·Clinical Research·

Posterior scleral reinforcement combined with vitrectomy for myopic foveoschisis

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Abstract

• **AIM: To investigate the effects of posterior scleral reinforcement (PSR) combined with vitrectomy for myopic foveoschisis.**

• **METHODS: Thirty-nine highly myopic eyes of 39 patients with myopic foveoschisis underwent PSR combined with vitrectomy. Best corrected visual acuity (BCVA), refraction error, and the foveal thickness by optical coherence tomography (OCT) were recorded before and after the surgery, and complications were noted.**

• **RESULTS: The follow-up period was 12mo, and the main focus was on the results of the 12-month follow-up visit. The mean preoperative BCVA was 0.96±0.43 logMAR. At the final follow-up visit, the mean BCVA was 0.46±0.28 logMAR, which significantly improved compared with the preoperative one (*P*=0.003). The BCVA improved in 33 eyes (84.62%), and unchanged in 6 eyes (15.38%). At the end of follow-up, the mean refractive error was -15.13±2.55 D, and the improvement was significantly compared with the preoperative one (-17.53±4.51 D) (*P*=0.002). Twelve months after surgery, OCT showed complete resolution of the myopic foveoschisis and a reattachment of the fovea in 37 eyes (94.87%) and partial resolution in the remained two eyes (5.13%). The foveal thickness was obviously reduced at 12-month follow-up visit (196.45±36.35 μm) compared with the preoperative one (389.32±75.56 μm) (*P*=0.002). There were no serious complications during the 12mo follow-up period.**

• **CONCLUSION: PSR combined with vitrectomy is a safe and effective procedure for myopic foveoschisis with both visual and anatomic improvement.**

• **KEYWORDS:** high myopia; myopic foveoschisis; posterior scleral reinforcement; vitrectomy

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INTRODUCTION

Myopic foveoschisis is one of the complications that may develop in highly myopic eyes [1]. It typically occurs in association with posterior staphyloma and is characterized by a splitting of the layers of the neurosensory retina [2-3]. With the use of optical coherence tomography (OCT), it has been estimated that the prevalence of myopic foveoschisis with posterior staphyloma ranged from 9% to as high as 34%[4-5]. The pathogenesis of myopic foveoschisis has remained unclear so far. The most common pathogenesis model is that it is caused by antero-posterior traction due to a posterior staphyloma and tangential traction caused by stretched retinal vessels and vitreofoveal adhesions [6]. The natural history of myopic foveoschisis is inactivity in most cases, with maintenance of stable visual acuity and retinal thickness. However, in a minority of cases (about 30%), progressive detachment of the fovea occurs and thus leading to decreased visual acuity or metamorphopsia. In these cases, surgery is often necessary to reattach the retina and prevent and even reverse the deterioration of visual acuity[7].

Several surgical options for myopic foveoschisis have been reported such as posterior scleral reinforcement (PSR) and vitrectomy [8-13]. Zhu *et al* [14] performed PSR for macular retinoschisis in 24 highly myopic eyes, and achieved a visual improvement of 0.1 or more in 18 eyes (75%) and complete resolution of myopic foveoschisis in 20 eyes (83.33%). However, Sun *et al* [15] did not achieve the same successful outcomes in their experience. They did not advocate PSR alone for myopic foveoschisis complicated by a premacular structure and they believed that vitrectomy was the most reliable method to remove vitreo-retinal traction. Several studies have proven the benefits of vitrectomy for foveoschisis by removing vitreoretinal traction. Myopic foveoschisis with decreased visual acuity has been treated by vitrectomy, and achieved positive results in eyes with an axial length of < 30 mm [16-18]. However, in eyes with marked axial elongation (axial length > 30 mm), vitrectomy has not often resulted in an improvement in visual acuity [19]. The possible reason is that relief from internal traction by removing the vitreofoveal adhesions alone may not be sufficient to improve the anatomical situation for the fovea in markedly axially elongated eyes with posterior staphyloma. Qi *et al* [19] compared the treatment effects of PSR in association with vitrectomy (n =14) and vitrectomy alone (n =14) on the extremely myopic patients with myopic foveoschisis, and found that patients underwent PSR in association with vitrectomy had a higher improvement in visual acuity. But their number of patients was relatively low.

We think that PSR combined with vitrectomy may be better than PSR or vitrectomy alone for myopic foveoschisis in eyes with posterior staphyloma. Therefore, in the present study, we evaluate the functional and anatomic outcomes of PSR combined with vitrectomy for myopic foveoschisis .

SUBJECTS AND METHODS

Subjects The study was approved by the Medical Ethics Committee of Zhengzhou University and adhered to the provisions of the Declaration of Helsinki for research involving human subjects. All the patients involved in the study gave written informed consent after thorough discussion on the potential benefits and risks of PSR combined with vitrectomy.

This study was a retrospective analysis of all cases of myopic foveoschisis treated with PSR combined with vitrectomy at our hospital in the period between January 2011 and July 2014. Surgeries were performed by one experienced surgeon.

Inclusion criteria for this study included high myopia defined as a refractive error of -12.0 D or higher, an axial length ≥28 mm, myopic foveoschisis, with or without associated foveal detachment and with or without inner macular hole, a progressive decreased visual acuity or metamorphopsia due to myopic foveoschisis. Patients were excluded from the study if they had other disease that could affect the central vision (full-thickness macula hole, retinal detachment, choroidal neovascularization, macular atrophy and so on), or they had undergone the procedure such as previous scleral buckle procedure, PSR or vitrectomy.

Surgical Procedures Firstly, all the patients were treated with PSR. The procedure was performed as described before [14]. A scleral buckle of donor sclera with a width of 12 mm to 14 mm was made, and then another scleral belt with the size of 8 mm×8 mm should be placed between scleral buckle and posterior staphyloma. The superior end of the cleral buckle was sutured to the nasal side sclera near the attachment of superior rectus muscle and the inferior end of the buckle was fixed to the nasal side sclera beside the attachment of inferior rectus muscle. After placing the scleral buckle, its location was checked. The position relation between the buckle and optic nerve should be especially tested with a strabismus hook. The distance should be kept about 3 mm to ensure that the scleral buckle covered the posterior staphyloma without compressing the optic nerve.

One month later, all the patients underwent a standard 23-gauge 3-port pars plana vitrectomy with the insertion of a beveled cannula under retrobulbar anesthesia. Triamcinolone acetonide (0.1-0.2 mL in a concentration of 20 mg/mL) was injected into the vitreous chamber to visualize the vitreous clearly. The central vitreous core was vitrectomized before the posterior hyaloid membrane was removed from the macular surface. A fluid-gas exchange was performed using 16% perfluoropropane gas. The internal limiting membrane was not peeled. After vitrectomy, the patients were asked to stay in a prone position for at least one week.

Outcome Measures The main outcome measures in our study were best corrected visual acuities (BCVA), refractive error, foveal thickness and the incidence of complications. All the patients underwent a broad ophthalmologic examination at preoperative and every postoperative follow-up visit (7d, 1, 3, 6, 9 and 12mo after vitrectomy) including BCVA measurement measured with Early Treatment Diabetic Retinopathy Study (ETDRS) charts at 4m distance, refractive error measured with streak retinoscopy (Heine Optotechnik GmbH & Co. KG, Herrsching, Germany), and foveal thickness measured with OCT (Stratus OCT; Carl Zeiss Meditec, Dublin, CA, USA). Refractive data were presented as the mean spherical equivalent refractive error. For statistical evaluation, the BCVA were converted into logarithm of the minimal angle of resolution (logMAR) format. An improvement or worsening of the postoperative BCVA was defined as a change of more than 0.2 logMAR units.

Statistical Analysis The parameters were presented as mean values ±standard deviations. Postoperative BCVA, refractive error, and foveal thickness were compared with the preoperative ones using paired t-test at each follow-up visit. The main focus was on the results of the 12-month follow-up visit. Statistical analyses were performed with SPSS for windows version 17.0 (IBM Corp., Armonk, NY, USA). A P value less than 0.05 was considered to be statistically significant.

RESULTS

Patient Demographics and Clinical Data Thirty-nine eyes of 39 patients (21 females and 18 males) were recruited in our study. The patients aged from 28 to 56 years old with a mean age of 42.46±5.64 years old. The mean preoperative BCVA, refractive error and foveal thickness were showed in Table 1. The follow-up period was 12mo.

Best Corrected Visual Acuity and Refractive Error At the 12-month follow-up visit, the mean postoperative BCVA was significantly improved compared with the preoperative one (P=0.003). The BCVA was improved in 33 eyes (84.62%), and remained stable in 6 eyes (15.38%). The mean postoperative refractive error was obviously lower than the preoperative one (P=0.002) at the end of the follow-up (Table 1).

Anatomical Outcomes Preoperatively, myopic foveoschisis was detected in all the eyes and the foveal thickness was obviously increased. Twelve months after vitrectomy, OCT showed complete resolution of the myopic foveoschisis and a reattachment of the fovea in 37 eyes (94.87%) and partial resolution in the remained two eyes (5.13%) (Figure 1). The mean postoperative foveal thickness was significantly reduced compared with the preoperative one (P=0.002) (Table 1). During the whole follow-up period, there was no occurrence of full-thickness macular hole or recurrence of foveoschisis.

Postoperative Complications One case (2.56%) had a choroidal detachment that occurred three days after vitrectomy, and was recovery within five days after topical and systemic application of corticosteroids. The IOPs of two patients (5.13%) were 26-28 mm Hg at 7-day follow-up, and dropped to 16-17 mm Hg after carteolol eye drops treatment for about five days. Retinal detachment from a peripheral retinal break occurred in one eye (2.56%) six weeks after vitrectomy. The patient was treated with vitrectomy combined with 16% perfluoropropane gas tamponade, and the retina was flat postoperatively. No other postoperative complications occur during the whole follow-up pierod.

DISCUSSION

We performed PSR combined with vitrectomy for the treatment of myopic foveoschisis and achieved both visual and anatomic improvement. In our current study, complete resolution of myopic foveoschisis was observed in 37 eyes (94.87%) after the surgery. Thirty-three eyes (84.62%) showed obvious improvement of BCVA at the end of the follow-up visit. The results of our current study were similar to those of Mateo *et al*[2]. They performed macular buckling associated with vitrectomy in 36 patients with myopic foveoschisis. Their results showed that visual acuity improved in 30 eyes (83.3%), and remained stable in three eyes (8.3%). However, in their study, three eyes (8.3%) had a decreased visual acuity after surgery and the most frequent postoperative complication was retinal pigment epithelium disturbances around the indented area. The main difference between our technique and theirs was that we used a donor sclera to perform the PSR surgery while they used a hard silicone implant or an Ando plombe. Zhu *et al*[14] performed PSR alone for macular retinoschisis in 24 highly myopic patients. They achieved complete resolution of foveoschisis in 83.33%, however, both recurrence of myopic foveoschisis and full-thickness macular hole were reported during the follow-up period. In our study, the percentage of complete

Table 1 Comparisons of BCVA, refractive error and foveal thickness between pre- and post-PSR combined with vitrectomy for myopic foveoschisis

Parameters	Pre-operation	Post-operation	*P*
BCVA (logMAR)	0.96±0.43	0.46±0.28	0.003
Refractive error (D)	-17.53 ±4.51	-15.13 ±2.55	0.002
Foveal thickness (μm)	389.32±75.56	196.45±36.35	0.002

PSR: Posterior scleral reinforcement; BCVA: Best corrected visual acuity; logMAR: Logarithm of the minimal angle of resolution; D: Diopter.

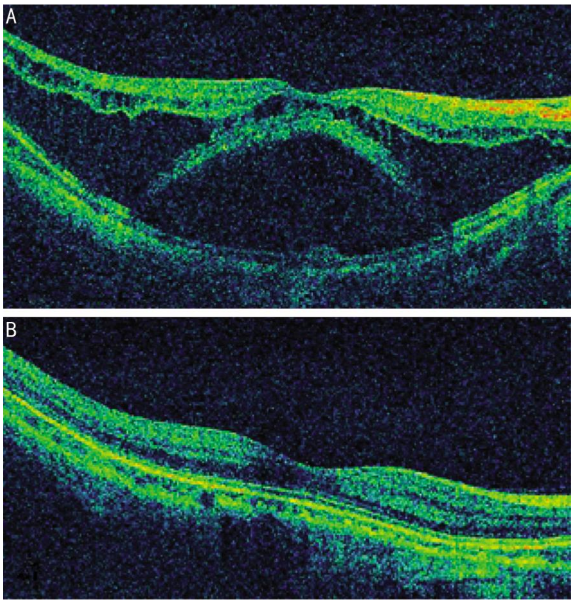

Figure 1 Optical coherence tomographic image of the macula A: Preoperative image of the macula revealed myopic foveoschisis; B: Twelve months after posterior scleral reinforcement combined with vitrectomy, image of the macula revealed the complete resolution of myopic foveoschisis.

resolution of myopic foveoschisis was slightly higher than that of theirs. Furthermore, no full-thickness macular hole or recurrence of foveoschisis occurred in our study. The reason why our results were better may be that our patients underwent additional vitrectomy to remove vitreo-retinal traction. Mii *et al* [20] performed 25-gauge pars plana vitrectomy for the treatment of myopic foveoschisis. Their results showed that the final BCVA in the foveal detachment group improved in 63%, remained unchanged in 31%, and worsened in 6%. In the no-foveal detachment group, the final BCVA improved in 21%, remained unchanged in 71%, and worsened in 8% of the eyes. Postoperative OCT showed a resolution of myopic foveoschisis and a reattachment of the fovea in all eyes during the follow-up period. However, full-thickness macular hole developed in one eye during the follow-up. In our study, more patients had visual improvement and no patients occurred macular hole during the whole follow-up period. The possible reason was that our patients received additional PSR which may decrease the antero-posterior traction due to a posterior staphyloma and thus improving the anatomical situation for the fovea in eyes with posterior staphyloma. We found that six patients whose logMAR BCVA were light perception at baseline remained stable vision during the complete follow-up in our study. We speculated that no-improvement of visual acuity in the six eyes might be limited by their poor preoperative BCVA.

PSR combined with vitrectomy seemed to be a safe and effective option for myopic foveoschisis, since it may remove both internal vitreoretinal traction and the stretching effect exerted by the posterior staphyloma. Qi *et al*[19] evaluated the effect of surgical PSR in extremely myopic patients (axial length 30 mm) with myopic foveoschisis. They found that PSR in association with vitrectomy (*n* =14), as compared with vitrectomy alone (*n* =14), was associated with a higher improvement in visual acuity. But the number of patients included in their study was relatively low. We included 39 patients in our study and the results were similar to those of Qi *et al* [19]. In our study, PSR combined with vitrectomy effectively improved the visual acuity, reattached the macular and reduced the risk of full-thickness macular hole in eyes with myopic foveoschisis. No serious complications occurred during the 12mo of follow-up period in the study.

There were several limitations in our study. The limitations included the retrospective design, lack of control group, the relatively short follow-up period and the relatively small number of patients from a single center. A further study with a control group, a larger sample size and longer follow-up period or a prospective study should be performed to precisely compare the effects of the surgical methods in the future.

In conclusion, our findings suggested that PSR combined with vitrectomy was a safe and effective procedure for myopic foveoschisis with both visual and anatomic improvement. Further studies are needed to determine the long-term safety and effectiveness of this therapy.

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