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Changes in Axial Length and Anterior Chamber Depth after Rhegmatogenous Retinal Detachment Repair

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Abstract

Purpose: This study measure the changes in Anterior Chamber Depth (ACD) and Axial Length (AL) after scleral buckle (SB) surgery or Pars Plana Vitrectomy (PPV) for the repair of rhegmatogenous Retinal Detachment (RD).

Methods: 102 eyes of patients undergoing rhegmatogenous retinal detachment repair were prospectively reviewed. 49 eyes of 49 patients scheduled to undergo SB surgery and 53 eyes of 53 patients scheduled to undergo PPV. ACD and AL were measured by spectral-domain optical coherence tomography (SD-OCT) and biometry, 1 day before surgery as well as 3 and 4 months postoperatively.

Results: ACD was not decreased significantly for patients undergoing PPV surgeries 3 months postoperative (p=0.0843) and 4 months postoperative (p=0.2616). ACD was observed to decrease significantly 3 months (p=0.029) and 4 months (p=0.0027) postoperatively for patients undergoing SB surgeries. AL increased significantly after SB surgery 3 months postoperative (p=0.0020) and 4 months postoperative (p=0.0001). AL not increased significantly after PPV surgery 3 months postoperative (p=0.0863) and 4 months postoperative (p=0.1576). The level of statistical significance was set at p<0.005.

Conclusion: Our results showed that SB surgery altered the shape of the eye by changing both ACD and AL, however, PPV not altered ACD and AL significantly. These findings should elucidate the changes to be expected after SB and PPV surgeries.

Keywords: Anterior chamber depth; Axial length; Optical coherence tomography; Retinal detachment

Introduction

A rhegmatogenous retinal detachment (RD) involves pathologic separation of the neural retina from the pigment epithelium because of break in the retina. Rhegmatogenous RD leads to the loss of visual function and usually requires prompt surgical therapy. RDs can be managed by pneumatic retinopexy, scleral buckling (SB) or vitreoretinal surgery. SB involves the use of an encircling or segmental element and was introduced in 1957 by Schepens et al. These external techniques may not only lead to changes in axial length but may also cause a reduction in anterior chamber depth (ACD) [1-4].

SB and vitrectomy can induce secondary glaucoma and changes in refractive error, most commonly, myopic shift. SB surgery changes the shape of the eye, altering the degree of corneal curvature as well as AL [5-10].

Anterior segment-optical coherence tomography (AS-OCT; Visante, Carl Zeiss Meditec AG 07745, Jena, Germany) is widely employed for clinical examination of the anterior segment. AS-OCT is a non-contact imaging method that provides high-resolution cross-sectional images of the anterior chamber angle and cornea as well as measurements of ACD. Several studies have established the technology's high reproducibility and repeatability, which are equal to or even better than other techniques currently used to measure ACD [11]. Lavanya et al. [13] and Nemeth et al. [11] showed that ACD measurements obtained by AS-OCT were significantly deeper than those obtained with the IOL Master or US immersion A-scan (Ultra Scan Imaging System, Alcon Laboratories, Fort Worth, TX).

The IOL Master is now widely used to obtain noninvasive, accurate AL measurements. The validity and repeatability of these measurements have been established [12].

Using the AS-OCT and IOL Master, we evaluated changes in ACD and axial length (AL) after SB and pars plana vitrectomy (PPV) surgeries. We compare our findings for both surgeries. These results should elucidate the changes to be expected after SB and PPV surgeries. This study investigates the postoperative ocular structure changes for RRD patients and provides information to guide surgery selection such as patients with the history of angle closure glaucoma, especially when the patients with shallow anterior chamber or narrower angle. Surgeons should avoid selecting the SB surgery which can cause the ocular structure changes. It can avoid the occurrence of postoperative complications such as avoiding induced glaucoma. The postoperative refractive state also can be explained by the surgery selection. The results have profound clinical significance.

Materials and Methods

This prospective study included 102 eyes of 102 patients with primary rhegmatogenous RD seen at the Department of Retina and Vitreous at the Second People's Hospital of Jinan, Shandong province,

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China, during the period from September 2010 to December 2011. All cases were acute RRD, phakic eyes. The inclusion criteria for the study were rhegmatogenous RD without age-related macular degeneration, cataract, vitreous hemorrhage, anterior proliferative vitreoretinopathy, choroidal detachment, macular holes, trauma, macular edema, intraocular inflammation, glaucoma, or retinal vascular occlusive diseases. Eyes with preexisting corneal disease were also excluded. Patients with systemic diseases, such as diabetes or hypertension, were excluded. Eyes that had undergone cataract, glaucoma, or refractive surgery were excluded from the study. If the tears were more than 2 disk diameter, the retinal detachment range was big (more than half of the retina) and obvious traction existed, we choose PPV; If retinal tears were small and gathered, the retinal detachment range was small and no obvious traction existed, we choose SB. PV grade showed no significant difference in the two groups, being less than grade B in all the patients.SB (Group A) and PPV (Group B) were successfully performed in 49 and 53 eyes, respectively. No instance of retinal redetachment was found within 4 months of follow-up in either group. Informed consent was obtained from all patients included in the study. The study was approved by the ethical committee of the Second People's Hospital of Jinan, Shandong province, China. The study adheres to the tenets of the Declaration of Helsinki.

In Group A, all patients underwent standard SB surgery. Retinal cryocoagulation was performed around the retinal breaks, which had been localized with precision. The reaction of cryocoagulation was moderate. Drainage performed 12 mm posterior to the limbus before cryocoagulation .The segmental element was placed circumferentially without an encircling band. The segmental element was fixed 12-14 mm posterior to the limbus with 5-0 silk sutures. No gas or air was used in any of the SB surgeries.

In Group B, all eyes underwent a standard 23-gauge 3-port PPV, laser photocoagulation, fluid-air exchange, and silicone oil (Bausch&Lomb 5000, centistokes) tamponade at the end of the surgery. All vitrectomies were performed without SB. All patients underwent pre- and postoperative best-corrected logMAR visual acuity (VA) testing, slit-lamp biomicroscopy, intraocular pressure (IOP) assessments, and dilated fundus examinations. AS-OCT was used to measure ACD. It was measured from the corneal endothelium to the anterior pole of the crystalline lens. The sectional plane is horizontal (0-180). Post-operative AS-OCT and IOL Master Measurements were obtained on dilated eyes with the patient in the seated position. A single researcher (JL) calculated ACD using AS-OCT software. AS-OCT and IOL Master Measurements were also obtained 3 and 4 months after surgery. The data are presented as mean ± standard deviation (SD). Statistical analyses were performed using the t-test for dependent paired samples and independent samples. The level of statistical significance was set at $p<0.005$.

Results

The average age of group A patients was 36.6 ± 17.1 years (range: 16–68 years); 27 were women (55.1%), and 22 were men (44.9%). The average age of Group B patients was 44.7 ± 12.8 years (range: 21–71 years); 25 were women (47.2%), and 28 were men (52.8%). High intraocular pressure occurred in 1 eyes of group and 4 eyes of group B patients within 2 weeks postoperative. The intraocular pressure of all patients decreased to normal level within 1 month postoperative. There were no other surgical complications among group A and group B.

In Group A, mean ACD was 3.20 ± 0.46 mm preoperatively, 2.95± 0.34 mm after 3 months, and 2.97 ± 0.25 after 4 months ($p<0.005$; Table 1). In Group B, mean ACD was 3.07 ± 0.28 mm preoperatively, 2.97 ± 0.31 mm after 3 months, and 3.02 ± 0.16 mm after 4 months (Table 2). The difference between preoperative and 3 months and 4 months postoperative ACD measurements was significant in SB groups ($p<0.005$; Figure 1).

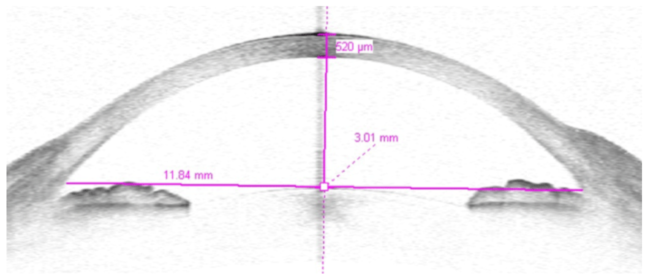

Figure 1: ACD was measured from the corneal endothelium to the anterior pole of the crystalline lens. The sectional plane is horizontal (0–180°). Rhegmatogenous RD patient, 42 years old, treated by Scleral buckling, Preoperative ACD, 3.01 mm.

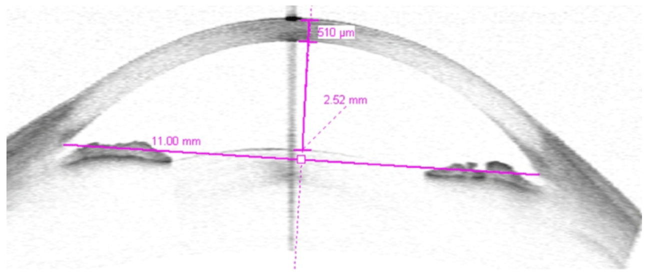

Figure 1-2: 3 months Postoperative ACD, 2.52 mm.

The difference between preoperative and postoperative ACD measurements was not significant in PPV groups ($p>0.005$; Figure 2).

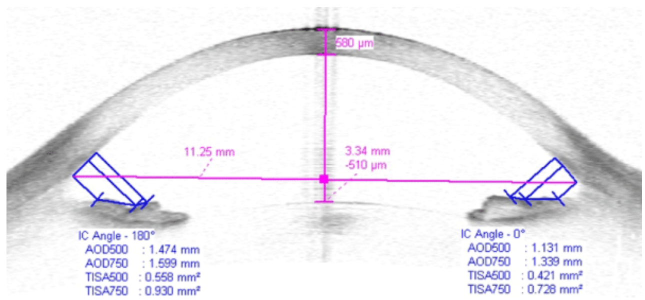

Figure: 2-1: Rhegmatogenous RD patient, 48 years old, treated by PPV. Preoperative ACD, 3.31 mm.

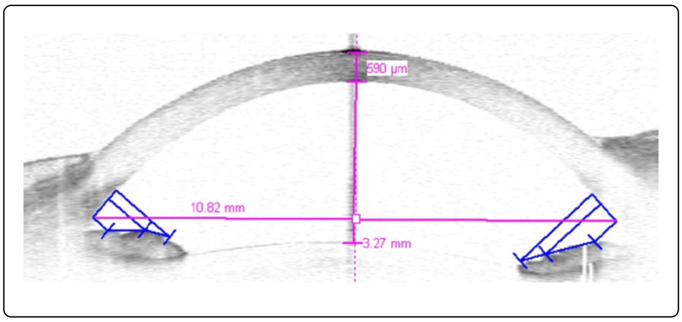

Figure 2-2: 3 months Postoperative ACD, 3.27 mm.

	Preoperative	3 month postoperative	4 month postoperative	P value (3 months)	P value (4 months)
ACD (mm)	3.20 ± 0.46	2.95 ± 0.34	2.97 ± 0.25	0.0029	0.0027
AL (mm)	23.47 ± 2.31	25.23 ± 3.11	25.25 ± 2.07	0.002	0.0001

Table 1: Preoperative and postoperative AS-OCT and IOL-MASTER findings of Group A (n=49).

In Group A, mean AL increased from 23.47 ± 2.31 mm preoperatively to 25.13 ± 3.11 mm 3 months postoperatrive (p=0.0020) and to 25.25 ± 2.07 mm 4 months postoperative (p=0.0001). In Group B, AL was similar before (23.35 ± 2.27 mm) and after surgery (24.18 ± 2.65 mm and 24.07 ± 2.90 mm) (3 months p=0.0863; 4 months p=0.1576 (Table 2).

	Preoperative	3 month postoperative	4month postoperative	P value (3 months)	P value (4 months)
ACD (mm)	3.07 ± 0.28	2.97 ± 0.31	3.02 ± 0.16	0.0843	0.2616
AL (mm)	23.35 ± 2.27	24.18 ± 2.65	24.07 ± 2.90	0.0863	0.1576

Table 2: Preoperative and postoperative AS-OCT and IOL-MASTER findings of Group B (n=53).

Discussion

In present study, we reported the changes in ACD and AL following vitrectomy or SB for rhegmatogenous RD. We found that SB caused significant changes in ACD. The decrease of ACD is insignificant for the PPV surgery group. Previous studies have found that changes in lens thickness and reductions in ACD after scleral buckle surgery .That thus altered the patient's refractive error [14]. Potential reasons for the observed changes include the following factors. Mechanical pressure: a scleral buckle can displace the lens, or increase intraocular pressure enough to increase lens convexity [14]. Trauma during surgery could stimulate contraction of the ciliary body muscle, resulting in increased lens thickness. Abnormally low intraocular pressure prior to surgery may have resulted in falsely high measurements of ACD. Scleral buckle surgery may impede blood flow and homeostasis postoperatively [15]. Burton et al. found increased lens thickness for at least 6 weeks after SB surgery [1]. Notably, methodological differences among studies may also account for this discrepancy in ACD measurements.

In the past, RDs were repaired using hard silicone explants or scleral implants [1,4]. In our sugery, we used scleral explants for SB surgery to avoid the need for scleral dissection; this may have contributed to the observed reduction in ACD. Ultrasound biomicroscopic studies after SB surgery demonstrated that ciliary effusion shifted the iris-lens diaphragm anteriorly, which resulted in a shallower anterior chamber [16]. The SB may have impeded uveal or retinochoroidal circulation, triggering ciliary body edema [17]. These factors, in combination with compression of the vitreous by the SB, may have decreased ACD.

As to the axial length changes, a number of studies have reported that SB surgery alters the shape of the eye by changing both corneal curvature and AL [5-10].

Chen et al. [18] reported a significant elongation of axial lengths and anterior shifting of lens in 32 eyes of retinal detachment treated with encircling procedures. The elongation was more significant in the implant group [19]. In Rubin's [19] retrospective study, he found that the refractive changes of the eyes of retinal detachment treated by scleral buckling were related to the strength of indentation by the exoplants. The axial length elongates when the posterior slope of the exoplant is still visible through the indirect ophthalmoscope.

Sheu et al. [20] compared the ocular change between the scleral-buckling (12 eyes) and pars plana posterior vitrectomy (10 eyes) for retinal detachment. In the scleral-buckling surgery, the elongation was significant. In the PPV surgery, the elongation was not significant.

In our study, the increase of the axial length was significant for the SB surgery and was insignificant for the PPV surgery. The results were consistent with the study of Sheu et al [20]. The differences could be explained by the fact that, in our scleral buckling surgery, silicone sponge was used, the position of the silicone sponge was much located in the equator, the silicone sponge was the tight, so the horizontal shortening was obviously.

The limitations of our study were the short follow-up time, the small sample size, and the subjective nature of the interpretations of the images. The long-term follow-up is necessary in our further study. In the present study, no attempt was made to determine the long-term complications, such as the change of the lens and redetachment of the retina. Hence, further follow-up is needed to observe the changes of postoperative ACD and AL.

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