# Improvements in Small-gauge Vitrectomy May Reduce Potential Complications

**BY ROHIT ROSS LAKHANPAL, MD**


*The Vit-Buckle Society (VBS) was originally formed by a group of vitreoretinal surgical fellows at the annual Fellow's Forum in Chicago in January 2006. The group, Derek Y. Kunimoto, MD, Rohit Ross Lakhanpal, MD, Thomas A. Albini, MD, Charles Mango, MD, and R.V. Paul Chan, MD, had become friends during the interview process 2 years earlier. At that time, they decided to form a new vitreoretinal society for emerging surgeons focusing on surgical innovation and technique while also fostering an atmosphere of discussion and camaraderie. Thus, the VBS mission statement is to provide an open forum for innovative vitreoretinal surgeons to share best practices, to foster the development and use of novel surgical technologies and strategies for retinal diseases, and to demonstrate the value of mentorship of emerging vitreoretinal surgeons. This includes mentoring upcoming vitreoretinal fellows.*

*Subsequently, new members joined the Steering Committee, which includes the original members along with Audina Berrocal, MD, John Kitchens, MD, and Andrew Moshfeghi, MD. Recently, in association with the American Society of Retina Specialists, VBS has conducted three annual meetings in which surgical challenges, techniques, and new innovations are openly discussed among 50 to 60 participating attendees. Timothy G. Murray, MD, MBA, has been the VBS mentor and has been invaluable in terms of his enthusiasm and expertise.*

## NEW COLUMN IN *RETINA TODAY*

*Beginning with this issue of* Retina Today, *the VBS will participate in a regular column featuring articles authored by VBS members to highlight topics of interest to the membership.Many of these articles will be cross-referenced to surgical videos on* Eyetube.net, *the ophthalmic video resource produced by Bryn Mawr Communications, publishers of* Retina Today.

**-Rohit Ross Lakhanpal, MD; and Thomas Albini, MD**

Small-gauge vitrectomy system (25-gauge and 23-gauge) use has increased rapidly since 2002 due to its advantages of decreased surgical time, reduced postoperative inflammation, and faster visual recovery compared with 20-gauge vitrectomy.[1-5] The 2009 Preferences and Trends (PAT) Survey from the American Society of Retina Specialists reported that nearly 80% of respondents commonly employ small-gauge systems. Recently, however, concerns have arisen that use of small-gauge systems may increase the risk of endophthalmitis.[6-9] Proper preoperative sterilization techniques along with improved methods in entry, exit and surgical technique should decrease these risks. This article highlights some of these methods.

## POTENTIAL RISKS OF SMALL-GAUGE SYSTEMS

The risk of endophthalmitis in 20-gauge systems has been previously reported to be 0.03% to 0.05%.[10-13] Retrospective reviews of 25-gauge endophthalmitis data have reported conflicting information: As compared with 20-gauge studies, Kunimoto et al[7] reported a 12-fold increased risk, Scott et al[8] reported a 28-fold increased risk, but Hu et al[14] reported no statistically significant difference (a 0.07% [1/1424] rate for the 25-gauge cases).

Several hypotheses have been proposed to explain why 25-gauge vitrectomy may lead to a higher rate of postoperative endophthalmitis: Complete wound closure may not be achieved;[15] unsutured wounds may lead to early

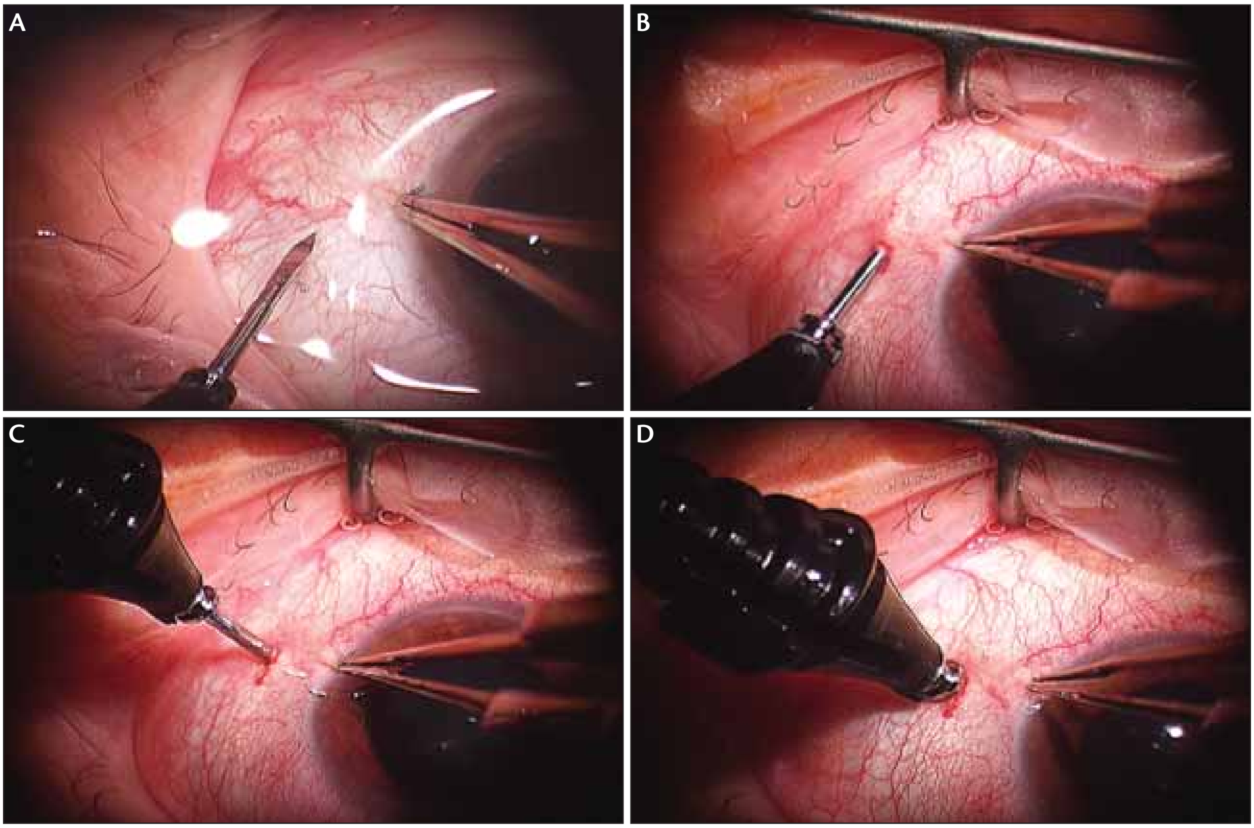


**Figure 1. First-generation 23-gauge trocar system (Alcon Surgical, Ft. Worth, TX): Insertion of 23-gauge trocars and microcannulas. The microcannulas are inserted through the conjunctiva into the eye by means of a trocar (A). Insertion is accomplished by first displacing the conjunctiva laterally by approximately 2 mm (B). An initial oblique, then a perpendicular tunnel is made parallel to the limbus through the conjunctiva and sclera (C), thus, creating a self-sealing wound (D).**

postoperative hypotony, allowing an intraocular influx of extraocular fluid and microorganisms;[1-4,10,16,17] lower infusion rates with reduced influx and efflux of fluid may allow a greater bacterial inoculum to remain in the eye;[1-3] residual vitreous skirt may facilitate bacterial adherence and sequester bacteria from normal immunologic factors and extraocular antibiotics;[18] vitreous wick prolapse through the sclerotomy site may create a potentially open conduit through the conjunctival and scleral wound that may facilitate entry of bacteria into the eye.[19]

## IMPROVEMENTS IN ENTRY TECHNIQUE

Successful outcomes in small-gauge vitrectomy are highly dependent upon preoperative preparation and entry technique. Preoperatively, the use of povidone-iodine along the lid margin and/or perioperative area significantly reduces bacterial flora, thus decreasing the risk of endophthalmitis. Furthermore, placing povidone-iodine for a few seconds near entry sites may further lower the risk, as direct application has been demonstrated in well-controlled studies to decrease the microbiologic flora before intraocular surgery.[20,21]

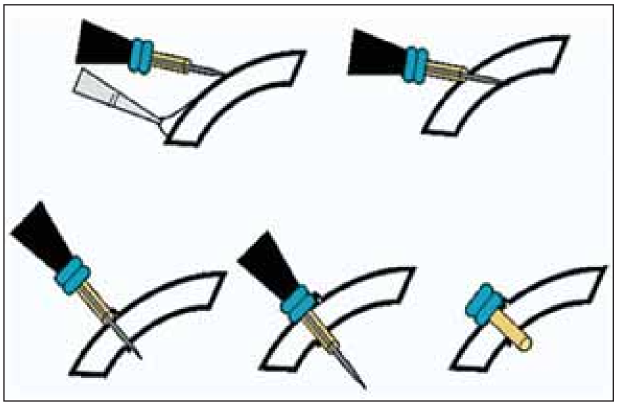

**Figure 2. Representations of oblique, beveled incision after conjunctival displacement (top row) and direct, perpendicular incision without conjunctival displacement (bottom row).**

Modifications in entry technique have also decreased complication risk. Original 25-gauge surgical systems employed a direct perpendicular entry through intact

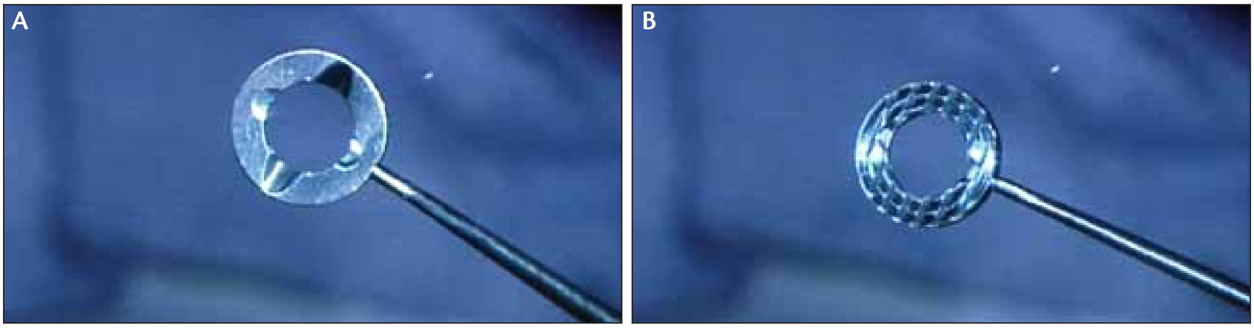


**Figure 3. Dugel EndPlate (DEP). Anterior surface of DEP displays angled grooves that approximate the beveled incision angle necessary for self-sealing sclerotomies; two other semi-circular indentations are used to remove the trocar from the microcannula in small-gauge surgery (A). Posterior surface of DEP demonstrates grooved ridges that assist in displacing the conjunctiva and firmly stabilizing the eye (B).**

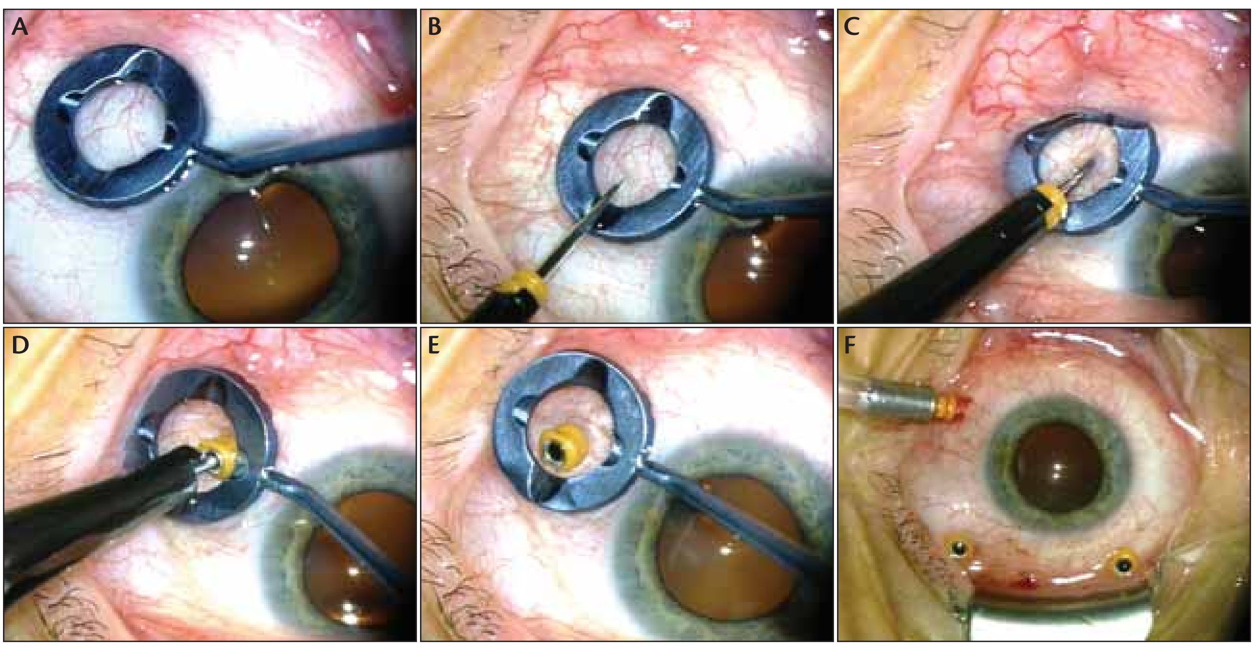


**Figure 4. Use of the DEP to stabilize the eye and displace the conjunctiva (A). Use of the angled groove to approximate the angle of entry into the globe with the second generation 23-gauge trocar system (B). Angled entry into the globe (C). Use of semi-circular indentations to free the microcannula from the trocar (D). Once the trocar blade is removed, the microcannula is seen at the appropriate oblique angle, designating the correct angle of entry (E). All three microcannulas in place prior to vitrectomy (F).**

conjunctiva without displacement.[1-3] This allowed a direct opening to the vitreous cavity, thus increasing the risks of endophthalmitis, hypotony, and choroidal detachment in early studies. Lakhanpal et al[3] reported no cases of endophthalmitis, but did report incidence of 4% of hypotony and persistent choroidal detachments associated with small blebs. Gupta et al[22] reported hypotony within the first 24-hour period in numerous eyes as well.

Such complications necessitated the following improvements in entry technique (Figure 1): First, the conjunctiva and sclera should be flattened in order to allow entry more parallel to the limbus; next, the conjunctiva should be displaced laterally in order to prevent communication between this incision and the scleral incision; third, rather than a perpendicular incision, a two-step incision should be used, in which an oblique, beveled incision parallel to the limbus through the conjunctiva and sclera is followed by a perpendicular tunnel entry, thus creating a self-sealing wound.[23] In one study, angled incisions were associated with significantly lower risk for external communication as opposed to straight incisions (Figure 2).[24]

Flattening and displacing the conjunctiva in order to create a self-sealing incision was an important development. This may be performed with a variety of instru-

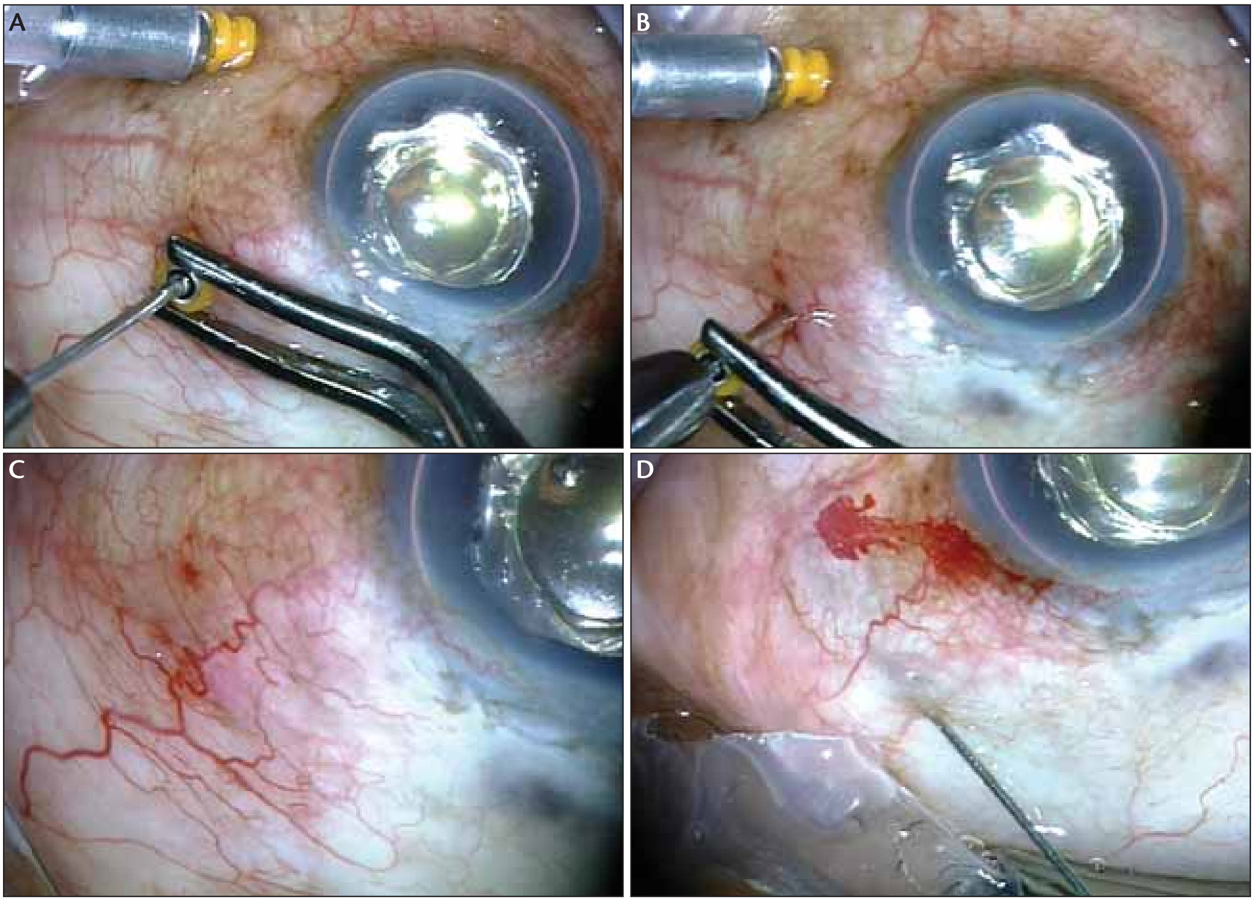


**Figure 5. The light pipe is inserted through the microcannula prior to removal to prevent vitreous wick prolapse (A). With the light pipe still positioned through the sclerotomy, the microcannula is removed with a plug-puller (B). Once the microcannula is removed, the light pipe is safely removed, and no discernible bleb or sign of extrusion is noted (C). Subconjunctival antibiotics are placed adjacent to the sclerotomy site as an added deterrent to bacterial migration into the eye (D).**

ments, such as a cotton-tip applicator, 0.3 forceps, or plug-pulling forceps. Another option is the Dugel End Plate (Peregrine Surgical, New Britain, PA): This instrument simultaneously flattens and displaces the conjunctiva, then designates the angle of entry, and finally aids in trocar removal (Figures 3 and 4).

## IMPROVEMENTS IN SURGICAL PROCEDURE AND CANNULA REMOVAL

A variety of techniques may be employed during small-gauge vitrectomy in order to decrease the risks of hypotony and endophthalmitis. Previous studies have postulated that insufficient vitreous removal during 25-gauge vitrectomy may provide an area for bacterial adherence.[25] Thus, performing a more complete vitrectomy, particularly with triamcinolone staining near the sclerotomy sites, is a simple way to correct this problem. Another potential issue is that prolapse of a vitreous wick through the sclerotomy site may create a potentially open conduit through the conjunctival and scleral wound that may facilitate entry of bacteria into the eye.[19] Once again, more complete vitrectomy at or near the sclerotomy sites decreases this risk. Also, the use of air tamponade at the conclusion of surgery may act as both a barrier to bacterial inoculation and a way to prevent hypotony.

Improvements in cannula removal and appropriate use of subconjunctival antibiotics near the sclerotomy sites may reduce potential complication risks. Vitreous wick prolapse may be prevented[19] during closure by simply placing the light pipe through the microcannula during removal (Figure 5). This prevents the suction-like effect that can occur during cannula removal. This mechanism of cannula removal with air tamponade may allow air rather than vitreous to seal the sclerotomy site wound. Finally, injection of subconjunctival antibiotics adjacent to the sclerotomy sites may decrease bacterial entry through sclerotomy sites. Some authors have recently proposed that there is a correlation between relative hypotony at the conclusion of surgery and the influx of bacteria through sclerotomy sites, increasing the risk of endophthalmitis.[26, 27] Air tamponade and relatively higher intraocular pressure may be a deterrent to bacterial influx.[27] Extra insufflation of air may also be necessary if the intraocular pressure is deemed to be too low. Many of these recommendations for small-gauge surgery improvements have been proposed by the Microsurgical Safety Task Force at the most recent meeting of the American Society of Retina Specialists.[28]

## CONCLUSIONS

Small-gauge vitrectomy systems have been in widespread use since 2002. For experienced surgeons, there has been a steep learning curve in terms of entry techniques, surgical technique and instrumentation, and microcannula removal. These improvements have decreased the relative risk of endophthalmitis, but longer-term study must be done. Hu et al[14] determined that there is no statistically significant difference in endophthalmitis rates between 20-gauge and 25-gauge systems, directly contradicting two previous studies.[7,8]

Currently, the prevailing evidence emphasizes the importance of the following measures to reduce endophthalmitis risk: Infection prevention measures, including lid scrubbing and direct povidone-iodine application; conjunctival displacement and angled/beveled incision; more complete vitreous removal adjacent to the sclerotomies; air tamponade; repositing potential extraconjunctival vitreous wick with light-pipe assisted cannula removal and subconjunctival antibiotic injection; and extra insufflation of air/gas, if necessary, to stabilize intraocular pressure.

Having performed thousands of small gauge vitrectomies since 2002 without a case of endophthalmitis, I believe that the increased risk is largely technique-dependent. The documented risk modifications described above should decrease the endophthalmitis risk dramatically. ■

*Rohit Ross Lakhanpal, MD is a Partner at Eye Consultants of Maryland and a Clinical Assistant Professor of Ophthalmology at The University of Maryland School of Medicine. He reports no financial or proprietary interest in any of the products or techniques mentioned in this article. He has been a Consultant in the past for both Bausch & Lomb and Alcon Surgical. He is currently the Vice-president of the Vit-Buckle Society (VBS). Dr. Lakhanpal is Section Co-Editor of the VBS page in* Retina Today *and on* EYETUBE.NET. *He can be reached at +1 410 581 2020 or via e-mail at retinaross@yahoo.com.*

*Thomas Albini, MD is Assistant Professor of Clinical Ophthalmology at the Bascom Palmer Eye Institute in Miami, FL. He specializes in vitreoretinal diseases and surgery and uveitis. He has served as a speaker for both Bausch & Lomb and Alcon Surgical, as well as consultant for Alcon Surgical. He is currently the Membership Chair of the Vit-Buckle Society (VBS). Dr. Albini is Section Co-Editor of the VBS page in* Retina Today *and on* EYETUBE.NET. *He can be reached at +1 305 482 5006; or via e-mail at talbini@med.miami.edu.*

1. Fuji GY, de Juan E Jr, Humayun MS, et al. A new 25-gauge instrument system for transconjunctival sutureless vitrectomy surgery. *Ophthalmology*. 2002:109:1807–1812.
2. Fujii GY, de Juan E Jr, Humayun MS, et al. Initial experience using the transconjunctival sutureless vitrectomy system for vitreoretinal surgery. *Ophthalmology*. 2002;109:1814–1820.
3. Lakhanpal RR, Humayun MS, de Juan E, et al. Outcomes of 140 consecutive cases of 25-gauge transconjunctival surgery for posterior segment disease. *Ophthalmology*. 2005;112(5):817–824.
4. Ibarra MS, Hermel M, Prenner JL, Hassan TS.Longer-term outcomes of transconjunctival sutureless 25-gauge vitrectomy. *Am J Ophthalmol*. 2005;139(5):831–836.
5. Eckardt C. Transconjunctival sutureless 23-gauge vitrectomy. *Retina*. 2005;25:208–211.
6. Acar N, Unver YB, Altan T, Kapran Z. Acute endophthalmitis after 25-gauge sutureless vitrectomy. *Int Ophthalmol*. 2007;27:361–363.
7. Kunimoto DY, Kaiser RS, Willis Eye Retina Service. Incidence of endophthalmitis after 20- and 25-gauge vitrectomy. *Ophthalmology*. 2007;114:2133–2137.
8. Scott IU, Flynn HW Jr, Dev S, et al. Endophthalmitis after 25-gauge and 20-gauge pars plana vitrectomy: incidence and outcomes. *Retina*. 2008;28:138–142.
9. Taban M, Ufret-Vincenty RL, Sears JE. Endophthalmitis after 25-gauge transconjunctival sutureless vitrectomy. *Retina*. 2006;26:830–831.
10. Aaberg TM Jr, Flynn HW Jr, Schiffman J, Newton J. Nosocomial acute-onset postoperative endophthalmitis survey: a 10-year review of incidence and outcomes. *Ophthalmology*. 1998;105:1004–1010.
11. Eifrig CW, Flynn HW Jr, Scott IU, Newton J. Acute-onset postoperative endophthalmitis: review of incidence and visual outcomes (1995–2001). *Ophthalmic Surg Lasers*. 2002;33:373–378.
12. Eifrig CW, Scott IU, Flynn HW Jr, et al. Endophthalmitis after pars plana vitrectomy: incidence, causative organisms, and visual acuity outcomes. *Am J Ophthalmol*. 2004;138:799–802.
13. Sakamoto T, Enaida H, Kubota T, et al. Incidence of acute endophthalmitis after triamcinolone-assisted pars plana vitrectomy. *Am J Ophthalmol*. 2004;138:137– 8.
14. Hu AY, Bourges JL, Shah SP, et al. Endophthalmitis after pars plana vitrectomy a 20- and 25-gauge comparison. *Ophthalmology*. 2009;116(7):1360-5.
15. Keshavamurthy R, Venkatesh P, Garg S. Ultrasound biomicroscopy findings of 25 G transconjunctival sutureless (TSV) and conventional (20G) pars plana sclerotomy in the same patient. BMC Ophthalmol [serial online] 2006;6:7. Available at: http://www.biomedcentral.com/1471-2415/6/7. Accessed January 21, 2009.
16. Shimada H, Nakashizuka H, Mori R, Mizutani Y. Expanded indications for 25-gauge transconjunctival vitrectomy. *Jpn J Ophthalmol*. 2005;49:397– 401.
17. Yanyali A, Celik E, Horozoglu F, et al. 25-Gauge transconjunctival sutureless pars plana vitrectomy. *Eur J Ophthalmol*. 2006;16:141–147.
18. Meredith TA. Antimicrobial pharmacokinetics in endophthalmitis treatment: studies of ceftazidime. *Trans Am Ophthalmol Soc*. 1993;91:653–699.
19. Chen SD, Mohammed Q, Bowling B, Patel CK. Vitreous wick syndrome—a potential cause of endophthalmitis after intravitreal injection of triamcinolone through the pars plana [letter]. *Am J Ophthalmol*. 2004;137:1159–1160.
20. Apt L, Isenberg S, Yoshimori R, Paez JH. Chemical preparation of the eye in ophthalmic surgery. III. Effect of povidone-iodine on the conjunctiva. *Arch Ophthalmol*. 1984;102:728 –729.
21. Apt L, Isenberg SJ, Yoshimori R. Antimicrobial preparation of the eye for surgery. *J Hosp Infect*. 1985;6(suppl):163–72.
22. Gupta A et al *Invest Ophthalmol Vis Sci*.2003, v 44
23. Inoue M, Shinoda K, Shinoda H, et al. Two-step oblique incision during 25-gauge vitrectomy reduces incidence of postoperative hypotony. *Clin Experiment Ophthalmol*. 2007;35:693–696.
24. Singh RP, Bando H, Brasil OFM, et al. Evaluation of wound closure using different incision techniques with 23-gauge and 25-gauge microincision vitrectomy systems. *Retina*. 2008;828:242–248.
25. Meredith TA. Antimicrobial pharmacokinetics in endophthalmitis treatment: studies of ceftazidime. *Trans Am Ophthalmol Soc*. 1993;91:653–699.
26. Taban M, Sharma S, Ventura AA, Kaiser PK. Evaluation of wound closure in oblique 23-gauge sutureless sclerotomies with visante optical coherence tomography. *Am J Ophthalmol*. 2009;147(1):101–107.e1. Epub 2008 Oct 4
27. Lakhanpal RR. Air tamponade reduces complications in 23-gauge vitrectomy. Presented at: 2009 Retina Congress; September 30-October 4, 2009; New York.
28. Kaiser RK. Endophthalmitis in sutureless vitrectomy surgery and the findings of the micro-surgical safety task force. Presented at: 2009 Retina Congress; September 30-October 4, 2009; New York.