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Safety and efficacy of 25G anterior vitrectomy in glaucoma and cataract with extremely shallow anterior chamber

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25G 前段玻璃体切除术治疗极浅前房青光眼合并白内障的疗效和安全性

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摘要

目的:观察巩膜瓣下 25G 前段玻璃体切除术在超声乳化联合小梁切除术治疗极浅前房青光眼合并白内障中的安全性及有效性。

方法:回顾性分析 18 例 18 眼青光眼合并白内障患者(8 例男性,10 例女性),其中 11 眼为原发性急性闭角型青光眼,7 眼为晶状体半脱位继发青光眼。所有患者经保守治疗后眼压不能控制,均接受白内障超声乳化并人工晶状体植入术、小梁切除术及巩膜瓣下前段玻璃体切除术。主要观察指标为最佳矫正视力、前房深度、眼压、裂隙灯显微镜、降眼压药物、眼底及并发症情况。

结果:患者平均眼轴为 21.5±0.6 mm,平均年龄为 62.3±7.9 岁。术前平均前房深度 0.78±0.43 mm,术后 1wk 平均前房深度 2.89±0.41 mm($P<0.001$)。术后 1wk 平均眼压 16.72±6.28 mmHg,较术前平均眼压 43.28±9.38 mmHg 显著下降($P<0.001$)。均未发生如眼内炎、视网膜脱离、脉络膜上腔出血、角膜内皮失代偿、恶性青光眼等并发症。

结论:巩膜瓣下 25G 前段玻璃体切除术在超声乳化联合小梁切除术治疗极浅前房青光眼合并白内障是安全有效的。

关键词:前段玻璃体切除;前房深度;眼内压

Abstract

• AIM: To observe the safety and efficacy of the 25G anterior vitrectomy surgical technique *via* scleral flap in phacoemulsification combined with trabeculectomy for glaucoma and cataract with extremely shallow anterior chamber.

• METHODS: This retrospective case review consisted of 18 eyes of 18 patients (8 males and 10 females), of those, 11 eyes had acute angle-closure glaucoma with angle-closure greater than 180 degree, and 7 eyes had lens subluxation combined with glaucoma. All 18 patients underwent phacoemulsification, intraocular lens (IOL) implantation, trabeculectomy, and anterior vitrectomy *via* the scleral flap in cases where conservative management techniques cannot control intraocular pressure (IOP). The main outcomes were best corrected visual acuity (BCVA), anterior chamber depth (ACD), IOP, slit-lamp microscopic examination, number of medications, fundus examination, and complications.

• RESULTS: The average axial length (AL) was 21.5±0.6 mm. Mean age was 62.3±7.9 years. Mean ACD increased significantly from 0.78±0.43 mm to 2.89±0.41 mm 1wk after surgery ($P<0.001$). Mean IOP decreased significantly from 43.28±9.38 mmHg to 16.72±6.28 mmHg ($P<0.001$). No serious complications, such as endophthalmitis, retinal detachment, suprachoroidal hemorrhage, corneal decompensation, and malignant glaucoma were observed.

• CONCLUSION: 25G anterior vitrectomy *via* scleral flap is a safe and effective technique for glaucoma and cataract with extremely shallow anterior chamber.

• KEYWORDS: anterior vitrectomy; anterior chamber depth; intraocular pressure
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INTRODUCTION

Glaucoma with crowded anterior chamber and cataract is a surgical challenge for ophthalmologists, which may lead to a series of complications, such as lens dislocation, corneal endothelial decompensation, iris prolapse, and posterior capsular rupture[1-2]. The mechanism of the narrow anterior chamber could be aqueous misdirection syndrome. Anterior vitreous is displaced forward so that it faces against the ciliary

body and lens, preventing normal aqueous humor flow[3]. The posterior pressure increases with the accumulation of aqueous humor in the posterior segment, which leads to the anterior displacement of the iris-lens diaphragm and extremely shallow anterior chamber[2,4-5]. The core step of the treatment is to re-establish the anterior chamber to provide more space for the surgical procedure and to allow for free diffusion of the aqueous humor from the vitreous to the anterior chamber. However, the anterior chamber depth (ACD) cannot be deepened easily even if viscoelastic agents are injected during surgery[6]. Chandler *et al*[7] first described the technique of vitreous aspiration with an 18G needle *via* a pars plana incision to form the anterior chamber. The technique was later abandoned due to the high incidence of cataract and the risk of retinal detachment. With the development of technology, vitrectomy with microincision has been widely used in ophthalmology. A previous study demonstrated the effectiveness of partial pars plana vitrectomy (PPV) in malignant glaucoma[1]. Zhang *et al*[8] also verified that 23G transconjunctival PPV combined with pars plana lensectomy (PPL) was helpful for glaucoma patients with cataract and shallow anterior chamber.

In our study, we used 25G anterior vitrectomy *via* scleral flap in phacoemulsification and trabeculectomy for glaucoma combined with cataract with extremely shallow anterior chamber to solve the problem of anterior chamber formation during the surgical procedure.

SUBJECTS AND METHODS

Ethical Approval The study was performed in accordance with the Declaration of Helsinki and approved by the Ethics Committee. This retrospective consecutive, non-randomized study consisted of 18 eyes of 18 patients (11 eyes with acute angle-closure glaucoma with angle-closure greater than 180 degree, and 7 eyes with lens subluxation combined with glaucoma) that had undergone treatment in the hospital between May 2016 and October 2020. All patients with extremely narrow anterior chamber and uncontrolled intraocular pressure (IOP) had no response to conventional medical therapy or laser iridotomy. Six of the 18 eyes had undergone YAG laser iridectomy. The patients underwent comprehensive examinations, including slit-lamp microscope, gonioscopy, best corrected visual acuity (BCVA), IOP, optical coherence tomography (OCT), corneal topography, A-scan ultrasound biometry, ultrasound biomicroscope (UBM), corneal endothelial cell count, HRT III, visual field examination and B-scan ultrasonography. The ACD and the anterior chamber angle were observed by UBM. ACD was defined as the distance between the posterior surface of the cornea and the anterior surface of the lens. Axial length (AL) and central corneal thickness (CCT) were obtained by A-scan ultrasound biometry. BCVA was measured using the LogMAR chart. The lens nucleus was graded from 2 to 4 using the Lens Opacity Classification System (LOCS III). The postoperative follow-up time was 6mo for all patients.

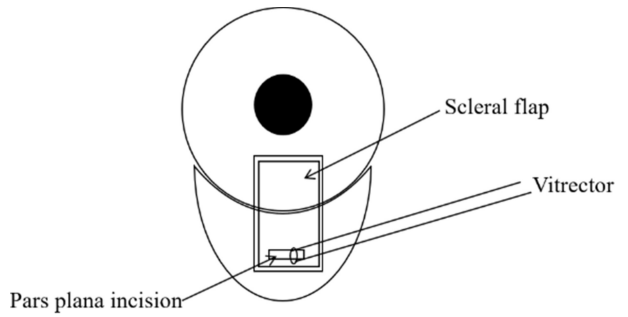

Figure 1 The site of 25G anterior vitrectomy *via* the scleral flap during the surgical.

Surgical Procedure All surgeries were performed by a skilled ophthalmologist. After successful local anesthesia, we made a conjunctival flap with the base of the fornix, then created a 3 mm×5 mm scleral flap, with a depth that was half of the scleral thickness. The anterior chamber was difficult to deepen even though the viscoelastic agent was injected through a self-sealing clear corneal incision. A pars plana incision 4.0 mm posterior to the limbus was made with a corneal cutter (about 20G) under the scleral flap. Then 25G anterior vitrectomy was performed through this incision (Figure 1). During the operation, we observed the outflow of aqueous fluid from the posterior chamber to the incision. After this pathway was created, the eyeball softened as the posterior pressure decreased, and the anterior chamber was easily deepened. Then, capsulorhexis, phacoemulsification, and intraocular lens (IOL) implantation were performed successfully. Trabeculectomy and iridectomy were subsequently performed. Four patients with subluxation were implanted with a capsular tension ring. The conjunctival and scleral flap were sutured with 10-0 nylon sutures. During the 25G anterior vitrectomy, no infusion or illumination was required. The scleral incision required no stitches.

Postoperatively, the patients received a standard treatment protocol, including tobramycin dexamethasone, eyedrops, and nonsteroidal anti-inflammatory eye drops, four times a day for 4wk. All the glaucoma medications were discontinued. Additional therapeutic measures were taken, if necessary. Postoperative examinations were arranged 1wk, 1mo, 3mo and 6mo after surgery. Additional follow-up visits were scheduled, depending on the condition.

Statistical Analysis Data were analyzed using SPSS software version 18.0. Normal distribution was assessed with the Kolmogorov-Smirnov test. A one-way analysis of variance (ANOVA) and Fisher's Least Significant Difference (LSD) *t*-test was used to analyze the differences among the groups. A *P*-value of <0.05 was considered to be statistically significant.

RESULTS

Basic information is presented in Table 1. The IOP varied from 29.0 mmHg to 58.0 mmHg before surgery, with a mean pressure of 43.28±9.38 mmHg (Table 2). The IOP was 16.72±6.28 mmHg 1wk after surgery, which decreased significantly. IOP was 14.94±5.17 mmHg, 14.28±4.13 mmHg and 14.60±3.90 mmHg 1mo, 3mo and 6mo after surgery,

Table 1 Participant demographics

Parameters	Mean±SD	Range
Gender (M:F)	8:10	
Age, y	62.3±7.9	46.0-73.0
AL (mm)	21.5±0.6	20.0-23.2
CCT (μm)	500±25	450-590

AL: Axial length; CCT: Central corneal thickness.

Table 2 Data of IOP and ACD before and after surgery

Parameters	IOP (mmHg)			ACD (mm)		
	Mean±SD	Range	*P*	Mean±SD	Range	*P*
Preoperative	43.28±9.38	29.0-58.0	<0.001	0.78±0.43	0.1-1.5	<0.001
1wk	16.72±6.28	5.0-28.0	<0.001	2.89±0.41	2.2-3.5	<0.001
1mo	14.94±5.17	7.0-25.0	<0.001	2.97±0.26	2.2-3.5	<0.001
3mo	14.28±4.13	8.0-21.0	<0.001	3.0±0.29	2.6-3.5	<0.001
6mo	14.60±3.90	7.0-21.0	<0.001	3.0±0.20	2.5-3.6	<0.001

IOP: Intraocular pressure; ACD: Anterior chamber depth.

Table 3 Data of best corrected visual acuity before and after surgery

Parameters	Visual acuity (LogMAR)		
	Mean±SD	Range	*P*
Preoperative	1.06±0.39	0.7-1.7	
1wk	0.66±0.24	0.3-1.0	<0.001
1mo	0.68±0.25	0.3-1.0	<0.001
3mo	0.62±0.21	0.3-0.9	<0.001
6mo	0.62±0.20	0.3-1.0	<0.001

respectively. We observed a significant increase in ACD, the preoperative mean ACD was 0.78±0.43 mm, the postoperative mean ACD was 2.89±0.41 mm, 2.97±0.26 mm, and 3.0±0.29 mm, and 3.0±0.20 mm respectively, during the follow-up time periods (Table 2). The BCVA was significantly improved in all cases (Table 3). No glaucoma medications were used in all patients after surgery. And no serious complications occurred during the follow-up time.

DISCUSSION

Glaucoma with extremely shallow anterior chamber and cataract is a complex clinical problem. High IOP and narrow anterior chamber for a long period of time may lead to severe visual impairment and decompensation of the corneal endothelium, thus increasing the risk of iris prolapse, capsular rupture, suprachoroidal hemorrhage, crystal dislocation, endothelial damage, and malignant glaucoma[1-2,9]. It has been reported that ciliary or pupillary blockage resulting in the forward displacement of the lens-iris diaphragm is the main mechanism of narrow anterior chamber[6,10]. When medical or laser treatment fails to induce IOP, surgical intervention becomes necessary. The main focus of the procedure is determining how to overcome the difficulties of surgery in the presence of high IOP and an extremely shallow anterior chamber.

Chandler[7] first described the technique of vitreous aspiration with an 18G needle *via* a pars plana incision. As the technology has developed, microincisional vitrectomy surgery (MIVS) has been widely used in clinical practice, with the advantages of shorter operation time, faster wound healing, less trauma, and less postoperative inflammation. Previous studies have confirmed that PPV is effective for softening the eye and deepening the anterior chamber by removing the anterior vitreous[11-13]. Sharma *et al*[1] described vitrectomy-phacoemulsification-vitrectomy for the management of malignant glaucoma. In this procedure, three pars plana incision were made. However, besides the pars plana incision *via* the scleral flap, no other incision or infusion was required in our surgery. He *et al*[14] also confirmed the clinical efficacy of modified partial PPV with zonulohyaloidectomy and phacoemulsification for malignant glaucoma after trabeculectomy or cataract surgery. Zhang *et al*[8] verified that 23G transconjunctival PPV and PPL were beneficial to glaucoma and cataract patients with narrow anterior chamber. But none of the eyes was implanted with IOL in their study. Owing to the 23G vitrectomy system, ultrasonic fragmatome was not available. Therefore, eyes with lens nucleus more than grade 4 or harder were considered as contraindication. But 47.1% of eyes needed glaucoma medications during the follow-up time, because the reconstruction of aqueous humor outflow path was not successful.

In our study, all the patients with high IOP and shallow anterior chamber that had no response to medical therapy or laser iridotomy required surgical intervention. However, the anterior chamber is difficult to deepen during surgery. At the beginning of surgery, 25G anterior vitrectomy was performed under the scleral flap to reduce the positive posterior pressure. Consequently, the eyeball softened and the anterior chamber deepened significantly. Based on previous experience, we suggested that the approximately 0.5 mL of the vitreous should be removed[15]. Matlach *et al*[16] recommended continuing to vitrectomy until the anterior chamber deepened, intraoperatively. Then, due to the availability of more space,

phacoemulsification, IOL implantation, and trabeculectomy can be performed, decreasing the risks associated with surgery. In our study, the anterior chamber was formed and postoperative IOP was well controlled. The mean IOP was 14.60±3.90 mmHg 6mo after surgery with no need of glaucoma medications, and its stability was maintained. At the final visit (6mo after surgery), the anterior chamber remained stable with a mean depth of 3.0±0.20 mm. The BCVA had improved in all 18 patients. No serious complications, such as endophthalmitis, retinal detachment, suprachoroidal hemorrhage, anterior chamber disappearance, corneal decompensation, and malignant glaucoma, occurred. A combination of anterior vitrectomy, phacoemulsification and trabeculectomy not only saves times, but also reduces the financial burden of multiple operations. According to our data, this technology was effective and safe in reforming the anterior chamber, decreasing the IOP and improving vision.

This technology has several advantages over other techniques. First, it reduces the disturbance of the conjunctiva and sclera, promoting faster wound healing and less inflammation. Second, the scleral incision requires less time, and no stitches are needed. Third, it also reduces the incidence of malignant glaucoma. Aqueous fluid from the posterior chamber flows into the anterior chamber to reduce IOP. Fourth, only one 25G vitreous cutter is used during vitrectomy. No precorneal contact lenses, fiberoptic illumination probe, or infusion are required, which can be easily operated on by an anterior segment surgeon. It is hoped that our experience will help simplify this operation and achieve satisfactory results. This study had some limitations. First, it was not possible to obtain all the preoperative corneal endothelium data, glaucomatous cup and visual field findings due to corneal edema and poor quality of credibility. Second, this study was a retrospective case review, not a controlled study. Third, follow-up was short, further research with longer follow-up is required.

In conclusion, 25G anterior vitrectomy *via* the scleral flap in phacoemulsification combined with trabeculectomy is safe and effective for glaucoma combined with cataract with extremely shallow anterior chamber. Further research with a larger sample size and longer follow-up is required to verify the safety and efficacy of this technology.

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