· Original article ·

Effect of toric intraocular lens to treat corneal astigmatism during cataract surgery

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Abstract

• AIM: To evaluate toric intraocular lens (IOL) implantation as a treatment of regular corneal astigmatism during phacoemulsification.

• METHODS: Forty - seven eyes in 41 patients with cataract and corneal astigmatism had toric IOL (22 eyes) or spherical IOL (25 eyes) implantation during phacoemulsification. Outcome measures were uncorrected distance visual acuity (UDVA), best - corrected distance visual acuity (BCDVA), postoperative refractive cylinder, toric IOL axis rotational stability and complications.

• RESULTS: Six months postoperatively, the mean UDVA was (0.73±0.37) in toric IOL group and (0.47±0.18) in spherical IOL group; the UDVA was better than 0.50 of 81.8% and 32.0% in two groups, respectively. The residual astigmatism was (0.53±0.40)D in toric IOL group and (2.13±0.76)D in spherical IOL group. The mean toric IOL misalignment was (4.22±1.46) degrees.

• CONCLUSION: Implantation of toric IOL during cataract surgery is effective, predictable and safe in correcting corneal astigmatism.

• KEYWORDS: cataract; astigmatism; toric intraocular lens
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INTRODUCTION

The direction of modern cataract surgery is refractive correction. Approximately 19% of patient in cataract have combination with corneal astigmatism. Spherical refractive address will not achieve the best postoperative visual outcomes in this kind of patients. In these years, many kinds of toric intraocular lens (IOL) provide an opportunity to address astigmatism at the time of cataract surgery to achieve the best distance vision in patients with cataract and corneal astigmatism. The purpose of this study was to evaluate the visual and refractive outcomes after implantation of Acrysof SN60TT toric IOL.

MATERIALS AND METHODS

Subjects This study enrolled 41 patients (47 eyes) that had cataract surgery and implantation of a toric IOL or spherical IOL between January 2010 and May 2011 at the First Hospital of Wuhan City. Twenty-two eyes received toric IOL (AcrySof Toric, Alcon, Inc.) and 25 eyes got a spherical IOL (AcrySof IQ, Alcon, Inc.) implantation. Exclusion criteria were shorter than 22.0mm in axis of eye, more than 0.50D change of astigmatism in 3 months preoperatively, iris abnormalities, irregular pupil, glaucoma, retina or optic nerve disease, previous surgery in the eye.

Methods

Preoperative exam Preoperatively, all patients had an extensive ophthalmic examination consisting of logMAR uncorrected distance visual acuity (UDVA), slit - lamp, intraocular pressure, fundoscopy, B ultrasonic. Corneal topography and pachymetry were obtained by Scheimpflug scanning-slit analysis (Pentacam, Oculus, Inc.). Eye axis and the spherical power of IOL were calculated by optical biometry (IOLMaster, Carl Zeiss Meditec AG) using SRK/Ⅱ formular. The goal in all patients was emmetropia to -0.5D myopia.

Calculation of toric IOL cylinder power and alignment axis The toric IOL cylinder power and alignment axis were calculated using a web - based toric IOL calculator program (www. acrysoftoriccalculator. com). In all patients, the keratometry (K) values of the optical biometer were used for toric IOL calculation. The incision location was according to surgeon's preference. The expected amount of surgically induced astigmatism (SIA) was -0.25D. The following 3 Acrysof toric IOL models were examined in this study: SN60T3, SN60T4, and SN60T5. SN60T3 was used in patient with astigmatism of corneal plane less than 1.5D, SN60T4 in case of 1.5 - 2.5D, SN60T5 in case of more than 2.5D, respectively.

Marking steps Thirty minutes preoperatively, the patient sit upright to the slit-lamp, the narrow rays of light and knob of slit-lamp were used to check the degrees. Corneal reference marks were placed at 0°, 180° and alignment axis obtained from toric calculator program.

Surgery After topical anesthesia was administered, standard phacoemulsification (Infiniti, Alcon, Inc.) was performed though a 3.0mm sclera limbal incision. In case of toric IOL

implantation, toric IOL was implanted and rotated to its final position by aligning the marks on toric IOL with alignment axis marks on cornea.

Postoperative exam Postoperative examinations were performed more than 6 months and included UDVA, CDVA, subjective and objective refractions, slit-lamp evaluation, Scheimpflug scanning-slit analysis and optical biometry. The orientation of toric IOL axis was determined at slit-lamp. The work of mark, surgery and observe of IOL rotation was done by one surgeon.

Statistical Analysis Data analysis was performed using SPSS for Windows (version 13.0, SPSS Inc.). t-test was used to compare difference between two groups. $P < 0.05$ was considered statistically significant.

RESULTS

Preoperative Population There were no statistically significant difference between toric IOL group and spherical IOL group preoperative in patient demographics and preoperative data.

Visual Acuity Postoperative UDVA results were shown in Table 1. There were significant differences between two groups at 1 week, 1 month and 6 months ($P<0.05$). Six months postoperatively, 5 eyes (22.7%) got UDVA better than 0.8 in toric group, 18 eyes (81.8%) better than 0.5 compared with 8 eyes (32.0%) in spherical group.

Residual Astigmatism Residual astigmatism postoperatively was shown in Table 2. Residual astigmatism in toric group was significantly lower than that in the spherical group ($P<0.05$).

Misalignment The mean toric IOL misalignment was (3.96±1.34)° at 1 week, (4.02±1.37)° at 1 month and (4.22±1.46)° at 6 months after surgery. Nineteen eyes (86.3%) had rotation less than 5° at the last time of review.

Table 1 Postoperative UDVA in toric IOL andspherical IOL groups $\bar{x}\pm s$

Groups	1 week	1 month	6 months
Toric IOL	0.64±0.21	0.78±0.34	0.73±0.37
Spherical IOL	0.45±0.17	0.51±0.24	0.47±0.18
P	<0.05	<0.05	<0.05

Table 2 Postoperative residual astigmatism in toric IOL and spherical IOL groups $\bar{x}\pm s$

Groups	1 week	1 month	6 months
Toric IOL	0.51±0.36	0.47±0.39	0.53±0.40
Spherical IOL	2.06±0.63	1.98±0.82	2.13±0.76
P	<0.05	<0.05	<0.05

DISCUSSION

As the development of microsurgery technique for cataract and production technics of IOL, spherical diopter can be corrected exactly. Cataract surgery goes into one kind of refract surgery. Toric IOL provide an opportunity to achieve the best distance vision and spectacle independence in patient with cataract and corneal astigmatism. It is more effective, predictive and less injury, compare with limbal relaxing incisions[1,2].

Postoperative residual refractive cylinder mainly comes from the astigmatism of corneal, which is combined from corneal astigmatism before surgery and SIA (surgically induced astigmatism). A web-based toric IOL calculator program calculate the cylinder power and alignment axis according to the preoperative corneal astigmatism, SIA, incision direction. Some studies showed good outcomes usingAcrysof toric IOL[3-6]. The residual astigmatism in toric group was significantly lower than that in spherical group. In this study, the residual astigmatism in toric group was significantly lower than that in spherical group in different time of review ($P<0.05$). Several toric IOL models are available[7-10]. Acrysof SN60TT (Alcon Laboratories, Inc.) were used in many studies to correct low to moderate corneal astigmatism during cataract surgery. In our study, we used SN60T3, SN60T4, SN60T5, cylinder powers at the IOL plane were 1.5D, 2.25D, 3D. Some studies[11-13] showed good outcomes with toric IOL for high amount of corneal astigmatism. Nienke *et al*[12] examined cataract surgery with toric IOL implantation with high corneal astigmastism (>2.5D), who had toric Acrysof SN60T6, SN60T7, SN60T8, SN60T9 IOL implantation, cylinder powers at the IOL plane were 3.75D, 4.5D, 5.25D, 6.00D. The mean UDVA was 0.61±0.26 (SD), mean BCDVA was 0.81±0.21(SD), the residual astigmatism was (3.2±2.8)°. Accurate positioning of a toric IOL is the most important factor determining the efficacy of the astigmatism correction[14]. Every degree of misalignment contributes to residual astigmatism. In most studies, a 3-step (ink marker-based) method of toric IOL implantation was commonly used[11,12,15,]. Nienke *et al*[11] found a mean total error of (4.9±2.1)° in the alignment of toric IOLs in cataract and refractive surgery using this method. In this study, we used 3-step method in toric IOL group. The mean misalignment was (3.96±1.34)° at 1 week, (4.02±1.37)° at 1 month and (4.22±1.46)° at 6 month postoperative. Nineteen eyes (86.3%) had rotation less than 5° at the last time of review. The stability of toric IOL was satisfied. We make an ink mark for the target axis preoperative on slit-lamp, which is more simple and convenient than the 3-step (ink marker - based) method.

Patients with regular corneal astigmatism are most suitable for toric IOL implantation. Preoperative pentacam exam was used in this study to assess the patient's corneal astigmatism. However, recent studies[16-21] show that toric IOL implantation is also effective in special cases. Park *et al*[16] implant toric IOL during combined 23-gauge micro-incisional vitrectomy surgery and phacoemulsification. The UDVA postoperative was obviously better than the control group. The mean misalignment of IOL was (3.52±2.75)°. Ugo *et al*[18] used toric IOL in eyes with cataract and high astigmatism after penetrating keratoplasty. Marek *et al*[19] used a toric IOL in a case of megalocornea. Ramon *et al*[20] used toric IOL for refractive lens exchange.

In conclusion, we believe that implantation of an Acrysof toric IOL is an effective and safe method to correct corneal astigmatism during cataract surgery. A study of longer

duration in a larger number of patients is necessary to observe the efficiency, accommodation, and functional visual results.

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Toric 人工晶状体植入矫正角膜散光的疗效观察

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摘要

目的:观察 Toric 人工晶状体(intraocular lens, IOL)植入用于治疗合并角膜散光的白内障患者的临床治疗效果。

方法:对 41 例 47 眼合并角膜散光的白内障患者行超声乳化白内障吸出及 IOL 植入术治疗,进行回顾性分析。其中 22 眼植入 Toric IOL,25 眼植入 Acrysof IQ IOL。术后随访 6mo,分析不同时间点裸眼视力、术后残余散光、并发症等,比较两种 IOL 的疗效。观察 Toric IOL 植入后的稳定性。

结果:术后随访观察 6mo,植入 Toric IOL 的试验组,术后裸眼视力平均 0.73±0.37,明显优于植入 Acrysof IQ IOL 的对照组(平均 0.47±0.18),结果有显著性差异。试验组术后裸眼视力 0.5 以上者占 81.8%,优于对照组 32.0%。试验组患者术后残余散光 0.53±0.40D,明显低于对照组(2.13±0.76D),差异有统计学意义。植入 Toric IOL 组,随访 6mo,术后平均旋转 4.22±1.46 度。

结论:对于合并角膜散光的白内障患者,行白内障超声乳化吸出联合 Toric IOL 植入,能够安全、有效的改善患者的散光,提高术后视觉质量,预测性好。

关键词:白内障; 散光; Toric 人工晶状体