공막돌륭술 시 돌륭의 위치 결정을 위한 새로운 공막누르개의 개발

Development of a New Scleral Depressor for Determining the Location of a Buckle during Scleral Buckling Surgery

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Purpose: To develop and characterize a new scleral depressor that can more accurately determine the location of a scleral buckle.

Methods: A light source was added to the center of the compression area of a sickle-shaped depressor, which was then used in scleral buckling surgeries. After examining the inner side of the eyeball with an indirect ophthalmoscope, the center of the compressed region was verified using transillumination. Based on the location of the retinal break, the surgeon implanted the buckle at the compressed region. Six patients were treated with the new depressor.

Results: During surgery, the new depressor accurately located the position of the retinal break on the scleral side. In the first patient, the center of the break was located at the top of the buckle because the posterior border of the break was not sufficiently protruded; therefore, intravitreal gas injection was performed after surgery. In the five remaining patients, the center of the buckle was located at the posterior border of the break. The retinas were well-flattened in all patients.

Conclusions: The new depressor accurately identified the position of retinal break on the scleral side.

Keywords: Retina; Retinal break; Rhegmatogenous retinal detachment; Scleral buckling; Vitreoretinal surgery

Introduction

Retinal detachment occurs when the neurosensory retina is separated from the retinal pigment epithelium and fluid accumulates in this space. There are four types of retinal detachment: exudative (serous), tractional, rhegmatogenous, and combined tractional/rhegmatogenous [1]. Among these types, rhegmatogenous retinal detachment is the most common. The three essential factors for occurrence of rhegmatogenous retinal detachment are liquefaction of the vitreous, tractional forces (which produce a retinal break), and a retinal break [2].

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Surgical treatments for rhegmatogenous retinal detachment, including scleral buckling, trans pars plana vitrectomy, and pneumatic retinopexy, are commonly used [3]. Scleral buckling is a surgical technique that pushes the sclera and choroid to the side of the retina by placing a buckle at the outside of the sclera to relieve vitreous traction and promote reattachment of the retina [4].

The causes of surgical failure for scleral buckling include an inadequate buckle, an incorrect buckle position, undetected breaks, proliferative vitreoretinopathy, choroidal detachment, and macular holes [5,6]. Among these causes, buckle malposition is one of the most common reasons for the failure of scleral buckling, so identification of the buckle location during surgery is important for anatomical success. Various factors can induce a buckle malposition, but the most common cause involves the surgeon incorrectly pressing the retina. When deciding the position for pressing, the surgeon watches the inner side of the eye and may push at an incorrect position without recognizing the malposition of the depressor. In addition, in cases of bullous retinal detachment where the retinal break is raised, placing the buckle is problematic because of difficulties in identifying the pressed location [6,7]. This error may result from a difference between the observation site and the surgical site because the operator applies pressure to the outside of the eyeball while observing the inside of the eyeball. To reduce malpositioning of the buckle, we developed a new scleral depressor to accurately locate the buckle through simultaneously observing the inside of the eyeball while determining the center of the pressed location.

Materials and Methods

The results for six eyes from six patients who were treated by the same retinal specialist from July of 2015 to January of 2017 were analyzed. There were two females and four males, and all patients underwent scleral buckling for rhegmatogenous retinal detachment of phakic eyes.

The new depressor used in this study had a sickle shape similar to other scleral depressors but included a light source attached to the center of the compression position so that there was transillumination of the inner side when the surgeon pressed the device against the sclera (Fig. 1). At the end of the scleral depressor, which was 0.46 mm in diameter, the

Figure 1. New scleral depressor. A light source was added to the center of the compression area of a sickle-shaped depressor that was similar to other existing depressors, and the depressor was used in scleral buckling surgery.

Figure 2. Intraoperative photographs taken during surgeries using an conventional scleral depressor (A) and the new scleral depressor (B). During the surgery with the conventional scleral depressor (A), the posterior border of the retinal break was located at the protruded position when the depressor pressed the sclera. In the scleral buckling surgery with the new depressor (B), the location of the retinal break can be identified more accurately by transilluminating the sclera. The position of the buckle can then be determined with the device by aligning the top of the buckle with the midpoint of the posterior boundary of the retinal break. Video clips are also available (conventional scleral depressor: <https://www.youtube.com/watch?v=vubj3wZ75Cw>; new scleral depressor: <https://www.youtube.com/watch?v=pHHn7Y5pMRk>).

fiber optic light was extended to the end of the metal tube resulting in a blunt end. The illumination system used a xenon light source system (Alcon, Fort Worth, Tx, USA).

All surgeries followed the general procedure for scleral buckling. This study complied with the guidelines of the Helsinki Declaration.

Results

We compared an existing scleral depressor with the new depressor using scleral buckling surgery for rhegmatogenous retinal detachment. During the scleral buckling surgery using the existing scleral depressor, the posterior border of the retinal break was located at the protruded position when the depressor was pressed onto the sclera (Fig. 2A, video clip: <https://www.youtube.com/watch?v=vubj3wZ75Cw>). In the scleral buckling surgery using the new sickle-shaped depressor, the location of the retinal break was identified more accurately by transilluminating the sclera (Fig. 2B, video clip: <https://www.youtube.com/watch?v=pHHn7Y5pMRk>). The position of the buckle was then determined by aligning the top of the buckle with the midpoint of the posterior boundary of the retinal break.

In the first patient treated with the new depressor, the fishmouth phenomenon was present and intravitreal gas injection was used. In the five other patients, the center of the buckle was located at the posterior border of the retinal break. The retinas were flattened in all six patients (Fig. 3).

Discussion

The annual incidence of rhegmatogenous retinal detachment has been reported as 10.5 per 100,000 in the general population [8]. Scleral buckling, trans pars plana vitrectomy, and pneumatic retinopexy are commonly used to treat rhegmatogenous retinal detachment, and pneumatic retinopexy and scleral buckling surgery are the most popular surgical methods in localized cases [3]. Among these methods, scleral buckling, introduced by Charles L. Schepens in 1951 [9], is up to 90% effective in retinal reattachment.

Many previous reports, including retrospective, prospective and meta-analyses, have compared scleral buckling and vitrectomy, as well as simultaneous operations with both of

Figure 3. Post-operative, wide-field, fundus photograph of a patient who was successfully treated using the new depressor during scleral buckling surgery.

Figure 4. Pre-operative (A) and post-operative (B) wide-field fundus photographs of the first patient who was treated using the new depressor. The retina was reattached after an intravitreal gas injection, which was needed due to the occurrence of the fishmouth phenomenon (arrowhead) after the first surgery. The retinal break was located at the midpoint of the buckle.

these, and reported that there was no significant difference in single-surgery success rates (%) among the various methods [2,3,10-20].

Scleral buckling is most useful in phakic eyes and has the advantages of a lower risk of endophthalmitis, iatrogenic breaks [21-25], and cataracts [3,26,27]. Surgical options for scleral buckling could be expanded if the surgical procedure was easier and the surgical time was shortened, which are possible using the novel depressor. Scleral buckling surgery can fail if the shape or size of the buckle is inadequate, if the buckle is located in the wrong position, or if there is proliferative vitreoretinopathy, a chorioretinal detachment, a macular hole, or a previously unknown retinal break [5,6]. Additionally, buckle malposition is a common reason for failure in scleral buckling surgery and can occur if the retina is pressed inappropriately.

The most common difficulty in scleral buckling surgery occurs when the surgeon presses the outer wall of the eyeball but observes the inner side of the eyeball. Because there may be a discrepancy between the surgical site and the surgeon's view of the site, we developed a device that renders it possible to view and operate on the same site. The surgeon can then locate a buckle in an adequate position by determining the location of the retinal break on the scleral side by transillumination of the outside of the sclera using the new depressor; this allows the surgeon to reconcile the inside and outside of the eyeball.

If a break occurs up to the midpoint of a buckle, the fish-mouth phenomenon can occur [28]. This occurred when using the new device on the first patient in this study so intravitreal gas was injected after the surgery (Fig. 4), and the retina remained flat. In that case, the scleral marking made by the new depressor was located more anteriorly than the marking made using the existing device. This is likely because the new device marks the exact position of retinal break in contrast with the existing device, which only shows the post-operative features of the scleral buckle. Therefore, after this surgery, the position of the buckle was more accurately determined by taking those discrepancies into account. In the case of this first operation using the new scleral depressor, it may have been helpful to confirm the location and to predict the postoperative features using the conventional scleral depressor.

In the five other patients, the center of the buckle was located at the posterior border of the retinal break. The ret-

inas were well-flattened in all six patients, and it was easy to identify the scleral side of the lesion on the inner side of the eyeball using the new scleral depressor device. The new depressor was therefore effective in determining the location of the retinal break on the side of the sclera, and use of this device may reduce the failure rate of scleral buckling surgery. Furthermore, the device could assist new surgeons in overcoming the difficulty associated with locating retinal breaks.

Conflicts of Interest

The authors declare no conflicts of interest relevant to this article.

References

1. Ghazi NG, Green WR. Pathology and pathogenesis of retinal detachment. *Eye (Lond)* 2002;16:411-21.
2. Sodhi A, Leung LS, Do DV, et al. Recent trends in the management of rhegmatogenous retinal detachment. *Surv Ophthalmol* 2008;53:50-67.
3. Heimann H, Bartz-Schmidt KU, Bornfeld N, et al. Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment: a prospective randomized multicenter clinical study. *Ophthalmology* 2007;114:2142-54.
4. Thelen U, Amler S, Osada N, Gerding H. Success rates of retinal buckling surgery: relationship to refractive error and lens status: results from a large German case series. *Ophthalmology* 2010;117:785-90.
5. Lincoff H, Kreissig I. Extraocular repeat surgery of retinal detachment. A minimal approach. *Ophthalmology* 1996;103:1586-92.
6. Thompson JT. The effects and action of scleral buckles in the treatment of retinal detachment. In: Sadda SR, Hinton DR, eds. *Retina*, 5th ed. London: W.B. Saunders, 2013; v. 3. chap. 99.
7. Sullivan P. Techniques of scleral buckling. In: Sadda SR, Hinton DR, eds. *Retina*, 5th ed. London: W.B. Saunders, 2013; v. 3. chap. 100.
8. Mitry D, Charteris DG, Fleck BW, et al. The epidemiology of rhegmatogenous retinal detachment: geographical variation and clinical associations. *Br J Ophthalmol* 2010;94:678-84.
9. Schepens CL, Okamura ID, Brockhurst RJ. The scleral buckling procedures. I. Surgical techniques and management. *AMA Arch Ophthalmol* 1957;58:797-811.

10. Jackson TL, Donachie PH, Sallam A, et al. United Kingdom National Ophthalmology Database study of vitreoretinal surgery: report 3, retinal detachment. *Ophthalmology* 2014;121:643-8.
11. Heimann H, Bornfeld N, Bartz-Schmidt UK, et al. Analysis of the surgeon factor in the treatment results of rhegmatogenous retinal detachment in the "scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment study". *Klin Monbl Augenheilkd* 2009;226:991-8.
12. Sun Q, Sun T, Xu Y, et al. Primary vitrectomy versus scleral buckling for the treatment of rhegmatogenous retinal detachment: a meta-analysis of randomized controlled clinical trials. *Curr Eye Res* 2012;37:492-9.
13. Pastor JC, Fernández I, Rodríguez de la Rúa E, et al. Surgical outcomes for primary rhegmatogenous retinal detachments in phakic and pseudophakic patients: the Retina 1 Project--report 2. *Br J Ophthalmol* 2008;92:378-82.
14. Brazitikos PD, Androudi S, Christen WG, Stangos NT. Primary pars plana vitrectomy versus scleral buckle surgery for the treatment of pseudophakic retinal detachment: a randomized clinical trial. *Retina* 2005;25:957-64.
15. Sharma YR, Karunanithi S, Azad RV, et al. Functional and anatomic outcome of scleral buckling versus primary vitrectomy in pseudophakic retinal detachment. *Acta Ophthalmol Scand* 2005;83:293-7.
16. Tewari HK, Kedar S, Kumar A, et al. Comparison of scleral buckling with combined scleral buckling and pars plana vitrectomy in the management of rhegmatogenous retinal detachment with unseen retinal breaks. *Clin Exp Ophthalmol* 2003;31:403-7.
17. Afrashi F, Erakgun T, Akkin C, et al. Conventional buckling surgery or primary vitrectomy with silicone oil tamponade in rhegmatogenous retinal detachment with multiple breaks. *Graefes Arch Clin Exp Ophthalmol* 2004;242:295-300.
18. Stangos AN, Petropoulos IK, Brozou CG, et al. Pars-plana vitrectomy alone vs vitrectomy with scleral buckling for primary rhegmatogenous pseudophakic retinal detachment. *Am J Ophthalmol* 2004;138:952-8.
19. Halberstadt M, Chatterjee-Sanz N, Brandenburg L, et al. Primary retinal reattachment surgery: anatomical and functional outcome in phakic and pseudophakic eyes. *Eye (Lond)* 2005;19:891-8.
20. Azad RV, Chanana B, Sharma YR and Vohra R. Primary vitrectomy versus conventional retinal detachment surgery in phakic rhegmatogenous retinal detachment. *Acta Ophthalmol Scand* 2007;85:540-5.
21. Ramkissoon YD, Aslam SA, Shah SP, et al. Risk of iatrogenic peripheral retinal breaks in 20-G pars plana vitrectomy. *Ophthalmology* 2010;117:1825-30.
22. Gosse E, Newsom R, Lochhead J. The incidence and distribution of iatrogenic retinal tears in 20-gauge and 23-gauge vitrectomy. *Eye (Lond)* 2012;26:140-3.
23. Misra A, Ho-Yen G, Burton RL. 23-gauge sutureless vitrectomy and 20-gauge vitrectomy: a case series comparison. *Eye (Lond)* 2009;23:1187-91.
24. Ehrlich R, Goh YW, Ahmad N, Polkinghorne P. Retinal breaks in small-gauge pars plana vitrectomy. *Am J Ophthalmol* 2012;153:868-72.
25. Issa SA, Connor A, Habib M, Steel DH. Comparison of retinal breaks observed during 23 gauge transconjunctival vitrectomy versus conventional 20 gauge surgery for proliferative diabetic retinopathy. *Clin Ophthalmol* 2011;5:109-14.
26. Jackson TL, Donachie PH, Sparrow JM, Johnston RL. United Kingdom National Ophthalmology Database Study of Vitreoretinal Surgery: report 1; case mix, complications, and cataract. *Eye (Lond)* 2013;27:644-51.
27. Wickham L, Bunce C, Wong D, et al. Randomized controlled trial of combined 5-Fluorouracil and low-molecular-weight heparin in the management of unselected rhegmatogenous retinal detachments undergoing primary vitrectomy. *Ophthalmology* 2007;114:698-704.
28. Birchall CH. The fishmouth phenomenon in retinal detachment: old concepts revisited. *Br J Ophthalmol* 1979;63:507-10.