• Brief Report •

# Treatment of myopic foveoschisis *via* macular buckling and vitrectomy

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## Abstract

**• The aim of the present study was to evaluate the efficacy and safety of the treatment of myopic foveoschisis patients using the macular buckling with L-shaped titanium plate and silicon sponge combined with vitrectomy. The data of the patients who underwent macular buckling combined with vitrectomy was collected. The study recorded the following parameters: best corrected visual acuity (BCVA), axial length, intraocular pressure, central macular thickness, and the position of the titanium plate. Following the surgery, the BCVA of the included patients were improved, whereas the axial lengths were reduced followed by resolution of the foveoschisis compared with that noted prior to the operations. All patients had orbital CT examination and the results indicated that the titanium plates were appropriately placed and were not in contact with the optic nerve. Therefore, it is effective to treat myopic foveaschisis by macular buckling using the L-shaped titanium plate and silicon sponge in the presence of vitrectomy.**

• **KEYWORDS:** myopic foveoschisis; macular buckling; vitrectomy
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## INTRODUCTION

High myopia is one of the most common diseases causing visual impairment worldwide. During disease progression, the axial length of the patient gradually extends, resulting in posterior scleral staphyloma. Thus a series of characteristic changes are caused by chorioretinal atrophy, incomplete posterior vitreous detachment and posterior cortex residues as a result of vitreoschisis. Foveoschisis is one of the common complications of patients with high myopia and posterior scleral staphyloma[1]. Several studies have shown that myopic foveoschisis is a chronic and progressive pathological change. However, it is possible that this condition will not cause symptoms of visual impairment for a long period of time. This is due to the outer layer of the retina not being detached from the retinal pigment epithelium (RPE), resulting in unaltered signal transduction. Therefore, it is advocated that close follow-ups should be conducted for the patients with myopic foveoschisis that present with early stage disease symptoms[2]. However, as the disease deteriorates, the continuous traction from the vitreous body to the macular region, and the posterior scleral expansion that is caused by high myopia, leads to progressive aggravation of the foveoschisis. Consequently, the central fovea retina can detach with lamellar or full-thickness macular hole causing further damage to the cellular photoreceptor function in the macular region and in turn produces serious functional visual impairment[3]. At present, there is no general consensus regarding the ideal timing of surgery. However, it has been suggested that patients with myopic foveoschisis should be operated if their vision and foveal retinal detachment was significantly deteriorated.

The surgical methods adopted for the treatment of myopic foveoschisis mainly include pars plana vitrectomy (PPV) with or without internal limiting membrane (ILM) peeling, and with or without intraocular gas temponade[4-7]. Previous reports demonstrated that, following removal of the traction of the vitreous body and the ILM, a number of factors can drive the further development of foveoschisis. Posterior scleral staphyloma of high myopia is considered one of the most important factors responsible for the postoperative recurrence of myopic foveoschisis[8]. Therefore, certain authors have suggested that posterior scleral reinforcement surgery alone could be sufficient to treat patients with high myopia macular retinoschisis *via* relieving the traction from the posterior scleral staphyloma to the retinal tissue that results in optimal treatment efficacy[9]. Myopic foveoschisis is the combined effect of the posteroanterior tractions that are transmitted on the retinal surface by the vitreous cortex, the ILM and the vascular stiffness, as well the anteroposterior traction exerted by the staphyloma behind the retina. What curative effect could we achieve if we undertake simultaneous treatment against the two kinds of forces acting on the retina?

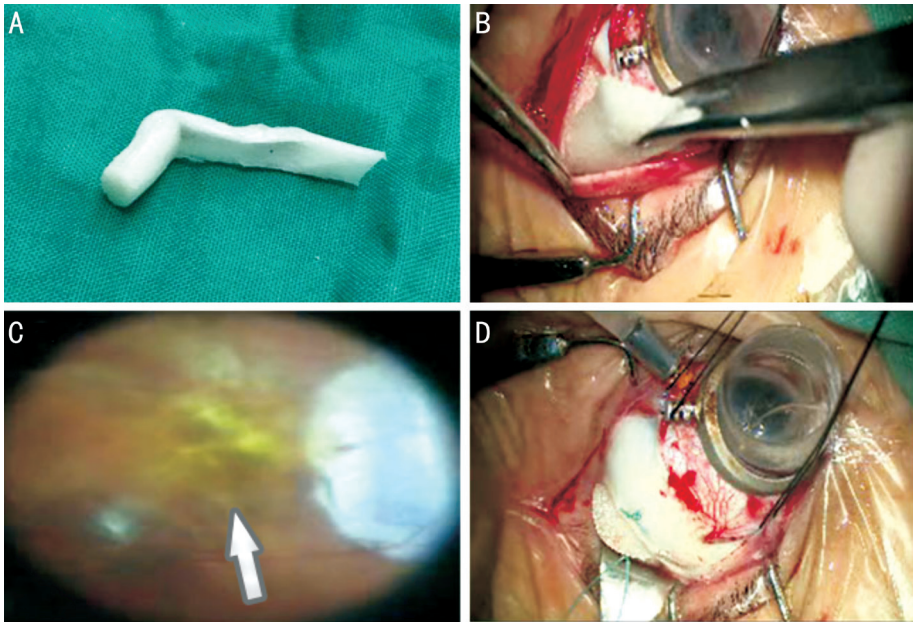


**Figure 1 Macular buckling procedure using L-shaped titanium plate and silicon sponge** A: Fold the titanium plate wrapped with silicon sponge into L shape (head=1 cm, arm=2 cm); B: The L-shaped titanium plate sheathed in silicon sponge (macular buckle) was placed in the superior temporal quadrant; C: Under the direct visualization of the microscope, the uplifting part is the location of the head of the macular buckle, it could avoid the direct contact with the optic nerve (white arrow indicates the head of the macular buckle); D: After desired indentation of the macula was achieved, the tail of the macular buckle was fixed to the sclera with a 5-0 suture.

In the present study, the therapeutic effects and complications of patients with myopic foveoschisis have been reported using the L-shaped titanium plate, sheathed in a silicon sponge for the macular buckling, combined with PPV, ILM peeling and long-acting gas filling.

## SUBJECTS AND METHODS

**Patients** This study conforms to the requirements of the ethics committee of Xiangya Hospital of Central South University. The patients with myopic foveoschisis who had undergone macular buckling with L-shaped titanium plate and silicon sponge combined with vitrectomy at department of ophthalmology of Xiangya Hospital from August 2015 to November 2015 were prospectively analyzed. Surgeries were performed by one experienced surgeon, with 6mo of postoperative follow-up. Inclusion criteria included: high myopia with a spherical equivalent more than -6.0 D and axial length greater than 26 mm, clinical examination indicated evidence of a posterior staphyloma, optical coherence tomography (OCT) demonstrated the presence of extensive macular schisis or foveoschisis associated with foveal retinal detachment.

**Ophthalmic Evaluation** All patients underwent a complete preoperative and postoperative ophthalmic examinations, including measurement of best corrected visual acuity (BCVA) using the 5 m Snellen acuity chart (converted into logMAR for statistical analysis), detection of intraocular pressure (IOP) by Goldmann applanation tonometry. OCT was used to analysis of foveal thickness and IOL Master was adopted to examine ocular axial length. CT scan was performed to detect the location of L-shaped macular buckle postoperatively.

**Surgical Procedure** Under retrobulbar anesthesia, a 360° peritomy was performed and the superior, lateral and inferior rectus muscles were isolated. Subsequently, a standard 3-port 23 G PPV was carried out (core vitrectomy; posterior vitreous detachment following triamcinolone acetonide injection; ILM peeling following injection of approximately 0.2 mL of 0.25% indocyanine green left in place for 30s). The L-shaped titanium plate sheathed in silicon sponge, was placed in the superior temporal quadrant in order to reach the macular region with the indenting head. This maneuver was carried out under the direct visualization of the microscope in order to avoid the direct contact with the optic nerve. The surgeon can slightly move this macular buckle under the microscope to observe that the uplifting part retains the location of the head of the macular buckle. The macular exoplant was sutured to the sclera with a 5-0 suture (Figure 1). Postoperative patients were asked to maintain a prone position for at least 2wk.

**Statistical Analysis** All the data is analyzed and processed by SPSS20.0 statistical package, and the descriptive approach for data measurement is average±standard deviation (±SD). Statistical analysis is made after preoperative and postoperative BCVA has been converted to logMAR vision. Paired *t*-test is adopted in the comparison of the measurement data, and $P<0.05$ indicates that the difference is statistically significant.

## RESULTS

This study includes 7 patients (7 eyes), 3 males and 4 females, right to left eye ratio was 2:5, mean age was 52.57±10.34 (41 to 71)y. The follow-up visits are of 6-month duration. The results

showed that the mean postoperative BCVA (logMAR) was significantly improved compared with that of the preoperative one ($P$=0.004). Meanwhile, the mean postoperative axial length was dramatically shortened than the preoperative one ($P$=0.031) at 6mo after the surgery (Table 1). All patients showed an increased foveal thickness on OCT examination. Myopic foveoschisis with foveal detachment was detected in 5 patients (71.4%). OCT showed that myopic foveoschisis was resolved and the fovea reattached to RPE layer at the end of the follow-up (Figure 2). The mean postoperative foveal thickness was significantly decreased compared with that of the preoperative one ($P$=0.016) (Table 1). All patients had the three-dimensional CT scan on the same day of surgery, which showed the titanium plates were appropriately placed and were not in contact with the optic nerve.

None of the patients had iatrogenic break, macular hole, retinal detachment, rejection reaction of the titanium plates, conjunctival erosion, intolerable pain, muscles injury with diplopia, endophthalmitis or other adverse complications. One patient experienced high IOP one week postoperatively, reaching 41 mm Hg, and two kinds of eye drops (timolol+brinzolamide, apply to the operated eye, twice per day) were used to partially reduce the IOP until it returned to normal. Cataract developed in two patients who underwent uneventful phacoemulsification with IOL implantation 3mo after surgery.

**Table 1 Preoperative and postoperative of BCVA, foveal thickness and length of ocular axis in patients with myopic foveoschisis treated by L-shaped titanium plate and silicon sponge combined with vitrectomy**

| Characteristic | Pre-operation | Post-operation | $P$ |
|---|---|---|---|
| BCVA (logMAR) | 1.55±0.50 | 0.93±0.40 | 0.004 |
| Foveal thickness | 687.66±223.68 | 186.50±158.16 | 0.016 |
| Axial length (mm) | 28.72±1.97 | 27.70±1.74 | 0.031 |

BCVA: Best corrected visual acuity; logMAR: Logarithm of the minimal angle of resolution.

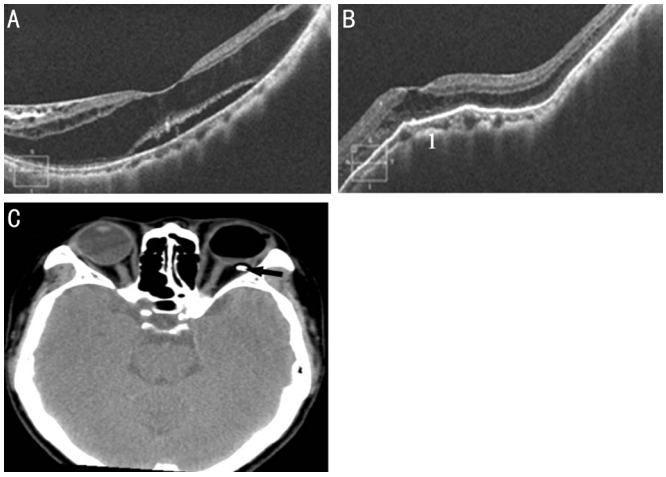


**Figure 2 Image of eyes with myopic foveoschisis** A: Myopic foveoschisis with foveal detachment was demonstrated on OCT examination; B: Postoperative OCT image showed that foveoschisis was resolved and the fovea was reattached by L-shaped macular buckle combined with vitrectomy (1 indicates the position of the macular buckle); C: Postoperative orbital CT indicated that the titanium plates were appropriately placed and were not in contact with the optic nerve (as shown by the black arrow). A complete intraocular gas tamponade in the left eye could also be observed.

## DISCUSSION

To date, different macular buckles have been designed and combined with PPV in order to achieve an optimal therapeutic effect for myopic foveaschisis, such as Ando's plombe (consists of a T-shaped semirigid silicone rubber rod internally reinforced with titanium wires and an indenting head at one end)[10], NBP macular buckling (made up of PMMA material covered by silicone, AJL company) and adjustable macular buckle (made up of silicone rubber)[11]. In the present study, myopic foveoschisis resolved in all cases that were treated by macular buckling procedure using the L-shaped titanium plate and the silicon sponge combined with vitrectomy. The results are consistent with the study by Parolini *et al*[12]. Several factors may explain this high anatomical success rate. Firstly, we reduced the traction in front of the retina, by removing the residual vitreous cortex with the aid of Triamcinilone Acetonide. It has been demonstrated that the traction of the posterior vitreous cortex in patients with high myopia plays an important role in the cause of myopic foveoschisis[13]. The stiff ILM was peeled off in order to improve the retinal elasticity that facilitated the resolution of foveoschisis and readapted the retina to the new posterior shape of the macular region[14]. Secondly, in the forming process of the posterior scleral staphyloma, the sclera expands backwards, producing the traction on the retinal tissues in the centrifugal direction. However, the degenerated retina that is typically observed in high myopia, cannot adapt to the expanded sclera, thereby causing myopic foveoschisis[15]. In the present study, the technique of macular buckling of the L-shaped titanium plate inside silicon sponge was adopted, which can reduce the average ocular axial length of the patients with high myopia by 1 mm, so as to relieve the traction of the posterior scleral staphyloma to the retinal neurosensory layers, and promote the healing of retinoschisis cavities in the macular region.

The findings indicate that postoperative vision of the patients is considered better than preoperative. It is speculated that the absorption of liquid in the schisis cavity can result in the recovery of the macular function. In contrast to this hypothesis, the restoration of the separation of the retinal neurosensory layers contributes to the connection of the photoreceptor cells with the RPE in order to restore visual function. Concomitantly, the titanium plates used in the operations are metallic and although their front ends are wrapped with the silicon sponge, their direct contact with the optic nerves may

damage the visual function of the patients. Therefore, during the implantation of the titanium plate with the silicon sponge, the movement locus of the implantation material that presses the sclera *via* intraocular illumination can be observed. This movement prevents the implantation material from direct contact and potential damage to the optic nerve. In addition, the observation of the postoperative imaging results has not been able to identify the displacement of the titanium plate with the silicon sponge. However, intra-operative high IOP has been observed, which may be associated with the excess of non-specific inflammatory substances following the operations that block the trabecular meshwork. Consequently, an abnormal balance is promoted between the expansibility of the gas C3F8 and the regulatory mechanism responsible for the aqueous fluid of the eyes. A total of two patients developed progressive cataract, which may be associated with the increased inflammatory mediator of the postoperative vitreous cavity that disrupts the metabolism of lens epithelial cells. Furthermore, the gas C3F8 oppressing the posterior capsule of the lens may affect the metabolism of the lens.

In conclusion, the operation of macular buckling of the L-shaped titanium plate and silicon sponge combined with vitrectomy can promote the healing of myopic foveoschisis. It can improve the visual function of the patients and reduce the postoperative complications. Future studies should focus on expanding the sample size of the patients with high myopia in order to observe the postoperative curative effect and complications for a longer period and confirm the safety of the long-term follow-up period.

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