

Comparison of 25-gauge sutureless vitrectomy and 20-gauge vitrectomy in the treatment of posterior capsule opacification in pseudophakic children

Xiao-Ming Wu^{1,2}, Li-Xin Xie²

¹Qingdao University Medical College, Qingdao 266071, Shandong Province, China

²Shandong Eye Institute, Qingdao 266071, Shandong Province, China

Correspondence to: Li-Xin Xie. Shandong Eye Institute, 5 Yanerdao Road, Qingdao 266071, Shandong Province, China. lixin_xie@hotmail.com

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Abstract

• **AIM:** To compare the effectiveness and safety of pars plana capsulotomy and vitrectomy using 25-gauge transconjunctival sutureless vitrectomy system and 20-gauge vitrectomy system for posterior capsule opacification (PCO) in pseudophakic children.

• **METHODS:** Retrospectively study. Pars plana capsulotomy and vitrectomy using 25-gauge sutureless vitrectomy system was performed for PCO in the study group (32 eyes). Patients in the control group (34 eyes) underwent capsulotomy and vitrectomy using standard 20-gauge vitrectomy system, providing a comparison between 2 groups with regard to preoperative and postoperative best corrected visual acuity (BCVA), intraocular pressure (IOP), and intraoperative and postoperative complications. The two groups were performed consequentially. The patients ages ranged from 2 to 13y (means: $6.61 \pm 2.73y$). Surgical technique, intraoperative and postoperative complications, visual acuity, IOP, and recurrent PCO were recorded.

• **RESULTS:** The surgical procedure was performed uneventfully in all patients. Visual acuity improved significantly in both groups. BCVA improved in 22 eyes (81.5%) in the study group and in 28 eyes (87.5%) in the control group. There was no statistical difference of visual acuity that were attainable in two groups ($H=0.115$, $P=0.909$). Mean postoperative IOP showed no significant difference between the groups at 1wk. All sort of PCO were accomplished by 20-gauge system, while 25-gauge system was effective for pearls style and 2 grade of fibrous PCO, and was insufficient to grade 3 of PCO. In the study group two cases were not accomplished by 25-gauge system while 20-gauge system conquered

them. Compared with the control group, mean operative time for opening and closing the sclerotomy in the study group was considerably reduced. The mean follow-up was 38.2mo (range: 8-79mo). During the follow-up period, no incision leakage, corneal edema, vitreous loss, IOL damage, retinal detachment, recurrent PCO, or other complications were noted.

• **CONCLUSION:** Pars plana capsulotomy and vitrectomy using 25-gauge transconjunctival sutureless vitrectomy appeared to be a safe and effective approach for PCO in pseudophakic children. Combined sutureless surgery needed shorter setup time for sclerotomy and caused less surgical trauma than combined surgery with 20-gauge vitrectomy. Therefore, this type of procedure would be a good option for selected cases with PCO in pseudophakic children.

• **KEYWORDS:** posterior capsular opacity; vitrectomy; cataract; children

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INTRODUCTION

Currently, posterior capsule opacification (PCO) is the most common complication after cataract extraction in children, especially with untouched capsule. Though primary capsulectomy combined with anterior vitrectomy and optic incarnation may inhibit the prevalence of PCO. Despite the use of these techniques, PCO remains a major complication of cataract extraction and IOL implantation in young children. Neodymium doped yttrium aluminum garnet (Nd:YAG) has been used to manage PCO in children, though the effect was undesirable, especially in the young. Capsulotomy is the thorough method to remove PCO in children. With the development of new methods and equipment, various processes emerges. We modified the process of capsulotomy and vitrectomy using 25-gauge vitrectomy system to manage PCO, and compared it with the clinical outcomes using standard 20-gauge vitrectomy system.

SUBJECTS AND METHODS

This study was performed with informed consent and following all the guidelines for experimental investigation in human subjects required by the Institutional Review Board/Ethics Committee. Medical records of pseudophakic pediatric eyes with PCO undergoing pars plana capsulectomy and vitrectomy between June 2003 and December 2008 at our institution were reviewed. Sixty-six eyes of 60 patients were enrolled in the study after the patients met the following criteria: all eyes had undergone cataract extractions and primary IOLs were implanted. They all had PCO and had been removed by pars plana capsulotomy and vitrectomy with 20-gauge vitrectomy system (Accurus 400VS; Alcon laboratories, Fort Worth, TX, USA) or 25-gauge transconjunctival sutureless vitrectomy system (Accrus 800CS, Alcon Laboratories, Fort Worth, TX, USA). PCO in all eyes involved the visual axis, resulting in a decrease in visual acuity.

Every case was evaluated by the PCO criteria of Kruger *et al*^[1]. That is, the capsule behind the optic was evaluated within a central area measuring 3.0 mm in diameter, and it was graded as 0=absent; 1=very mild; 2=moderate; 3=dense white. A distinction was made between fibrosis and Elschnig regenerates. Each form of PCO, fibrosis and Elschnig regenerates, was graded semiquantitatively from 0 to 3. The posterior segment was checked by UBM and B scan.

Surgical Technique All surgeries were performed by one surgeon (Xie LX). General anesthesia or peribulbar anesthesia was used according to children's cooperation. The surgical process of 25-gauge vitrectomy system: Preoperatively, the pupil was dilated with 0.5% tropicamide and 0.5% phenylephrine hydrochloride (Mydrin-P; Santen, Osaka, Japan). A 1-mm clear corneal incision was made at the 3-o'clock of the limbus. A point was ascertained at 10 o'clock from the limbus according to the patient's age^[2]. After the sclera was fixed using a toothed forceps, a microvitrectoretinectomy (MRV) blade was used to make a sclerotomy through the pars plana area at the point. A vitrectomy cutter (Accurus 800CS; Alcon, USA) was introduced into anterior vitreous through the sclera, and an opening diameter 3.0-4.0 mm was created in the center of posterior capsule using the vitrectomy cutter. The vacuum aspiration was set at 250 mm Hg, the cutting rate at 1200 cuts per minute. After removal the opaque posterior capsule, the vitrectomy cutter was removed without suture. Before completion the procedure, balanced salt solution was injected in anterior chamber to maintain intraocular pressure (IOP) from the 3-o'clock clear corneal incision.

The surgical procedure of 20-gauge vitrectomy system has been described before^[3]. Simply described like this: after a

3-mm conjunctival incision was made in superotemporal quadrant at the 11 o'clock position approximately posterior to the limbus followed by electrocautery for stanching. Then a 1-mm clear corneal incision was made near 2 o'clock limbus, and an infusion was inserted into the incision affiliated to BSS. Then a 20-gauge vitrectomy cutter (Accurus 400VS; Alcon laboratories, Fort Worth, TX, USA) was introduced into anterior vitreous and removed the center of opaque posterior capsule, diameter 3.0-4.0 mm also. The cut rate was set 750 cuts per minute, and the vacuum aspiration was set 200 mm Hg, and the bottle height at 60 cm. After complete removal of the opaque posterior capsule and anterior vitreous, the vitreous cutter and the infusion cannula were removed from the eye. The scleral incision was sutured with 10-0 nylon sutures and the conjunctival wound was closed by electrocautery.

Major Outcome Measures In both groups, the major outcome measures were preoperative and postoperative best corrected visual acuity (BCVA), IOP, intraoperative and postoperative complications, and the facility of performance. Visual acuity was tested using the Snellen chart and was converted into a logarithm of the minimum angle of resolution score for analysis. IOP measurements in the eye having surgery were obtained preoperatively and at 1, 3, 7d using an application tonometer (Tono-pen XL, Medtronic Solan). Hypotony was defined as an IOP of less than 8 mm Hg. Recurrent PCO, retinopathy and reoperation were also noted.

RESULTS

Sixty patients (66 eyes) were included in our study. There were 39 boys and 21 girls with a mean age of 6.61 ± 2.73 y (range: 2-13y). The primary diagnosis included 38 cases (44 eyes) of congenital cataract and 22 cases (22 eyes) of traumatic cataract. The mean period between IOL implantation and PCO formation was 24.91 ± 24.33 mo (varied 1 to 99mo). Twenty-eight patients (32 eyes) has been performed capsulectomy during primary IOL implantation, and 32 cases (34 eyes) with untouched capsule, among which three cases underwent Nd:YAG capsulectomy ever.

All patients achieved a capsular hole diameter 3-4 mm, and a transparent visual axes. Preoperative visual acuity ranged hand motions at 10 cm to 20/40. Postoperatively, forty-four patients (50 eyes, 75.8%) were recovered to the best level of preoperation, 9 patients (9 eyes, 13.6%) remained unchanged, and another 7 patients (7 eyes, 10.6%) were not cooperative enough to perform visual acuity testing by Snellen chart. None was worse than preoperation. In the study group, median preoperative BCVA was 20/200 (range 20/40 to counting fingers), and median postoperative BCVA at 1wk was 20/60 (range 20/20 to counting fingers). Postoperative BCVA improved in 22 of 27 eyes (81.5%), remained

Table 1 Comparison of BCVA of two systems before and after pars plana capsulotomy and vitrectomy

| BCVA | Control group | | Study group | |
|----------|---------------|---------------|--------------|---------------|
| | Preoperative | Postoperative | Preoperative | Postoperative |
| | n (%) | | | |
| ≤0.05 | 13 (40.6) | 4 (12.5) | 8 (29.6) | 5 (15.3) |
| 0.05-0.1 | 6 (18.8) | 4 (12.5) | 8 (29.7) | 1 (3.7) |
| 0.1-0.3 | 6 (18.9) | 12 (37.5) | 9 (33.3) | 10 (37.0) |
| 0.3-0.5 | 6 (18.1) | 4 (12.5) | 2 (7.4) | 3 (11.1) |
| >0.5 | 1 (3.1) | 8 (25.0) | 0 (0.0) | 8 (29.6) |
| Total | 32 | 32 | 27 | 27 |

unchanged in 5 eyes (19%). In the control group, median preoperative BCVA was 20/200 (range 20/25 to counting fingers), and median postoperative BCVA at 1wk was 20/80 (range 20/20 to counting fingers). Postoperative BCVA improved in 28 of 32 eyes (87.5%), remained unchanged in 2 eyes (12%). There was a statistically significant difference between preoperation and postoperation at 1wk totally. There were no significant difference between two groups, whether preoperation ($H=0.031$, $P=0.976$), postoperation 1wk ($H=0.115$, $P=0.909$) (Table 1).

The mean preoperative IOP was 14.91 ± 3.59 mm Hg (range 9-21 mm Hg) in the control group, and was 16.12 ± 4.15 mm Hg (range 9-21 mm Hg) on the first postoperative day. Transient high postoperative IOP was noted in 1 patient, and was cured with brimonidine eyedrops in three days. The mean IOP was 14.41 ± 3.06 mm Hg (range 9-21 mm Hg) and 14.82 ± 2.44 mm Hg (range 11-19 mm Hg) at 3 and 7d, respectively. Compared with preoperative IOP, there was no significant difference in IOP at 1, 3, 7d ($t=1.573$, 0.872 , 0.142 , $P=0.125$, 0.389 , 0.888).

In the study group, the mean preoperative IOP was 13.84 ± 3.48 mm Hg (range 9-21 mm Hg), and was 14.47 ± 4.87 mm Hg (range 4-22 mm Hg) on the first postoperative day. Hypotony was noted in 2 patients, and spontaneously recovered 3d later. The mean IOP was 14.94 ± 3.24 mm Hg (range 9-21 mm Hg) at 3, 7d, respectively. Compared with preoperative IOP, there was no significant difference in IOP at 1, 3, 7d ($t=0.795$, 2.027 , 1.403 , $P=0.433$, 0.051 , 0.171). All kind of PCO were completed by 20-gauge vitrectomy system, whereas transconjunctival sutureless vitrectomy (TSV)-25 couldn't conquer 2 PCO patients derived from traumatic cataract with serious fibrogenesis, and had to alter to 20-gauge vitrectomy cutter to accomplish the procedure. All other patients were uneventfully finished (Table 2).

The facility of both operational procedure was noted. The TSV-25 needs shorter setup time because there was no need to make sclerotomy for infusion than 20-gauge vitrectomy system. During the operations, the anterior chamber was more stable and quiet, there was no IOL damage, IOL dislocation. During the following-up period, there were no

Table 2 Distribution of different degrees PCO (eye)

| Groups | 1 degree | 2 degree | 3 degree | Total |
|---------------|----------|----------|----------|-------|
| Control group | 3 | 14 | 17 | 34 |
| Study group | 3 | 17 | 12 | 32 |
| Total | 6 | 39 | 21 | 66 |

corneal edema, retinal detachment, vitreous hemorrhage, macular edema and recurrent PCO *etc.*

DISCUSSION

PCO is a common problem after cataract extraction in children, especially in young children. Although the Nd:YAG laser posterior capsulotomy can be used to treat PCO, but because turbidity will be formed again in a few months, so the results are unsatisfactory^[4]. In addition, young patients usually cannot cooperate with the procedure, and it led to IOL damage. And more energy was required for dense PCO and more the risk of IOL damage. Therefore, surgical treatment of PCO in some cases is necessary, especially in young patients.

With the wide using of pars plana posterior capsulotomy to manage secondary cataract, pars plana capsulectomy and vitrectomy for PCO emerged. Xie and Huang^[3], Cacciatori and Arpa^[5] and Moreno-Montanes *et al*^[6] modified the procedure through lateral corneal incision for infusion, which is not only easy to operate, but also avoid a large number of infusion fluid directly into the vitreous cavity, hydration, swelling vitreous body and avoid vitreous incarceration.

In recent years, with TSV-25 have been gradually applied in clinical, the advantages of TSV-25 gradually being recognized. TSV-25 has the merits of high cutting rate, less aspiration flow, can cut vitreous gel regularly, and reduce the drag and vibration of vitreous body, then reduce the risk of retinal detachment. Because of exquisite vitrectomy cutter, TSV-25 decreases the convalescence period, the operating time, and the postoperative inflammatory response versus 20-gauge vitrectomy system^[7]. The technique was applied to the treatment pediatric cataract by some authors^[5,6,8-10]. In 2005, Biglan^[8] modified TSV-25, using non-infusion technique to perform posterior capsulotomy and anterior vitrectomy in pediatric cataract. It made anterior chamber more stable, vitreous disturbance slighter, learning curve shorter, and easier to master. In 2009, Xie and Huang^[11] performed posterior capsulotomy through pars plana using TSV-25 without infusion in pediatric cataract surgery. In the procedure only one scleral incision was required that simplified the surgical procedure and minimized surgically induced trauma further. We improved the technique and applied the non-infusion vitrectomy technique in the treatment of PCO in children.

Traditional posterior capsulotomy *via* pars plana need 2 scleral incisions, for infusion and vitrectomy cutter using 20-gauge vitrectomy system^[12]. Xie and Huang^[3] modified the technique and removed PCO *via* pars plana capsulectomy and vitrectomy with an infusion through sutureless clear cornea. But compared with the dimension of pediatric eye, 20-gauge vitrectomy cutter is still thick, and need suture, which may cause vitreous incarceration and retinal detachment.

Chang *et al*^[13] demonstrated the TSV-25 needs shorter setup time for sclerotomy and causes less postoperative ocular irritation than 20-gauge vitrectomy system. Small-incision, sutureless operation is of great advantage to both patients and surgeons.

In our opinion pars plana anterior vitrectomy is different from the full-vitrectomy, because vitreous base is not completely removed, so the infusion of balanced salt solution need to be controlled in the application of 20-gauge vitrectomy system for anterior vitrectomy. Otherwise, high infusion would lead to vitreous prolapse from the scleral incision increasing the potential risk of retinal detachment, while low infusion will lead to collapse of the eye, increasing the risk of eye injury. Owing to the smaller vitrectomy port and less aspiration flow compared with the conventional 20-gauge vitrectomy system, there is less risk of collapse of the eye in the operation. And the slight hypotony can reduce the vitreous herniation in theory. To maintain IOP, BSS can be injected in anterior chamber through corneal incision when a long time is needed for cutting. So only one scleral incision is adequate and another scleral incision for infusion can be omitted.

Clearly, there remain shortcomings that need to be improved with regard to the TSV-25 system, on count of the small aperture of the cutting probe and low aspiration flow, as with the other vitrectomy instruments, aspiration of rigid or inelastic tissue into the aperture may be difficult or requires using alternate cutting instruments. 20-gauge vitrectomy cutter has the relatively thicker diameter and can cut denser fibrosis. Therefore, 20-gauge vitrectomy system has a wider scope of application. In our study 20-gauge vitrectomy system was suitable for all types and degree of PCO, from pearl type to dense fibrous one, with a matching scleral puncture knife, and had a more wide adaptability. In contrast, TSV-25 system is handier to the treatment of mild to moderate PCO, but is more difficult for three-degree fibrous PCO. In our study, TSV-25 failed in two cases of PCO happened after traumatic cataract surgery which were classified into 3 degree fibrin-type. Although scleral paracentesis knife had cut the posterior capsule into stripes, but TSV-25 still cannot remove the fibrous tissue, and had to altered to 20-gauge vitrectomy cutter. So proper selection of

patients is essential to the successful use of TSV-25. In recent years with understanding of mechanisms of PCO increasing significantly, PCO occurrence has decreased, at least the severity has been reduced. The application of 20-gauge vitrectomy system will be greatly reduced, then TSV-25 should have more opportunities.

Transient postoperative hypotony is one of the common complications of sutureless 25-gauge vitrectomy in adults^[14-16]. However, last studies have not found incision leakage and sustained hypotony^[5,6,8-11], which confirmed the safety of 25-gauge vitrectomy system in clinical. In the studies of 25-gauge sclerotomy healing process *in vivo* with ultrasound biomicroscopy (UBM)^[11,17,18], it was found that 25-gauge puncture scleral incision was mostly unable to detect within 15d postoperatively, and at 30d almost all would not be detected, while 20-gauge incision took up 6-8wk^[17]. Two cases of TSV-25 group in our study exhibited hypotony on the first postoperative day, which was 4 and 6 mm Hg respectively. Under close observation, the IOP of these 2 cases was normalized within 3d spontaneously. There was no hypotony case in 20-gauge vitrectomy group. Although there was no detectable leakage in these cases, but we thought the incisions without suture was a possible cause^[9]. To prevent hypotony and wound leakage, some authors recommended some measures, including oblique scleral sclerotomy^[19], conjunctival coverage of the sclerotomies^[13], and retaining some vitreous around the sclerotomies^[20].

The results of pars plana capsulotomy and vitrectomy for PCO showed their safety and effectiveness with the 20-gauge vitrectomy system and TSV-25. Pars plana capsulotomy and vitrectomy, especially with regard to the TSV-25, is relatively new to most ophthalmic surgeons. We suggest that less dense cases with softer fibrous PCO or pearl type PCO be considered as initial candidates. Developing a strong learning curve and proper selection of patients are essential to the successful use of this type of procedure. Pars plana capsulotomy and vitrectomy without infusion using the 25-gauge vitrectomy system appears to be a good choice for anterior segment surgeons in the treatment of slight PCO in pseudophakic children.

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