Performance Characteristics of a Straight Versus Bent 25-Gauge Vitrector

Jeffrey L. Olson, MD; Leslie A. Wei, MD; Melanie J. Fortin, BSc; Scott C.N. Oliver, MD; Hugo Quiroz-Mercado, MD; Naresh Mandava, MD; Arthur Korotkin, MD

BACKGROUND AND OBJECTIVE: During vitrectomy in phakic patients, lens damage can occur while shaving the peripheral vitreous. Modifying the vitrector with a slight bend can diminish this risk.

MATERIALS AND METHODS: To assess whether the bent vitrector performs to standard, the cutting and aspiration functionality of a straight and bent cutter was tested on both the vitreous from an enucleated porcine eye and balanced salt solution. Data were analyzed using a paired two-tailed *t*-test for comparison of two small sample means.

RESULTS: The average time for removal of vitreous was 19.32 seconds with the straight cutter and 19.26 seconds for the bent cutter. There was no statistically significant difference between the removal rates ($P = .87$). The average time for aspiration of balanced salt solution was 14.3 seconds with the straight tip and 14.16 seconds with the bent tip. There was no statistically significant difference between the aspiration rates ($P = .55$).

CONCLUSION: Both unmodified and bent vitrectors demonstrate an equally efficient rate of removal of vitreous and balanced salt solution in vitro.

[*Ophthalmic Surg Lasers Imaging Retina.* 2014;45:153-155.]

VIDEO

INTRODUCTION

Cataract formation after pars plana vitrectomy (PPV) is a common phenomenon, with up to 80% of vitrectomized patients developing visually significant lens opacities or experiencing progression of existing cataracts. The etiology of cataract formation after vitrectomy is likely multifactorial, being a combination of mechanical trauma to the posterior lens face, light toxicity, lens protein oxidation, and exposure to irrigating solution, silicone oil, and gas. Not only are vitrectomized patients more likely to develop lens opacities, but cataract surgery after vitrectomy is more challenging due to weakened zonules and loss of posterior support.

Direct damage to the crystalline lens by vitreoretinal instruments is more likely when attempting to remove the anterior vitreous base (Figure 1A, page 154). Modification of the vitrector to have a slight bend may reduce the risk of inadvertent lens touch during surgery (Figure 1B). While a bent vitrector may improve access to the peripheral retina, its cutting and aspirating ability compared to a straight vitrector has not been previously tested.

TECHNIQUE

A 25-gauge vitrector was modified by bending the shaft midway along its length against the curvature of a 20-diopter lens or medicine cup. The vitrector was manually molded to the curve of the 20-diopter lens by the surgeon, with care being taken to keep the cutter side down. Figure 2 (page 155) and the Video (*available at www.Healio.com/OSLIRetina*)

From the Department of Ophthalmology, University of Colorado Hospital Eye Center, Aurora, Colorado (JLO, LAW, SCNO, HQM, NM); the University of Colorado at Colorado Springs, Colorado Springs, Colorado (MJF); and the Eye Center of Northern Colorado, Fort Collins, Colorado (AK).

Presented at the Association for Research in Vision and Ophthalmology annual meeting, May 8, 2012, Ft. Lauderdale, FL.

Dr. Quiroz-Mercado is a consultant for Allegro Pharmaceutical. Dr. Oliver receives research support from ThromboGenics. The remaining authors have no financial or proprietary interest in the materials presented herein.

Address correspondence to Jeffrey L. Olson, MD, University of Colorado Eye Center, University of Colorado School of Medicine, 1675 N Aurora Court, Mail Stop F731, Aurora, CO 80045; 720-848-5029; fax: 720-848-5014; email: Jeffrey.Olson@ucdenver.edu.

doi: 10.3928/23258160-20140306-10

TABLE

Comparison of Removal Time for BSS and Vitreous With 25-Gauge Straight and Bent Vitrectors

	Straight		Bent	
Test	**BSS**	**Vitreous**	**BSS**	**Vitreous**
1	13.1 s	20.3 s	15.1 s	21.1 s
2	15.8 s	16.9 s	13.2 s	20.3 s
3	15.3 s	20.3 s	13.1 s	18.5 s
4	13 s	21 s	14.5 s	17.4 s
5	14.3 s	18.1 s	14.9 s	19 s
Average	14.3 s	19.32 s	14.16 s	19.26 s

BSS = balanced salt solution.

demonstrate modification and intraoperative use of a 25-gauge curved vitrector and diathermy. The angle of the bent vitrector measures 14° and is reproducible within a few degrees if the same curved object is used to shape the vitrector. Vitreous from an enucleated porcine eye was removed and 1 cc placed in a standard 3-cc syringe. The Accurus surgical system (Alcon, Ft. Worth, Texas) was used for all testing. The straight 25-gauge cutter (vacuum: 200 mm Hg; cut rate: 1,800 cpm) was then placed in the syringe and time to complete removal was recorded. The same procedure was then performed with the bent cutter on the same settings. The aspiration rate (vacuum: 200 mm Hg; cutter off) of each type of vitrector was then tested by placing 2 cc of balanced salt solution in a syringe and recording the time to removal. Each type of vitrector was tested five times with both porcine vitreous and balanced salt solution. Data were analyzed using a paired two-tailed *t*-test for comparison of two small sample means with Excel statistical software.

RESULTS

The average time for removal of vitreous was 19.32 seconds with the straight cutter and 19.26 seconds for the bent cutter (Table). There was no statistically significant difference between the removal rates of the straight versus the bent cutter ($P = .87$). The average time for aspiration of balanced salt solution was 14.3 seconds with the straight tip and 14.16 seconds for the bent tip. There was no statistically significant difference between the aspiration rates of the straight versus the bent cutter ($P = .55$). There was no incidence of vitrector malfunction or breaking during bending of the vitrector or performance testing.

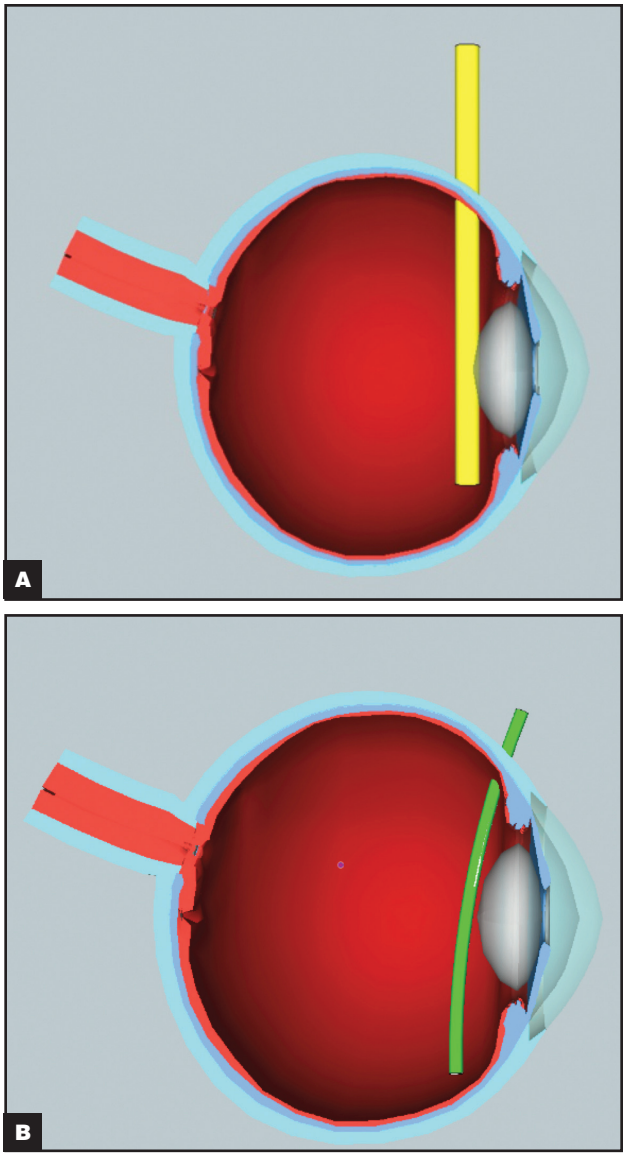

Figure 1. (A) Schematic demonstrating impingement of the crystalline lens during vitrectomy when attempting to reach the opposite side vitreous base with a conventional straight cutter. (B) Schematic demonstrating absence of lens touch when using a bent vitrector to reach the opposite side vitreous base.

DISCUSSION

The anterior vitreous base is the most difficult portion of vitreous to remove surgically. Obtaining access and adequate visualization requires scleral depression by an assistant as well as delicate maneuvering by the surgeon to avoid damaging the lens in phakic patients. Cataracts are one of the most common delayed complications of vitrectomy surgery, necessitating a second surgery with increased risk of retinal detachment. Although cataracts resulting from direct lens touch with the vitrector are less common, using

a bent or curved vitrector that simulates the natural contour of the crystalline lens can further reduce the risk of intraoperative lens damage.

Both 20- and 25-gauge curved vitrectors have been described previously in the literature.[1-3] Chalam et al tested curved and straight instruments in cadaveric human eyes and found the distance from the posterior lens capsule was 2.5 mm greater with the curved vitrector compared to the straight from a 4-mm sclerotomy site.[3] They also noted that at 180° from a 4-mm sclerotomy site, the curved vitrector was able to reach 2.8 mm anteriorly to the ora serrata, whereas the straight vitrector was only able to extend up to 2.4 mm posteriorly to the ora. In vivo, both the 20- and 25-gauge curved vitrectors were found to be effective in removing peripheral vitreous and vitreous incarcerated in sclerotomy sites, with no cases of mechanical lens trauma.[1,2] Similarly, curved endolaser probes and cannulas have been described in the literature and have been found to be more effective than straight instruments.[4,5]

The curved vitreoretinal instruments employed in previously published reports (Rumex International Co., Clearwater, FL; and Bausch + Lomb, Rochester, NY) were manufactured rather than modified from straight vitrectors.[1,3] The advantages of modifying a vitrector in the operating room with a slight bend is increased control over the angle and lower cost compared to utilizing a specially manufactured curved instrument. Disadvantages include potentially breaking the vitrector or damaging the guillotine cutting function while bending it. Difficulty maneuvering past the elbow of the bend, with accidental removal of the trocar, is another potential disadvantage of a bent vitrector. The ideal angle at which to bend the vitrector remains unknown. Limitations of this study include the use of porcine vitreous, which is much thicker than human vitreous and required a slower cut rate.

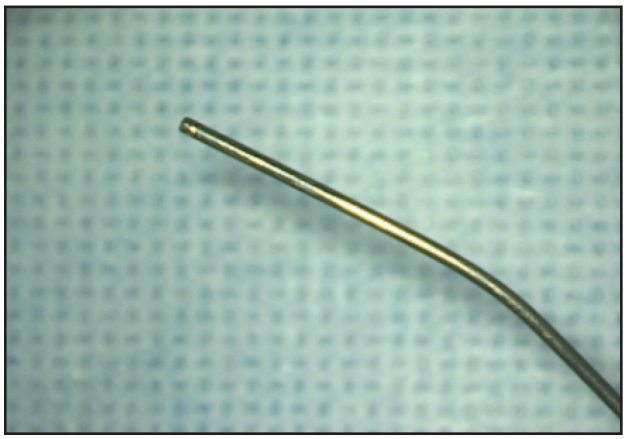

Figure 2. A bent 25-gauge vitrector.

The cutting and aspirating performance of straight and modified bent vitrectors in vitro is equivalent. Future research will be directed toward comparative testing of straight and bent vitrectors in vivo.

REFERENCES

1. Chalam KV, Gupta SK, Agarwal S. Illuminated curved vitrectomy probe for vitreoretinal surgery. *Ophthalmic Surg Lasers Imaging.* 2008;38(6):525-526.
2. Natarajan S, Malpani A, Nirmalan PK. A new curved vitreous cutter for managing phakic retinal detachment with proliferative vitreoretinopathy. *Indian J Ophthalmol.* 1998;46(2):87-89.
3. Chalam KV, Shah VA, Gupta SK, Tripathi RC. Evaluation and comparison of lens and peripheral retinal relationships with the use of endolaser probe and newly designed curved vitrectomy probe. *Retina.* 2003;23:815-819.
4. Gross JG, Freeman WR. The 30-degree curved endolaser probe. *Ann Ophthalmol.* 1990;22(10):382-384.
5. Liu W, Wang DD, Huang SY, Li JQ, Wu SH, Hang L. A bent infusion cannula for vitreous surgery. *Am J Ophthalmol.* 2005;140(1):151-152.