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Efficacy of modified folding intraocular lens suspension surgery in treatment of traumatic dislocation of lens

Ya-Guang Hu, Xi Qiao*, Xuan Liu, Jian-Qin Lei, An-Ming Xie, Jing-Ming Li, Wan-Hu Zhang*

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Department of Ophthalmology, the First Affiliated Hospital of Xi'an Jiaotong University, Xi'an 710061, Shaanxi Province, China

Co-first authors: Ya-Guang Hu and Xi Qiao

Correspondence to: Wan - Hu Zhang. Department of Ophthalmology, the First Affiliated Hospital of Xi'an Jiaotong University, Xi'an 710061, Shaanxi Province, China. wanhuzhang@163.com

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改良折叠式人工晶状体悬吊术治疗外伤性晶状体脱位

胡亚光*,乔 茜*,刘 轩,雷剑琴,谢安明,李晶明,张万虎

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作者单位:(710061)中国陕西省西安市,西安交通大学第一附属医院眼科

*:胡亚光和乔茜对本文贡献一致。

作者简介:胡亚光,毕业于中山大学,博士,住院总医师,研究方向:眼外伤与眼眶眼整形;乔茜,西安交通大学在读硕士研究生,规培医师,研究方向:玻璃体视网膜疾病。

通讯作者:张万虎,毕业于兰州大学,本科,副主任医师,研究方向:晶状体疾病. wanhuzhang@163.com

摘要

目的:评价改良折叠式人工晶状体(IOL)悬吊治疗外伤性晶状体脱位的手术技术。

方法:前瞻性随机对照研究。共15例患者接受了改良折叠式IOL悬吊手术。其中,9例患者选择了Akreos AO IOL,使用聚丙烯缝线穿过IOL的环状襻,经巩膜引导穿刺后,缝合线末端热膨胀固定在巩膜。6例患者选择了Tecnis ZA9003 IOL,未使用缝合线,巩膜穿刺引导IOL襻穿出巩膜后,直接将IOL襻末端热膨胀固定在巩膜内。观察所有患者的最佳矫正视力(BCVA,LogMAR)及术后并发症。

结果:研究共纳入15例患者,其中男7例,女8例,平均年龄64.00±9.85岁,平均病程5.80±3.17wk。人口统计学和基线临床特征之间没有显著差异。接受改良折叠式IOL悬吊手术后,所有患者视力均有明显改善。术后3mo,患者的BCVA(LogMAR)从1.28±0.56改善至0.52±0.30。其中,选择Akreos AO IOL患者的BCVA(LogMAR)从1.39±0.62改善至0.59±0.25,选择Tecnis ZA9003 IOL患者的BCVA(LogMAR)从1.12±0.45改善至0.42±0.35。此外,在我们的研究中没有观察到严重的术后并发症。仅1例患者IOL脱位,IOL光学面轻度倾斜。

结论:改良折叠式IOL悬吊手术具有良好的视觉效果和预后,无严重并发症,是IOL悬吊手术的有效选择。

关键词:人工晶状体悬吊术;晶状体脱位;巩膜固定术

Abstract

• AIM: To evaluate the efficacy of modified folding intraocular lens (IOL) suspension surgery in treatment of traumatic dislocation of lens surgery technique.

• METHODS: Prospective randomized controlled study. A total of 15 patients underwent the modified folding IOL suspension surgery. Among them, 9 patients chose Akreos AO IOL, and polypropylene sutures were used to thread the haptics of IOL. After guided to puncture out through the sclera, the ends of sutures were thermal expanded and fixed in the sclera. And 6 patients chose Tecnis ZA9003 IOL and no sutures were used. After guided the haptics to puncture out through the sclera, the ends of haptics were thermal expanded and fixed in the sclera. The best corrected visual acuity (BCVA, LogMAR) of all patients and postoperative complication were observed.

• RESULTS: This study included 15 patients, among them, 7 were male and 8 were female, the mean age was 64.00±9.85 years old, the mean course of diseases was 5.80±3.17 wk. There were no significant differences between the demographic and baseline clinical characteristics. After underwent the modified folding IOL suspension surgery, visual acuity of all patients were obviously improved. After 3mo of the surgery, the BCVA (LogMAR) of patients were improved from 1.28±0.56 to 0.52±0.30. More specifically, the BCVA (LogMAR) of patients who chose Akreos AO IOL were improved from 1.39±0.62 to 0.59±0.25, and those who chose Tecnis ZA9003 IOL of the BCVA (LogMAR) were improved from 1.12±0.45 to 0.42±0.35. Furthermore, there was no severe postoperative complication observed in our study. Only one patient suffered IOL dislocation and the IOL optical surface was mild oblique.

• CONCLUSION: Modified folding IOL suspension surgery technique resulted in good visual and outcomes with no severe complication, making it an effective option for IOL suspension surgery.

• KEYWORDS: intraocular lens suspension surgery; dislocation of lens; scleral-fixated technique
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INTRODUCTION

Traumatic dislocation of lens is a common complication of ocular blunt trauma, and it may lead to loss of vision, glaucoma, vitreous hemorrhage and retinal detachment[1-2]. So, the patients with traumatic dislocation of lens should receive surgery as soon as possible. Instead of implanting the intraocular lens (IOL) into the capsular bag, IOL suspension surgery is preferred in treatment of traumatic dislocation of lens. The IOL must be fixated in alternative sites of the eye globe, for example, in the iris or the sclera[3-4]. Surgical options includes anterior chamber IOL, iris claw IOL, iris sutured IOL and scleral-fixated posterior chamber IOL which are either sutureless or use suture or glue[5-8]. In recent years, most ophthalmologists prefer the surgery for suture IOL in posterior chamber[9-10]. However, the surgery is complex and it is prone to the postoperative complications, such as slip off, breakage and degradation of the suture. Our study conducts a modified folding IOL suspension surgery in treatment of traumatic dislocation of lens. Suspension with polypropylene suture with no sewing, even suspension with no suture was used in the surgery. The modified surgery efficiently improved the postoperative visual acuity, reduced the surgical injury, lowers the surgical difficultly and avoids the post-operation complications.

SUBJECTS AND METHODS

Subjects There were 15 patients included in this study. The inclusion criteria were listed as follows: 1) The patients were suffered traumatic dislocation of lens would like to receive folding IOL suspension surgery; 2) The best corrected visual acuity (BCVA) was better than uncorrected visual acuity (UCVA); 3) Pupil diameter was less than 5 mm under natural light. The exclusion criteria were listed as follows: 1) The patients were suffered traumatic retinopathy or severe eye traumas; 2) The patients who had a history of keratitis, glaucoma, retinopathy or some other eye diseases; 3) The patients who underwent ophthalmic surgery before. This study was conducted from January 2020 to February 2021 in the department of ophthalmology, the First Affiliated Hospital of Xi'an Jiaotong University. The study was approved by the ethics review committee of Xi'an Jiaotong University and was conducted in accordance with the Declaration of Helsinki. We obtained informed consent from each subject for all examinations and procedures.

IOL Selection Two aspheric folding IOL were selected in our study. One was Akreos AO, a single-piece IOL, it had four circular haptics. Another was Tecnis ZA9003, a triplicate-pieces IOL, which was made of polymethyl methacrylate. The haptics of Tecnis ZA9003 were robust and would not kink or break easily. Additionally, even when the haptics had been bent acutely, they would return to their original configuration. The detailed characters of the two IOL were shown in Table 1. All the patients selected one type by themselves, based on the personal preference, such as the materials, price and brand.

Preoperative Managements All the patients received complete physical examination, including blood coagulation, blood pressure, blood glucose and cardio-pulmonary function, in order to make sure that they could sustain the ophthalmic surgery. Then, complete ophthalmic examinations were performed, including parameters of cornea and corneal endothelium, fundus image, ocular A/B-ultrasound and so on. The IOL degrees were measured by IOL Master 700 and target degree was set as -0.5D. SRK-Ⅱ formula was used. The visual acuity was measured by Snellen visual acuity chart and recorded using five-grade notation. Besides, patients used levofloxacin eye drops for 12 times and received rinsing lacrimal passage before the surgery. The same ophthalmologist performed all of the surgeries.

Modified Surgical Technique When Akreos AO IOL was used, we first marked the patient carefully and ensured that the four marks were exactly 180° apart and exactly the same distance from the limbus. Then we threaded two unilateral haptics of Akreos AO with 5-0 polypropylene sutures. Then, 27-gauge syringe needle was used to guide the polypropylene sutures to puncture out through the sclera (1.5 millimeter behind the corneal limbus). The direction was started from posterior chamber to the ocular surface. After four sutures were all appropriately placed, the ends of sutures were thermal expanded with thermal cautery set. As a result, the sutures were fixed in the sclera (Figure 1).

When Tecnis ZA9003 IOL was used, we first marked the patient carefully and ensured that the two marks were exactly 180° apart and exactly the same distance from the limbus. Then we implanted Tecnis ZA9003 into anterior chamber. Then, 27-gauge syringe needle was used to make two incisions on the sclera (1.5 millimeter behind the corneal limbus). The haptics of Tecnis ZA9003 were guided and puncture out from the sclera incision with intraocular microforceps. After two haptics were both appropriately placed, the ends of haptics were thermal expanded with thermal cautery set. As a result, the haptics were fixed in the sclera (Figure 2).

Statistical Analysis SPSS 17.0 software (SPSS Inc, Chicago, IL, USA) was used for statistical analysis. Results are expressed as $\bar{x} \pm s$. The data was normally distributed. Two

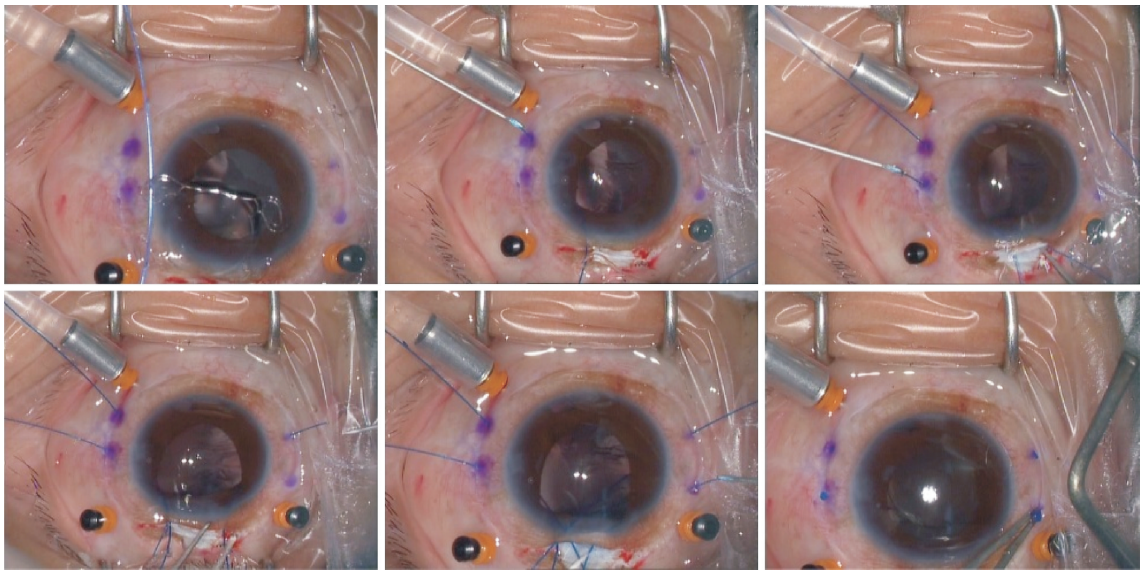

Figure 1 Modified folding IOL suspension surgery with Akreos AO IOL (5-0 polypropylene sutures).

Table 1 Characters of Akreos AO and Tecnis ZA9003

IOL types	Pieces	Materials	Feature	Optic diameter (mm)	Spherical Aberration (μm)	Constant
Akreos AO	Single	Disk: Acrylate Haptics: Acrylate	Hydrophile	6	0	118.0
Tecnis ZA9003	Triplicate	Disk: Acrylate Haptics: Polymethyl methacrylate	Hydrophobicity	6	-0.27	118.8

IOL: intraocular lens.

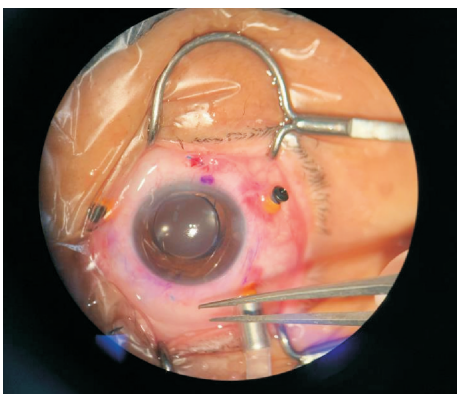

Figure 2 Modified folding IOL suspension surgery with Tecnis ZA9003 IOL (no sutures).

independent groups were compared by Student's t test and Chi-square test. P values < 0.05 were considered to be statistically significant.

RESULTS

Demographic and Baseline Clinical Characteristics of the Patients The demographic and baseline clinical characteristics of the patients (age, gender, course of disease and IOL type) were shown in Table 2. And the preliminary analysis was shown in Table 3. There were 9 patients chose Akreos AO IOL and 6 patients chose Tecnis ZA9003 IOL. There was no significant difference between each group (P>0.05).

Clinical Characteristics of Patients After Surgery After the surgery at 1 and 3 mo , we observed BCVA (LogMAR) of the patients. At 1mo post-surgery, the BCVA (LogMAR) of all patients was 0.59±0.28. The BCVA (LogMAR) of patients who chose Akreos AO was 0.68±0.23, and those who chose Tecnis ZA9003 was 0.43±0.31. At 3mo post-surgery, the BCVA (LogMAR) of all patients was 0.52±0.30. The BCVA (LogMAR) of patients who chose Akreos AO was

Table 2 Demographic and baseline clinical characteristics of the patients

Patients	Age (years)	Gender	Course (wk)	BCVA (LogMAR)	IOL
1	62	Female	5	0.5	Akreos AO
2	82	Female	8	1.0	Akreos AO
3	66	Female	7	1.7	Akreos AO
4	54	Female	5	1.1	Akreos AO
5	55	Male	1	0.5	Akreos AO
6	69	Male	9	2.0	Akreos AO
7	72	Female	6	2.0	Akreos AO
8	50	Female	6	1.7	Akreos AO
9	69	Male	2	2.0	Akreos AO
10	55	Male	5	2.0	Tecnis ZA9003
11	74	Male	12	1.1	Tecnis ZA9003
12	55	Male	3	0.8	Tecnis ZA9003
13	54	Male	8	0.9	Tecnis ZA9003
14	77	Female	1	1.1	Tecnis ZA9003
15	66	Female	9	0.8	Tecnis ZA9003

BCVA: best corrected visual acuity; IOL: intraocular lens.

Table 3 Preliminary analysis of demographic and baseline clinical characteristics of the patients

Parameters	Total	Akreos AO	Tecnis ZA9003	*P*
Numbers of patients (*n*)	15	9	6	
Age ($\bar{x}\pm s$, years)	64.00±9.85	64.33±10.14	63.50±10.33	0.88
Gender (Male∶Female)	7∶8	3∶6	4∶2	0.20
Course of disease ($\bar{x}\pm s$, wk)	5.80±3.17	5.44±2.60	6.33±4.08	0.61
BCVA ($\bar{x}\pm s$, LogMAR)	1.28±0.56	1.39±0.62	1.12±0.45	0.38

BCVA:best corrected visual acuity.

0.59±0.25, and those who chose Tecnis ZA9003 was 0.42±0.35. Visual acuity of all the 15 patients was significantly enhanced at 1 and 3mo after the modified folding IOL suspension surgery (all $P<0.05$; Figure 3). Meanwhile, the duration of surgery dramatic declined.

Observation of Postoperative Complications We observed the postoperative complications 3mo after the surgery, which including IOL dislocation, corneal endothelial edema, pupillary block and hemorrhage (Table 4). There was one patients suffered a mild IOL dislocation. The IOL optical surface was mild oblique. Besides, there was no severe complication occurred.

Table 4 Postoperative complications after modified folding IOL suspension surgery *n*

Parameters	Total	Akreos AO	Tecnis ZA9003
Numbers of patients	15	9	6
IOL dislocation	0	0	1
Corneal endothelial edema	0	0	0
Pupillary block	0	0	0
Hemorrhage	0	0	0

IOL:intraocular lens.

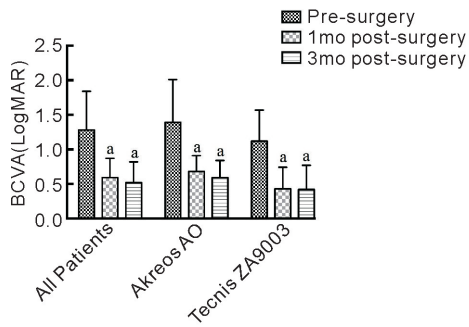

Figure 3 The BCVA of patients improved significantly after modified folding IOL suspension surgery $^{a}P<0.05$ *vs* pre-surgery.

DISCUSSION

Intrascleral IOL haptic fixation via a double-needled, flanger haptic technique (Yamane technique) was first described by Yamane and colleagues[11]. It had been used as a replacement for a dislocated IOL or as rescue therapy when the lens were dislocated. The technique has been popularized but two issues still existed, the suture remains over the sclera and the knot, due to its thickness, it was not easily buried inside the eye, and it often requires enlargement of sclerotomy, making leakage more frequent.

In the past decades, efforts have been made to avoid IOL incline or decentring, increase suture longevity, and minimize complications[12-13]. In our study, we presented two modified folding IOL suspension surgery technique and overcame the problems of leakage. Two kinds of IOL including Akreos AO and Tecnis ZA9003 were used. We chose Akreos AO because it had four annular haptics, and we could thread 5-0 polypropylene sutures through the haptics. Furthermore, after the polypropylene sutures were guided and puncture out through the sclera, the ends of sutures were thermal expanded to fix in the sclera. This modified scleral fixation of IOL without sewing obtained a lower risk of suture exposure, and reduced the operating time because it avoided intricate surgical techniques. In 2020, Canabrava *et al*[14] reported a four-flanged intrascleral IOL fixation technique. He used 5-0 polypropylene suture and a bipolar cautery to fixate the IOL. Our study also used four flanged. The difference was that we thread 5-0 polypropylene sutures through the annular haptics and the four flanged were all fixed in the sclera. Obviously, four haptics could achieve more stable IOL fixation. The second surgery technique with Tecnis ZA9003 in our study further avoided suture. The haptics of Tecnis ZA9003 were guided and puncture out from the sclera incision. Then, the ends of haptics were thermal expanded and fixed in the sclera. The risk of suture erosion, exposure and breakage were thorough eliminated, and it further reduced the operating time.

Loosened or broken sutures might lead to malposition of IOL, which was one of the severe complications in IOL suspension surgery. A study with an intra-scleral fixation technique reported a 12.5% to 24% IOL dislocation[15-18]. The visual acuity would decrease and it had a higher risk of physical contact with the iris and corneal endothelium. Besides, suture erosion could induce inflammation and increase risk for endophthalmitis[19-20]. One reason of IOL dislocation was that the suture knots between suture and loop were not firm, and the suture was slipped. Another reason was the degradation and breakage of the suture. In our study, only one patient showed IOL dislocation during the investigation stage. The IOL optical surface was mild oblique. We guessed that it was caused by the weak fixation. The other nine patients who chose Akreos AO avoided this problem well. Moreover, it might due to the relatively short follow-up period in our study. Severe postoperative complications were not evident in our study, such as intraoperative hyphema, vitreous hemorrhages and secondary glaucoma[21]. But we still asked all the patients

in our study to visit subsequently every 3mo. Another possible long-term complication which we had not encountered to date was exposure of the haptic tips. In our study, the ends of sutures were thermal expanded with thermal cautery set. It was blunt and no easily punched out through the conjunctiva.

To sum up, the results of our study showed that modified folding IOL suspension surgery technique resulted in good visual and outcomes with no severe complication, making it an effective option for IOL suspension surgery.

In conclusion, our study conducts a modified folding IOL suspension surgery with no sewing or no suture. It efficiently improved the postoperative visual acuity, reduced the surgical injury, lowers the surgical difficultly and avoids the post-operation complications.

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