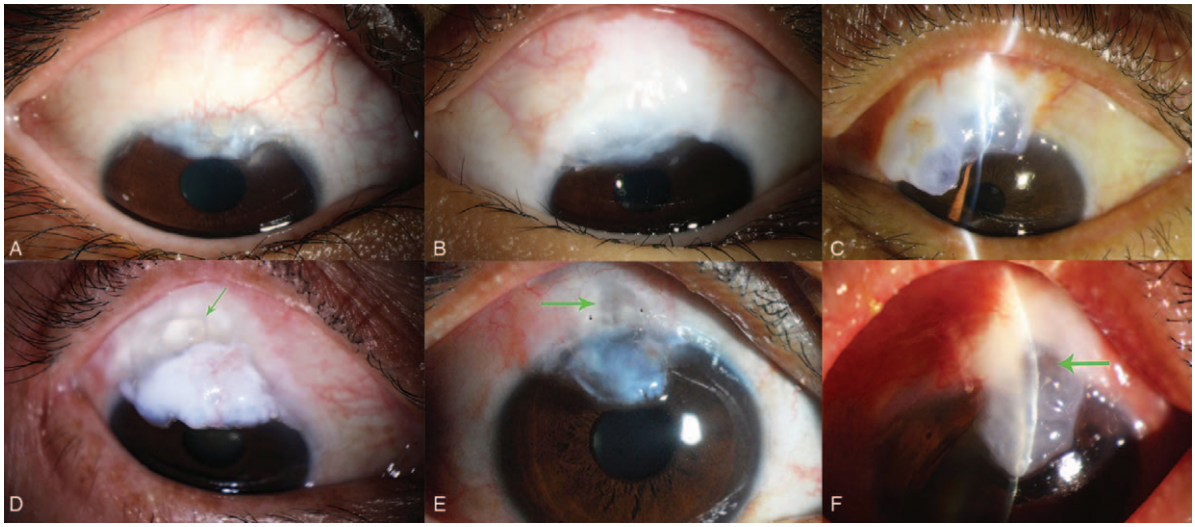

FIGURE 3. Slitlamp photos showing conjunctivalization of the upper cornea following trabeculectomy with adjunctive Mitomycin C. A–F, The bleb has migrated onto the limbus and cornea. D–F, The green arrow indicated the thin-walled bleb formation.

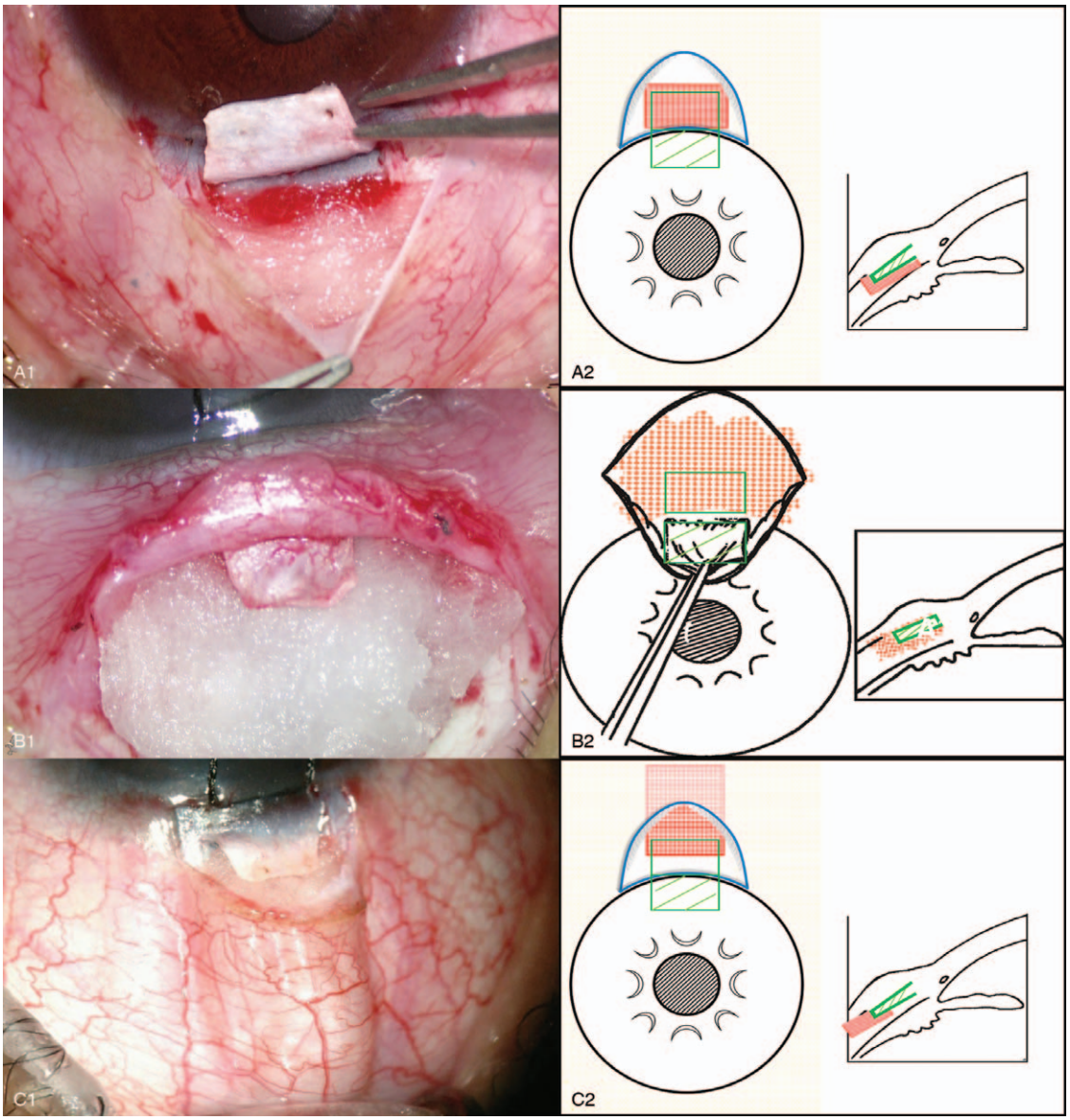

FIGURE 4. The comparison of different patterns of Mitomycin C (MMC)-soaked sponge placement and schematic diagrams. A, Transverse placement of MMC-soaked sponge in the filtering area and sketch map. B, Irregular and oversized placement of MMC-soaked sponge in the filtering area. C, A recommended placement of MMC-soaked sponge in the filtering area. The long edge of the rectangle is perpendicular to the limbus, which may facilitate formation of a posteriorly-directed filtering tunnel.

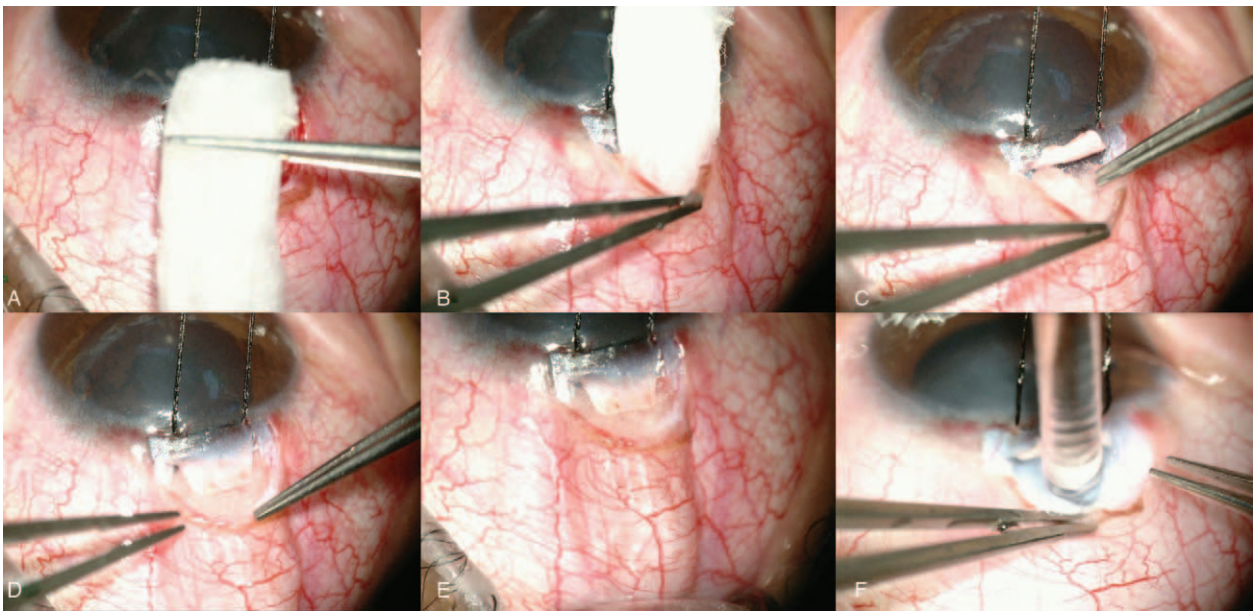

FIGURE 5. A recommended vertical and posterior-directed placement of Mitomycin C (MMC)-soaked sponge or cotton pad in the filtering area. A, Prepare a piece of 3.5 mm × 10 mm MMC-soaked sponge or cotton pad. B, Insert the sponge vertically and posteriorly into the conjunctival bed without touching the edge of incision or cornea. C, Place the sponge under the scleral flap, avoiding contact with the transparent cornea under the scleral flap. D, The sponge was placed inside the conjunctival bed and under the scleral flap, without touching the limbus, transparent cornea under the scleral flap and the edge of conjunctival incision. E, The sponge was placed vertically and posteriorly inside the conjunctival bed and under the scleral flap. The filtering area was incubated with MMC as the shape of the sponge for several minutes to form a posteriorly-directed filtering tunnel. F, Irrigate the conjunctival bed and filtering area thoroughly with 150 to 200 ml of BSS.

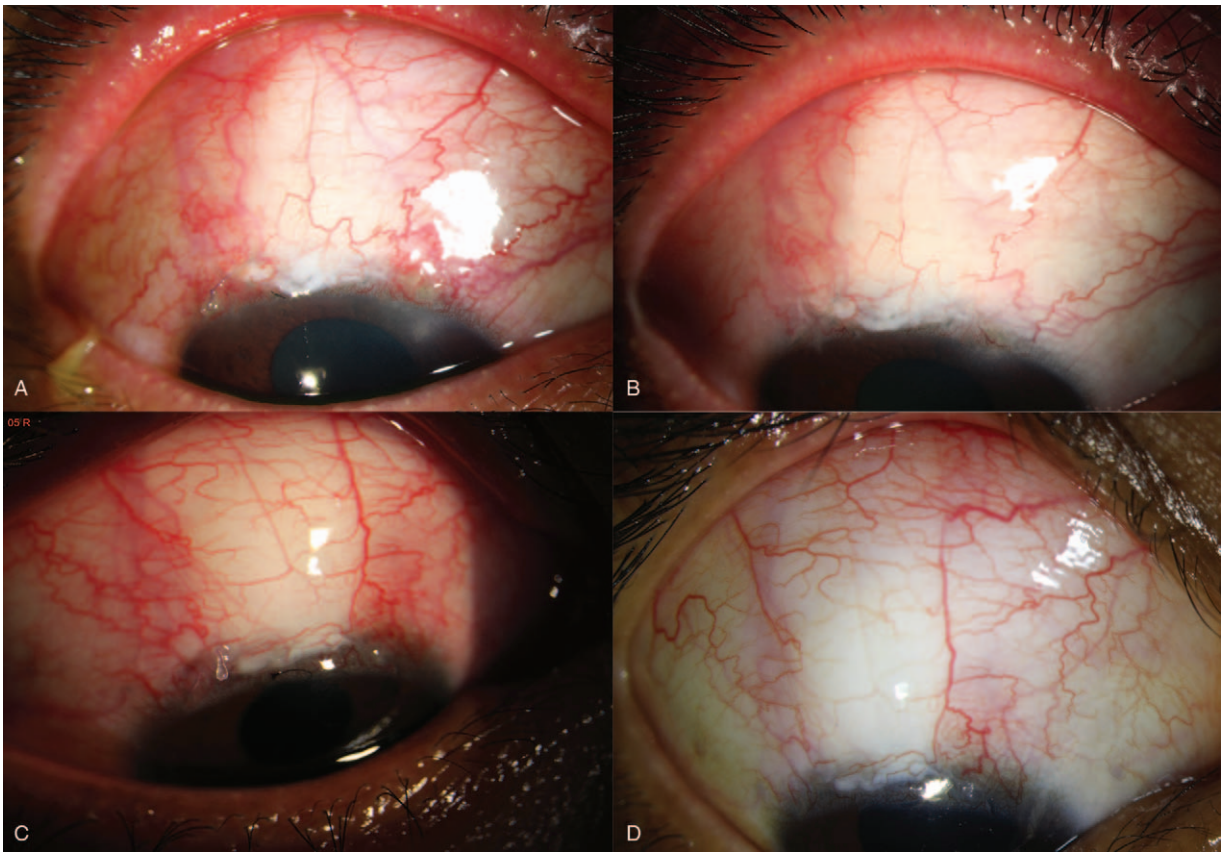

FIGURE 6. Postoperative effects using the proposed Mitomycin C (MMC) placement method. In two cases with trabeculectomy with adjunctive MMC using the proposed way of MMC placement, diffused, functional filtering blebs were observed with posteriorly directed filtering tunnel. The drainage channel was perpendicular to corneal limbus, and conjunctival injury was minimal. No bleb-related complications were found in these two cases. A and B, 1 week and 1 month following trabeculectomy with adjunctive MMC. C and D, 1 week and 3 months following the surgery.

the maximum extent, particularly reducing the risk of forming the "ring of steel" scarring and cystic bleb. The method is quantitative in the size and positioning of the sponge, and the incubation time and the concentration of MMC could be altered according to the surgeons' preferred choice, in which the characterized information of patients should be considered.

Placing the long side of the MMC-soaked sponge perpendicular to the corneal limbus may lead to effective functional filtering blebs formation, reduce conjunctival injury and the incidence of bleb-related complications. Long-term observation and further evaluation of the safety and efficacy of this modified technique of applying the MMC-soaked sponge during trabeculectomy through large-scale, randomized control trials seem warranted.

REFERENCES

1. Taylor HR. Global blindness: the progress we are making and still need to make. *Asia Pac J Ophthalmol (Phila)*. 2019;8:424–428.
2. Ha A, Park KH. Optical coherence tomography for the diagnosis and monitoring of glaucoma. *Asia Pac J Ophthalmol (Phila)*. 2019;8:135–145.
3. Moghimi S, Hou H, Rao H, et al. Optical coherence tomography angiography and glaucoma: a brief review. *Asia Pac J Ophthalmol (Phila)*. 2019;8:115–125.
4. Singh K, Sherwood MB, Pasquale LR. Trabeculectomy must survive! *Ophthalmol Glaucoma*. 2020. doi:10.1016/j.ogla.2020.08.009.
5. Sheheitli H, Tirpack AR, Parrish RKII. Which patients would most likely to benefit: MIGs or MEGs, which one is it? *Asia Pac J Ophthalmol (Phila)*. 2019;8:436–440.
6. Gillmann K, Mansouri K. Minimally invasive glaucoma surgery: where is the evidence? *Asia Pac J Ophthalmol (Phila)*. 2020;9:203–214.
7. Gedde SJ, Vinod K, Wright MM, et al. Primary open-angle glaucoma Preferred Practice Pattern®. *Ophthalmology*. 2020;128:71–150.
8. Aung T, Crowston J. Asia Pacific Glaucoma Guidelines. Amsterdam, Netherlands: Kugler Publications; 2016.
9. Chen CW. Enhanced intraocular pressure controlling effectiveness of trabeculectomy by local application of mitomycin-C. *Trans Asia Pacific Acad Ophthalmol*. 1983;9:172–177.
10. Palmer SS. Mitomycin as adjunct chemotherapy with trabeculectomy. *Ophthalmology*. 1991;98:317–321.
11. Vinod K, Gedde SJ, Feuer WJ, et al. Practice preferences for glaucoma surgery: a survey of the American Glaucoma Society. *J Glaucoma*. 2017;26:687.
12. Do JL, Xu BY, Wong B, et al. A randomized controlled trial comparing subconjunctival injection to direct scleral application of Mitomycin C in trabeculectomy. *Am J Ophthalmol*. 2020;220:45–52.
13. Kandarakis SA, Papakonstantinou E, Petrou P, et al. 1-year randomized comparison of safety and efficacy of trabeculectomy with MMC subtenon injection versus MMC-infused sponges. *Ophthalmol Glaucoma*. 2021. S2589-4196(21)00138-1.
14. Esfandiari H, Pakravan M, Yazdani S, et al. Treatment outcomes of Mitomycin C-augmented trabeculectomy, sub-tenon injection versus soaked sponges, after 3 years of follow-up: a randomized clinical trial. *Ophthalmol Glaucoma*. 2018;1:66–74.
15. Jampel HD, Solus JF, Tracey PA, et al. Outcomes and bleb-related complications of trabeculectomy. *Ophthalmology*. 2012;119:712–722.
16. Kitazawa Y, Suemori-Matsushita H, Yamamoto T, et al. Low-dose and high-dose mitomycin trabeculectomy as an initial surgery in primary open-angle glaucoma. *Ophthalmology*. 1993;100:1624–1628.
17. Laspas P, Wahl J, Peters H, et al. Outcome of bleb revision with autologous conjunctival graft alone or combined with donor scleral graft for late-onset bleb leakage with hypotony after standard trabeculectomy with Mitomycin C. *J Glaucoma*. 2021;30:175–179.
18. Razeghinejad MR, Havens SJ, Katz LJ. Trabeculectomy bleb-associated infections. *Surv Ophthalmol*. 2017;62:591–610.
19. Khaw PT, Chiang M, Shah P, et al. Enhanced trabeculectomy: the Moorfields Safer Surgery System. *Dev Ophthalmol*. 2017;59:15–35.