Toric Iols Designed To Correct Astigmatism In Cataract Surgery

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Abstract:

Purpose: To evaluate the refractive and visual outcome of toric IOL implantation for correction of pre-existing corneal astigmatism in cataract surgery.

Materials and methods: In this retrospective study, 56 eyes of 30 patients who underwent implantation of toric IOL following regular phacoemulsification were divided into two groups based on the types of toric IOL implanted: group 1 patients received Acrysof toric (Alcon) and group 2 patients received AT-Torbi (Zeiss Meditech) **IOLs**. Pre-and post-operative corneal and refractive astigmatisms, and post-operative distance vision were investigated. Statistical analysis was carried out using the paired student t-test when necessary. Factors affecting the success of toric IOL implantation are discussed and recommendations are made to optimize the outcome.

Results: The mean age of all patients was 75.56 ± 9.87 years. No statistical difference was observed between pre-and post-operative corneal astigmatism (p =0.819). Postoperative refractive astigmatism was significantly less in both groups (group 1: p = 0.0014; group 2: p=<0.00001). The best-corrected distance visual acuity was 6/12 or better in 95 % of group 1 and 100 % of group 2 patients.

Conclusion: Toric IOL implantation is a viable and highly predictable method of correcting the corneal astigmatism. It allows correction without compromising the integrity of the cornea. Careful selection of the patient, accurate keratometry and precise alignment of the cylindrical axes are some of the factors to be considered for a superior outcome.

الخلاصة:-

الغرض من الدراسة:

لتقييم النتائج البصرية والاخطاء الانكسارية بعد زراعة العدسات (التوريك) اي (المكورة والاسطوانية معاً في نفس العدسة) لتصحيح استكماتزم القرنية الموجود مسبقاً عند اجراء عملية رفع الساد مع زرع عدسة.

طريقة العمل:

اجريت هذه الدراسة في مستشفى الحياة الاهلي وتم فيها اجراء عملية لـــ (٥٦) عيناً تعود لـــ (٣٠) مريضاً تم زراعة عدسات توريك لهم بعد اجراء عملية رفع الساد بواسطة الامواج فوق الصوتية بطريقة (الفاكو) . تم تقسيمهم لمجموعتين، المجموعة الاولى تم زراعة عدسات نوع (اكري سوفت توريك شركة الكون)، والثانية تم زراعة عدسات (اي-تي توبري شركة كارل زايس) وتم قياس درجة الرؤيا ودرجة استكماتزم القرنية قبل وبعد اجراء العملية حللت النتائج.

النتائج:

١- معدل اعمار المرضى 9.87±75.56 سنة.

٢- الاستكماتزم بعد العملية كان اقل بشكل ملحوظ. المجموعة الاولى 1-p=0.0014 ، المجموعة الثانية 2-

p=<0.0001

٣- احسن رؤيا للبعيد بعد العملية 6/12 او احسن بالنسبة لـــ ٩٥% من المجموعة الاولى و ١٠٠% للمجموعة الثانية.

الاستنتاج:

ان زرع العدسات التوريك يعتبر طريقة فعالة ومفيدة بشكل عالي لتصحيح استكماتزم القرنية وبدون تأثيرات سلبية على القرنية ولكن الاختيار الدقيق للمريض مع فحص درجة تحدب محاور القرنية الصحيحة ووضع محور العدسة بشكل صحيح عند عملية الزرع تعتبر هذه العوامل المذكورة آنفاً مهمة جداً للحصول على النتيجة الجيدة جداً.

Introduction

Modern cataract surgery had evolved from a mere cataract removing procedure to a regular component of the refractive surgery. Refractive outcome following cataract surgery is not always as perfect as a surgeon or a patient would like to have. Existence of significant post-operative residual astigmatic error, even in patients who are implanted with a toric IOL, is not uncommon (jack 2011) Number of potential sources such as error in biometry (keratometry, measurement of ocular dimensions), size and direction of the incision, implant position and centration of the IOL affects it (American 2010)

In the eye, the corneal astigmatism is modified, either compensated or enhanced, by the internal lenticular astigmatism resulting in a difference between keratometry and refractive astigmatism(huynh s 2006). However, in a pseudophakic eye, well positioned monofocal IOL (or conventional IOL) hardly induces any internal astigmatism unless it is tilted to or decentred from the visual axis(jonathan s 2002). Therefore, keratometric astigmatism is likely to manifest as a total refractive astigmatism post operatively, and thus leading to a suboptimal visual outcome. Lower-order aberrations, namely defocus and astigmatic errors, have a greater impact on visual acuity(jonathan s 2002). Defocus is relatively easier to correct with spectacle; however, spectacle correction of the astigmatism creates meridional asymmetry of retinal images due to variable magnification especially if the astigmatism is of moderate to high magnitudes(kaufmam c 2005). Moreover, adaptation of such distorted image, particularly in elderly individuals, is challenging(corneal 2004).

Adaptation becomes easier when the astigmatism is corrected in the corneal plane (e.g. contact lens correction) or IOL plane (correction with toric IOL) as the meridional magnification is negligible(norrby s 2008). This opto-physiological understanding has lead to innovation of different methods attempting to control the corneal astigmatism intra-operatively. Corneal (or limbal) relaxing incision, astigmatic keratotomy (e.g. excimer laser keratotomy), variation in incision site and implantation of toric IOL are the commonest techniques being used. Corneal incision methods are reported to correct zero to 1D astigmatism depending on size, site and number of relaxing incisions (jack 2011). However, amount of correctable astigmatism with these procedures is unpredictable. Toric IOL implantation method is the most preferred technique as it is highly predictable and can correct even an extreme form of astigmatism(novis c 2000). Performance of a toric IOL relies on various factors including accurate biometry data (keratometry and axial length measurement), surgical procedure, IOL designs and post operative complications . In this study, we retrospectively analysed the data of 56 eyes implanted with one of AT-Torbi or AcrySof toric IOL. Outcome measures included pre and post operative keratometry and refraction, post operative uncorrected and best corrected distance vision. Postoperative corneal and refractive astigmatic changes were

also investigated with a special interest to determine surgically induced astigmatism (SIA).

Materials and methods:

Records of cataract patients implanted with two types of toric IOL (AT-Torbi and AcrySof) were retrospectively analysed. Total 63 records were identified, out of which 56 eyes of 30 patients were included in the study. Remaining 7 eyes were excluded for insufficient data available. Patients were categorized into two groups based on the type of toric IOL implanted. Group 1 and group 2 patients were implanted with AcrySof and AT-Torbi toric IOLs respectively. There were 20 (35.7 %) eyes in group 1 and 36 (64.3 %) eyes in group 2.

AT-Torbi is an acrylic bitoric plate haptic IOL with 6mm optic and 11 mm total diameter. It is available up to 12.0D cylinder in 0.50D steps. AcrySof is a single piece acrylic IOL with open loop L-shaped haptics. This IOL has 6.0 mm optics and the overall diameter is 13 mm. It is available with specification of T3 through T9 (1.50D to 6.0D cylinder in steps of 0.75D).

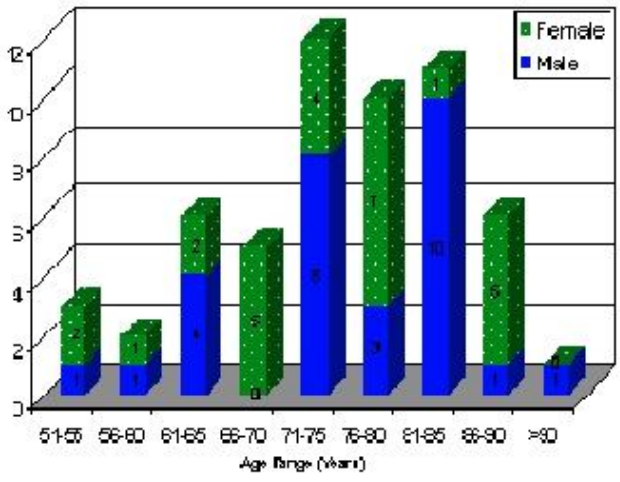
All eyes included in the study underwent uneventful phacoemulsification procedure through 2.7 mm wide clear corneal incision located at 120 degrees (for group 1) or temporal incision (for group 2; zero degrees in left eye and 180 degrees in right eye).
The anterior chamber was maintained using a cohesive viscoelastic material throughout the procedure and during implantation of the IOL which was aspirated at the end of the procedure. Variables collected for analysis included age, gender, pre and post-operative keratometry value, pre & post-operative subjective refraction and uncorrected & best corrected visual acuities. Surgically induced refractive change (SIRC) was calculated for individual surgeon.

Results:

1. Demography

Mean age of all cases was 75.56 ± 9.87 years (range 51 – 91 years). Out of the total, 27 (48.21 %) were male and 29 (51.79 %) were female patients. Mean age of group 2 and group 1 patients were 79.3 ± 5.5 years (range 69-90 years) and 73.8 ± 11.6 years (range 51-91 years) respectively. Age group and gender of all the participating patients are illustrated in Figure 1.

Figure 1: Age and gender distribution of subjects astigmatism included in the study.



2. Corneal astigmatism

Pre-operative corneal astigmatism of the total patients was 2.60 ± 1.35D (range 1 – 5.75D). For Group 1 and 2, mean pre-operative corneal astigmatism were 2.32 ± 1.10D (1 – 5.25D) and 3.11 ± 1.62D (1 – 4.75D), respectively. Post-operatively, mean corneal astigmatism of the total patients was 2.50 ± 1.49D (range 0.75 – 6.88D) whichstatistically did not differ from the pre-operative astigmatism (p = 0.711). Mean corneal astigmatism in Group 1 was 2.10 ± 1.12D (range 0.75 – 5.63D, p = 0.394) and in Group 2, it was 3.23 ± 1.81D (range 1.25 – 6.88D, p = 0.819). No statistical difference occurred between the groups (p = 0.064). Pre and post operative corneal astigmatism of the total patients and individual group can be seen in Figures 2 to 4.

Figure 2: Pre & post-operative corneal astigmatism of total patients (p = 0.711). Each concentricring represents 2.0D astigmatic strength.

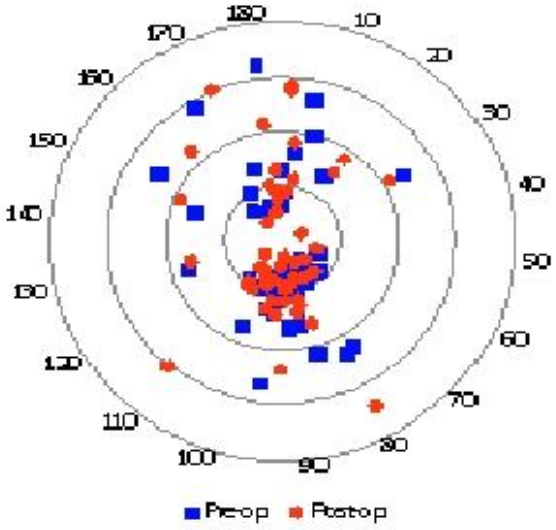


Figure 3: Pre & post-operative corneal astigmatism of Group 1 patients (p = 0.064). Each concentricring represents 2.0D astigmatic strength.

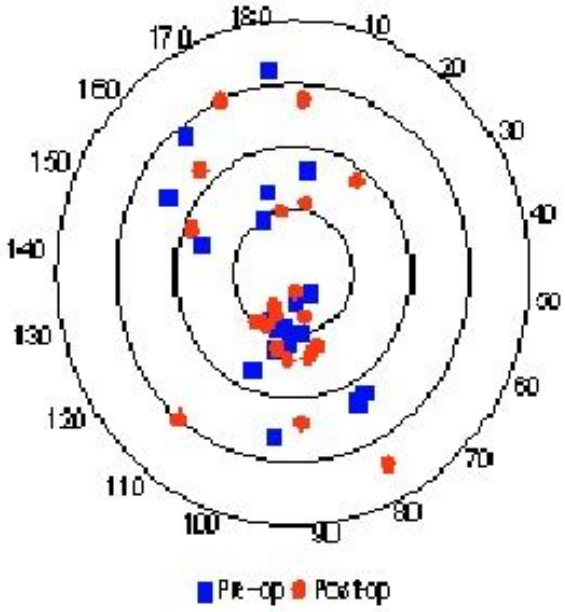
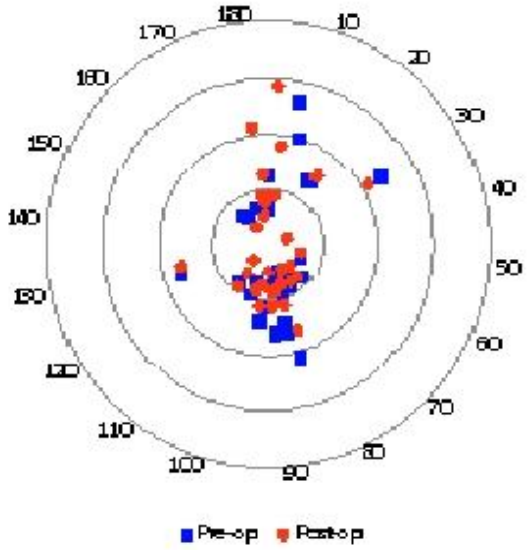


Figure 4: Pre & post-operative corneal astigmatism of Group 2 patients (p = 0.349). Each concentric ring represents 2.0D astigmatic strength.



3. Refractive astigmatism

Mean pre-operative refractive astigmatism of the total patients was 2.63 ± 1.66D (range 1– 6.50D). Group wise, it was 3.12 ± 2.13D for Group 1 and 2.36 ± 1.29D for Group 2 which did not differ statistically (p = 0.158). There was a significant drop in refractive astigmatism post operatively in total eyes and individual group. Of the total, mean post operative astigmatism reduced to 0.91 ± 0.78D (range 0 – 4.0D; p = <0.00001). Group 1 patients had mean post operative refractive astigmatism 1.33 ± 0.96D (range 0.5 – 4.0D) which statistically differed from the pre-operative astigmatism (p = 0.0014). Group 2 patient had mean astigmatism of 0.681 ± 0.55D (range 0 – 3.00D) which was significantly different from pre-operative astigmatism (p = <0.00001). A statistical difference was observed in mean post-operative refractive astigmatism between the two groups (p = 0.011). Pre and post operative refractive astigmatism for total patients and individual group can be seen in Figures 5 to 7.

More than 37 % of the total patients (n = 21) achieved post-operative astigmatism within 0.50D and 76.79 % (n = 43) achieved within 1.0D. 60 % of Group 1 and 86.10 % of Group 2 patients had refractive astigmatism within 1.0D post-operatively. Only 7.16 % of the total patient, 15 % of group 1 and 2.78 % of group 2 patient had post operative residual refractive astigmatism > 2.0D.

4. Surgically induced astigmatism (SIA)

Surgically induced corneal astigmatism may be defined as the combined changes in post operative corneal astigmatism from preoperative. Actual changes in corneal astigmatism were used in calculating the surgically induced astigmatism. Overall, the corneal astigmatism changed by 0.676±0.616D @ 1.35±9º in group 1 and 0.587±0.52D @ 2.35±9º in group 2 patients.

Figure 5: Pre & post-operative refractive astigmatism of total patients (p = <0.00001). Each concentric ring represents 2.0D astigmatic strength.

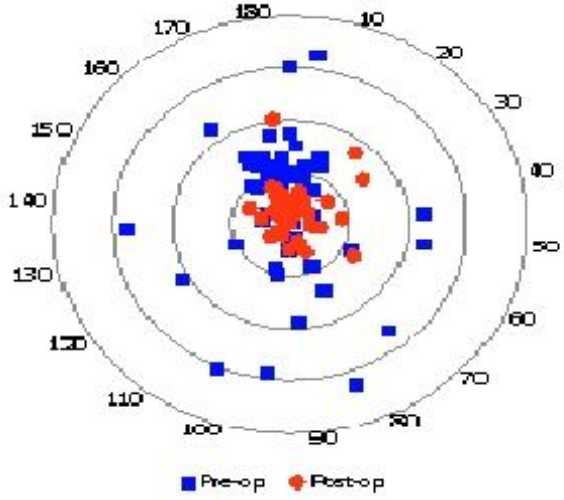


Figure 6: Pre & post-operative refractive astigmatism of Group 1 patient (p = 0.0014). Each concentricring represents 2.0D astigmatic strength.

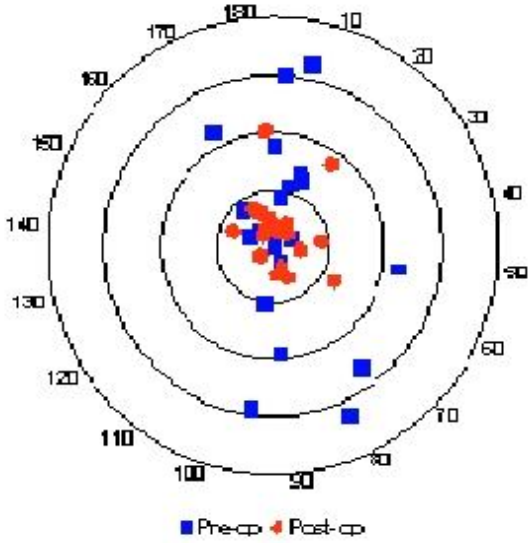
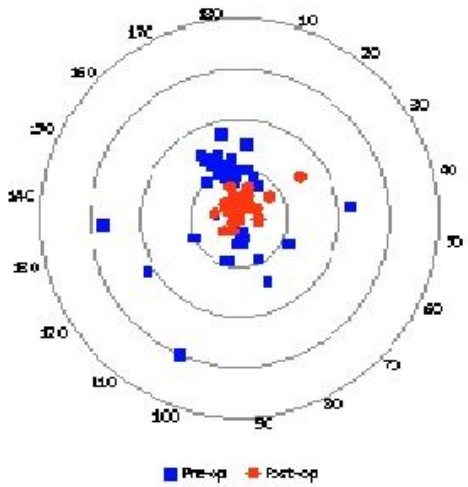


Figure 7: Pre & pos-operative refractive astigmatism of Group 2 patient (p = 0.00001). Each concentricring represents 2.0D astigmatic strength



5. Visual acuity

Practically, visual acuity is one of the most important parameters determining the success of cataract surgery. There was no difference in pre-operative visual acuities between the two groups postoperatively. Uncorrected visual acuity was 6/6 or better in 16.64 % and 6/12 or better in 69.64 % of the total eyes. Approximately 54 % achieved best corrected visual acuity 6/6 or better and 98.21 % achieved 6/12 or better. 95 % in group 1 and 100% in group 2 eyes obtained 6/12 or better best corrected distance visual acuity post operatively (Table 1).

Table 1 : Best corrected post-operative distance visual acuity

BCDVA	Total	Group 1	Group 2
≥ 6/6	30 (53.57 %)	10 (50.00 %)	20 (55.56 %)
< 6/6 – 6/12	25 (44.64 %)	9 (45.00 %)	16 (44.44 %)
< 6/12 – 6/18	1 (1.79 %)	1 (5.00 %)	0 (0.0 %)
< 6/18 – 6/60	0 (%)	0 (0.0 %)	0 (0.0 %)
< 6/60	0 (%)	0 (0.0 %)	0 (0.0 %)

Conclusion:

Implantation of a toric IOL can effectively correct corneal astigmatism thereby enhancing the postoperative visual outcome. It is a viable and highly predictable method and allows correction without compromising integrity of the cornea. Real time intraoperative refraction would be an ideal method for an accurate IOL placement, but before this technique is readily available, certain careful measures in selecting patients, measuring corneal curvature and aligning cylinder axis may further optimize the outcome.

References:

Jack J Kanski Brad Bowling 2011.

American Academy 2010.

Huynh S (2006). An evaluation of keratometry in 6-year old children. Cornea Irene R., Ursula S et al (2000). Astigmatic Correction with a foldable toric intraocular lens in cataractpatients.

Jonathan S, Paul R et al (2002). Toric Intraocular Lens Implantation: 100 consecutive case.

Kaufmann C, Peter J et al (2005). Limbal relaxing incisions versus on-axis incisions to reduce.

Corneal astigmatism at the time of cataract surgery 2004.

Norrby S (2008). Sources of error in intraocular lens power calculation.

Novis C (2000). Astigmatism and toric intraocula.