Application of Scleral Fixed Capsular Tension Ring in Surgery for Moderate and Severe Lens Dislocation

Shanjun Wu, Li Cai
Cataract Special Department, Ningbo Eye Hospital, Ningbo 315040, Zhejiang, China
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Abstract: Objective — To investigate the effect of phacoemulsification cataract extraction in patients with moderate or severe lens subluxation with scleral fixed capsular tension ring implantation. Methods — A total of 43 patients (47 eyes) with lens subluxation (scope of dislocation exceeds 120 degrees) underwent phacoemulsification cataract aspiration in our hospital from November 2018 to May 2019. During intraoperative injection/aspiration of the lens cortex, the scleral fixed capsular tension ring was put into the lens capsule, and then the capsular tension ring was fixed on the sclera with sutures to summarize the surgical methods and observe the preoperative and postoperative visual acuity. Pentacam anterior segment analysis system and UBM were used to observe the capsular center and record the related complications. Results — There were statistically significant differences in the distribution of corrected visual acuity before and after operation (P<0.01). The fixations stability of MCTR and intraocular lens proved to be in good condition. There was no IOL displacement and no serious complications after 6 months of observation. Conclusion — The scleral fixed pocket tension ring is a safe and effective method for the treatment of moderate and severe lens dislocation, which can improve the surgical safety, prevent intraocular lens deviation and reduce surgical complications.
***Keywords*:** lens subluxation, phacoemulsification, scleral fixed capsular tension ring, modified capsular tension ring

Introduction

Lens subluxation is a common clinical ophthalmic disease that leads to the displacement of the lens position. It is difficult to operate in lens surgery, which is prone to increase the complication rate. Clinically, the use of capsular tension ring can improve the safety of cataract surgery, effectively prevent vitreous loss, maintain the physiological contour of the capsular, and prevent long-term complications such as IOL tilt[1-2]. Capsular tensional ring (CTR) has been widely used in capsular lens dislocation surgery. However, for patients with a wide range of suspensory ligament loss and lens dislocation, traditional tension ring can not improve the unsatisfactory intraocular lens neutral problem[3-4]. A modified capsular tension ring (MCTR) is required to maintain the stability and neutrality of the IOL. We used MCTR to treat 43 patients (47 eyes) with moderate and severe lens dislocation.The postoperative vision, lens position and complications were observed and the results were satisfactory. The report is as follows.

1. General information

Clinical data were collected from 43 patients (47 eyes) who underwent scleral fixation capsular tension ring implantation in our hospital from November 2018 to May 2019. There were 19 males and 24 females, aged from 4 to 79 years old, with an average age of (52.26±17.93) years old.Besides, 4 patients were under 20 years old and the ages of 2 patients range between 20 and 40 years old. There were 24 patients aged 40 to 60 years and 17 patients aged over 60 years. 22 cases were diagnosed with the disease in right eye and 25 cases with left eye. Preoperative corrected visual acuity: ≥0.5 patients were proved in 4 eyes, 0.3~<0.5 proved in 4 eyes, 0.1~<0.3 diagnosed in 13 eyes, <0.1 in 25 eyes. 1 cased was not clarified in the visual acuity measurement. The suspensory ligament abnormalities ranged from 120° to 180° in 25 cases and 21 eyes. >180°~270° 18 cases, 26 eyes. The causes of dislocation were reviewed: 33 cases of external injury (33 eyes) and 2 cases of Marfan syndrome (3 eyes). Congenital cataract with dislocation of lens: One case (1 eye). The cause was unknown in 10 cases (10 eyes). All patients were informed and agreed to be included in this study, and all signed informed consent.

1.1 Preoperative preparation

Preoperative routine visual acuity, intraocular pressure, anterior segment photography, atrioscopy and A/B ultrasound were performed. Preoperative routine dilated pupil and slit lamp microscope were performed to understand the scope of lens dislocation and the hardness of lens nucleus. The position of iris, ciliary body and lens and the suspensory ligament

of lens were investigated by ultrasonic biometric microscopy (UBM). UBM was combined with atrioscopy to understand the atrioscopy. All patients underwent A/B ultrasound examination before surgery, except retinal detachment or choroid detachment. The IOL degree was calculated by SRK-T formula. MCTR (Type 1G and Type 2S) made by Moller, Germany were implanted. Patients with secondary ocular hypertension were controlled with drugs until the iOP was good and stable for 1 month before surgery.

1.2 Surgical methods

A 2.0mm corneal transparent incision was made at 11 o'clock position at the scleral margin of the affected eye, and an auxiliary incision was made at the 3 o'clock position. An appropriate amount of viscoelastic agent was injected into the anterior chamber, followed by a 5.0mm continuous annular capsulorhexis, water separation and water stratification, and rapid nuclear splitting and intracapsular ultrasound. A tension ring is inserted into the pouch, one arm was fixed with a 10-0 polypropylene ribbon knot-tied and placed on the dislocation side of the lens. The needle was inserted through the ciliary sulcus below the iris and sutured on the scleral wall. The fixed position was 1.5mm behind the margin of the hornsclera. The tightness of the suture was adjusted according to the strength of the residual suspensory ligament and the neutral position of the pouch to reach the appropriate position. The implanted foldable intraocular lens (ALCON SN60WF) was fixed in the pouch. Patients with vitreous prolapse underwent anterior vitrectomy. The primary incision was sutured with one needle, the lateral incision was closed with water, and the bulbar conjunctiva was sutured discontinuously. In this project, MCTR (Type 1G and Type 2S) of Moller Company in Germany is implanted. Type 1G was fixed under the lateral sclera with severe lens dislocation, and Type 2S was sutured under the contralateral sclera with another needle. Routine local anti-inflammatory and mydriatic treatment were given after operation.

1.3 Postoperative follow-up

The best corrected visual acuity, location of capsular complex and postoperative complications were recorded for follow-up after six months of operation .

2. Results

2.1 Postoperative vision

Phacoemulsification, MCTR and IOL implantation were successfully completed in 47 eyes of lens subluxation patients. Postoperative corrected visual acuity was improved in 10 eyes (≥0.5), 9 eyes (0.3~<0.5), 10 eyes (0.1~<0.3) and 8 eyes (<0.1). There was significant difference in the distribution of corrected visual acuity before and after operation (x^2=13.472, P=0.006).

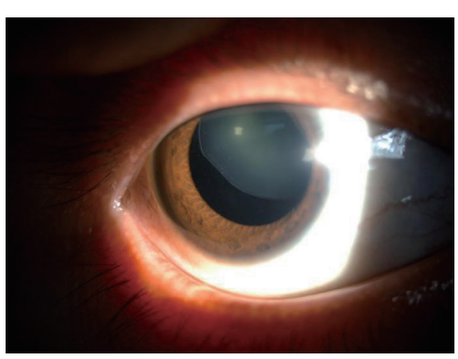

Figure 1. The lens is dislocated upward of the nose, with a range greater than 210° with posterior iris septum

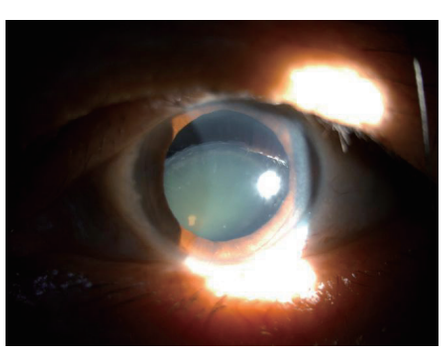

Figure 2. The lens is shifted downward with a range greater than 150°and iridotromos

2.2 Position of lens after surgery

Iol tilt and placement neutrality: Image measurements and objective analysis of iOL tilt and neutral position were obtained using the Pentacam Anterior Segment analysis system (Oculus, USA). Image analysis IOL was neutral and MCTR fixed hook was stable between iris and lens capsule. No IOL displacement was observed at 6 months.

2.3 IOL loop and MCTR position

The position of the IOL and MCTR was observed by ultrasound in vivo microscope (UBM SE-3200, Tianjin Suowei Electronic Technology Co., Ltd.). The results showed that the IOL and MCTR were located in the capsular of the lens in all patients, and the fixing hook of MCTR was located between the iris and the capsular membrane in a stable position, which was kept at a certain distance from the back of the iris. There is no friction and damage to iris.

3. Postoperative complications

Early postoperative complications (within 1 month): Postoperative transient intraocular hypertension (IOP) occurred in 1 eye. The pouch tension ring was removed on the second day after the operation, and the iOP was well controlled. Postoperative long-term complications (within 1-6 months): posterior capsular opacity occurred in 2 eyes, and Nd: YAG laser posterior capsulotomy was performed in 1 eye. There were no serious complications such as explosive choroid hemorrhage, nuclear plunge into vitreous body and capsular tear.

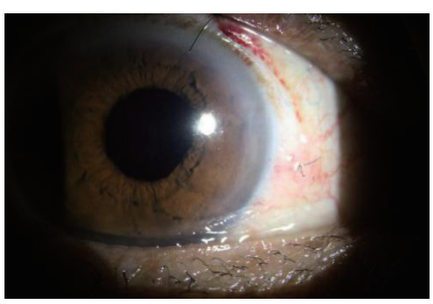

Figure 3. Two weeks after implantation of scleral fixable pouch tension ring, the intraocular lens is in positive position and the scleral sutures were observed

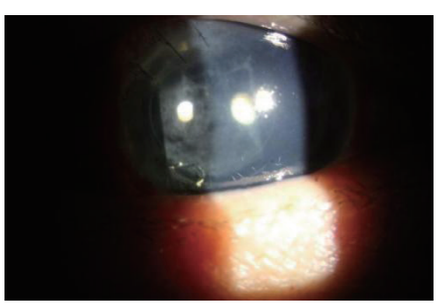

Figure 4. Two months after scleral fixable sac tension ring implantation, the IOL was in position and posterior capsular opacity was observed after pupil expansion

4. Discussion

Lens subluxation is a group of diseases in which the lens position changes due to partial rupture of the suspensory ligament of the lens caused by congenital or mechanical forces, which is relatively common in clinic[5]. According to the quadrant of the involvement of the suspensory ligament of the lens, mild abnormalities were classified into one inner quadrant (< 120°). Moderate anomalies ranged from 1 to 2 quadrants (120° to 180°). Severe anomalies were in 2~3 quadrants (>180°~270°) [6].

As the conjunctive evidence of phacoemulsification, the traditional methods of treatment for lens incomplete resection are to remove the dislocated lens in or out of the capsular and fix the posterior chamber IOL with scleral suture or implant the anterior chamber IOL[7]. These surgical methods demonstrated severe damage to intraocular tissue, leading to postoperative IOL tilt, secondary glaucoma, corneal endothelial decompensation, macular cystoid edema and other serious complications[4,8]. The appearance of CTR makes the implantation of intracapsular folding intraocular lens to be realized, which can enable IOL in a physiological position and achieve good visual effects[9]. However, for patients with moderate

and severe lens subluxation with a wide range of lens dislocation and severe suspensory ligament damage, the effect of traditional tension ring is limited[10].

The most difficult problem for patients with moderate and severe lens subluxation surgery to overcome is how to maintain the stability of the dislocated lens capsule and how to avoid further damage to the suspensory ligament of the lens[11]. Because of the fluid flow of phacoemulsification, cleavage and nuclear rotation during phacoemulsification may aggravate the injury of the suspensory ligament of the lens. If CTR implantation alone is performed, the IOL capsular complex is still eccentric after surgery, and the capsular contraction may further worsen the suspensory ligament injury of the lens, or the progression of the disease may lead to further fracture of the suspensory ligament of the lens, resulting in complete dislocation of the IOL capsular complex and fall into the vitreous body, leading to blindness[12-13].

Our experience in the operation is summarized as follows. 1. To master the timing of implantation of capsular tension ring: (1) After continuous capsular tearing; (2) After phacoemulsification of the lens nucleus; (3) After the extraction of the cortex. 2. To pay attention to the operation points of scleral fixed capsular tension ring surgery: (1) To keep good continuity of the capsulorhexis; (2) To keep the size of the front mouth in moderate range, excessively small size may lead to the overstretching of the edge of the capsular, otherwise, slip of the tension ring and capsular tear can occur; (3) When pupil dilation is not ideal, iris retractor should be used to assist surgery in time; (4) Minimizing the operation of fixing tension ring on ciliary sulcus under blind sight to avoid damage to ciliary iris tissue.

The other 4 patients in this group (Disengagement went beyond the 180 degrees) were treated with modified tension ring with 2 scleral fixation holes (2S-MCTR), which were successfully implanted. Our experience is as follows. (1) Successful and reasonable application of capsulorhexis and viscoelastic agent is very important. Meanwhile, capsulorhexis can be used to increase the identification of capsulorhexis to facilitate the capsulorhexis operation. The middle capsulorhexis generally ranged between 5.0~5.5mm, which is convenient for CTR implantation and stability. (2) When severe lens dislocation occurred, the iris hook should be used as far as possible. On the one hand, the pupil should be enlarged to expose the misaligned lens to complete capsuloravy. On the other hand, the hanging capsular should be lifted to maintain the center and stability of the intraoperative capsuloravy. (3) The parameters of phacoemulsification should be adjusted appropriately, such as reducing negative pressure and flow to facilitate safe operation. (4) The flexible C loop foldable IOL should be selected for IOL implantation, and the loop type or straight plate integrated IOL with large elastic difference should be avoided as far as possible to avoid the injury of suspensory ligament under pressure again during IOL implantation.

The results of this study show that the sclera can fix the capsular tension ring, making the surgical procedure of patients with moderate and severe subluxation of lens over 120 degrees more simple and safe. As a result, the postoperative visual acuity is significantly improved ($P < 0.01$) with fewer complications. In addition, imaging observations and measurements of IOL showed good stability and positivity, and good visual effects were obtained. Meanwhile, the use of scleral fixable capsular tension ring reduced the risk of redislocation of IOL capsular complex caused by progressive and aggravated suspensory ligament abnormalities after surgery, and more perfect surgical results were obtained.

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