·Clinical Research·

Effects of scleral encircling surgery on vitreous cavity length and diopter

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Abstract

• AIM: To observe the changes of vitreous cavity length and diopter after scleral encircling (SE) produce.

• METHODS: This prospective study included 68 eyes of 68 non-consecutive patients with macula-off retinal detachment who were operated by SE surgery. The corneal refractive power, ocular axial length and diopter were measured by keratometer, A-mode ultrasonic meter and computed dioptometer.

• RESULTS: There was no significant difference in corneal refractive power among preoperative and post operative 1, 3 and 6mo (0.57±0.54 D at pre-surgery; 0.72±0.26 D at 1mo; 0.71±0.34 D at 3mo; 0.69±0.31 D at 6mo; all P>0.05). Axial lengths were obviously lengthened, especially in vitreous cavity length (17.87±3.09 mm, 19.69±3.12 mm, 18.97±3.56 mm, 18.76±3.47 mm, 18.68±3.42 mm at pre-surgery, 1wk, 1, 3 and 6mo postoperatively, P<0.05) and diopter also increased at beginning and then recovered gradually. After 1 and 3 mo, axial length (vitreous cavity length) and myopia were more and in higher degree than before surgery.

• CONCLUSION: The change of postoperative vitreous cavity length is the main factor that results in the changes of axial length and then makes the change of diopter.

• KEYWORDS: sclera encircling; vitreous cavity length; diopter; axial length

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INTRODUCTION

With the surgery technology improvement in recent years, although scleral buckling (SB) surgery achieves a high anatomical success rate in patients with primary rhegmatogenous retinal detachment (RD), the visual recovery remains less satisfactory. Several studies [1-4] have reported that preoperative visual acuity, duration of macular detachment, and extent of RD, location and size of retinal break, proliferative vitreoretinopathy are the major factors related to postoperative visual outcome. However, the change of vitreous cavity length (VCL) after surgery also may result in refractive changes and decreases visual acuity significantly. In this study, we try to analysis the relation of change between VCL and refractor in the postoperative patients with RD and further to improperly estimate visual outcome after uncomplicated scleral encircling (SE) surgery in patients with RD.

SUBJECTS AND METHODS

Subjects Between 1st June, 2012 and 31st July 2014, 68 patients with primary rhegmatogenous RD without involving macula who underwent SE surgery were enrolled in this study. These patients were followed up for at least 6mo after a successful SE surgery. Patients' age ranged from 14 to 68y (mean 42.5y). RDs were associated with high myopia in 16 eyes. All patients were excluded from the study as well as those with previous ocular surgery, glaucoma, ocular infection, acute or chronic ophthalmological disease, contact lens users.

Methods Patients were observed before surgery, and 1wk, 1 and 3mo after surgery. The observed items included 1) visual acuity, corneal refractive power (CRP), refractive status; 2) ocular axial length (AL): anterior segment length (ASL) +VCL; 3) intraocular pressure (IOP). Some items were measured 3 times and expressed as mean: 1) CRP was measured by a TopconKM-5 keratometer. CRP average and astigmatism at two orthogonal meridians were computed; 2) refractive status was detected with streak retinoscopy (spherical equivalent was measured for astigmatic patients) or computer optometry; 3) AL was measured by type-A ultrasonic meter (Biometer AI-100, Tomey Corporation, Japan). Four items were measured 1) AL was defined as distance from corneal vertex to the vitreoretinal interface at the posterior pole. This distance which excludes the posterior wall thickness is theoretically closer to optical axial length;

Table 1 Changes of the components of AL in the pre-and post-surgery $\bar{x} \pm s$ (mm)

Parameters	Pre-surgery	Post-surgery			
		1wk	1mo	3mo	6mo
AL	24.76±3.04	26.95±2.48	25.78±3.14	25.43±3.25	25.32±3.09
ASL	6.35±0.45	6.25±0.44	6.30±0.53	6.32±0.48	6.31±0.50
VCL	17.87±3.09	19.69±3.12	18.97±3.56	18.76±3.47	18.68±3.42

AL: Axial length; ASL: Anterior segment length; VCL: Vitreous cavity length.

2) ASL was defined as distance from corneal vertex to posterior pole of lens; 3) VCL was defined as distance from posterior pole of lens to the vitreoretinal interface at the posterior pole; 4) IOP was measured by a noncontact tonometer (NCT). Informed consent was obtained from all subjects. The procedures complied with the Declaration of Helsinki and were approved by the Anhui Province Hospital institutional review board.

Statistical Analysis Data were expressed as mean±SD. For comparison in the pre- and post-surgery values, the Dunnett's test was applied. A value of $P<0.05$ was considered to be statistically significant. The data analysis was carried out with the SPSS software version (SPSS 17.0 for windows, SPSS Inc., Chicago, IL, USA).

RESULTS

Changes of the Corneal Astigmatism at the Pre- and Post-surgery Mean corneal astigmatism (CA) at pre-surgery was 0.57±0.54 D, and then was 0.76±0.32 D at 1wk after SE surgery which showed a rising trend compared with the data of the pre-surgery. However, there was no statistically significant ($P>0.05$). Subsequently, mean CAs did not significantly change at 1, 3 or 6mo postoperatively (0.72±0.26 D at 1mo; 0.71±0.34 D at 3mo; 0.69±0.31 D at 6mo; all $P>0.05$).

Changes of the Refractive State in the Pre- and Post-surgery Mean diopter before SE surgery was -1.35±0.42 D, and then was -2.86 ±0.34 D in the postoperative 1wk. Compared with the data of pre-surgery, the result was significantly difference ($t=0.236$, $P=0.001<0.05$). The mean diopter were -2.38±0.54 D, -2.36±0.46 D, -2.35±0.51 D at 1, 3, 6mo postoperatively, respectively. The statistical analysis revealed significant differences compared with the preoperative values respectively (t=0.193, 0.147, 0.126; all $P<0.05$). Furthermore, there was also statistically significant between the both data of the postoperative 1wk and 1mo ($t=0.116$, $P=0.001<0.05$). However, the differences were no statistically significant between the both data of the postoperative 1 and 3mo ($t=2.065$, $P=0.187>0.05$) as well as the statistical analysis revealed similar result between the three months and six months ($t=2.402$, $P=0.196>0.05$).

Changes of the Components of Axial Length in the Pre- and Post-surgery Results of AL before and after surgery are showed in Table 1. ALs significantly changed at 1wk, 1, 3 and 6mo postoperatively (P=0.001, 0.000, 0.000<0.05). ASLs did not significantly change at 1wk, 1, 3 and 6mo postoperatively (P=0.103, 0.114, 0.121, 0.120>0.05). VCLs significantly changed at 1wk, 1, 3 and 6mo postoperatively (P=0.000, 0.000, 0.000, 0.000<0.05).

DISCUSSION

There are few reports in China about the changes of VCL and diopter after SE. For this reason, this study was conducted results show that CA was enhanced but insignificantly ($P>0.05$) and myopia degree increased significantly ($P<0.05$) at 1wk after surgery. The CA degrees at 1, 3 and 6mo after surgery slightly declined from 1wk after surgery, but were basically similar to the levels before surgery. The possible causes are the eyeball deformation and corneal surface convexing shortly after surgery. With the prolonging of time, the encircling ridge and the refractive change gradually stabilized. As reported [5-7], the astigmatism due to SE is mainly associated with radial encircling. At 1wk after surgery, AL and myopia degree were both significantly increased from preoperative levels. At 1mo after surgery, AL and myopia degree were both reduced from levels at 1wk after surgery, but were both significantly increased from preoperative levels. These results are similar to the report by some investigators[8-13], and also indicate that the extension of ocular axis is a major cause for the increase of myopic diopter after surgery.

As showed in Table 1, ASLs do not change significantly, which is consistent with the observations with ultrasonic biological microscopy (Fan *et al* [14] and Wei *et al* [15]). On the contrary, VCLs significantly increase after surgery ($P<0.05$). The causes of the changes may be resulted from the methods used in operation (encircling buckling or segmental buckling spanning). As reported [16], with the change of diopter, the variations of AL and VCL are closely correlated with high consistency and correlation coefficient of 0.87. Therefore, VCL determines AL and then refractive status. By the age of 3y, the eye anterior segment is basically mature or approaches the level of adults. Thus, after age 3y, all changes related to refractive status occur at the posterior segment, which are consistent with the results by McBrien and Millodot [17]. Our study also indicates that the variation of VCL after SE is the major cause for the extension of ocular axis, which then induces changes in diopter.

As reported [18-20], changes of diopter and AL gradually stabilize at 3mo after surgery, which are consistent with our study. Thus, optometry is acceptable after 3mo postoperatively, since changes of diopter and AL have already stabilized then.

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