
SHORT TERM REFRACTIVE AND VISUAL RESULTS AFTER Acrysof TORIC INTRAOCULAR LENS IMPLANTATION AND THE COMPARATIVE ANALYSIS OF VISUAL OUTCOMES IN VARIOUS TYPES OF ASTIGMATISM

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Abstract

Keywords:

Toric intra ocular lens, pre existing astigmatism, surgical correction of astigmatism.

Back Ground: Astigmatism is one of the most common causes of dependence on corrective lenses for distance vision in patients after cataract surgery. The modern surgical technique of phaco emulsification has considerably decreased the surgical wound induced astigmatism. Acrysof Toric intra ocular lens is aimed at correcting pre existing astigmatism. This study evaluates the short term results of Acrysof Toric intra ocular lens **Methods:** This is a retrospective study of 32 eyes of 32 patients who underwent phacoemulsification cataract surgery with Acrysof Toric intra ocular lens implantation. The pre operative and post operative one month data were retrieved from the medical records and analyzed. **Results:** Pre operatively the mean of spherical equivalent is $-0.87 \pm 2.60D$ but post operatively the mean is $-0.21 \pm 0.29D$. It is found that 17(54%) out of 32 patients gained uncorrected visual acuity 6/6 post operatively while none of the patients had 6/6 pre operatively **Conclusion:** Acrysof Toric intra ocular lens significantly corrected pre existing astigmatism and improved visual functions when used for cataract surgery.

INTRODUCTION

Astigmatism is one of the most common causes of dependence on corrective lenses for distance vision in patients after cataract surgery¹. It has been estimated that 15% to 29% of cataract patients have more than 1.50 dioptres (D) of refractive astigmatism due to corneal astigmatism (CA). The reduction of this pre-existing astigmatism can improve the visual outcome and the spectacle independence after cataract surgery². Traditionally this astigmatism has been reduced during the cataract procedure by incisive relaxation technique or by corneal ablative refractive surgery later on. The advent of toric intraocular lenses (IOL) helps us correcting preexisting corneal astigmatism by implanting a toric IOL. Naturally occurring (idiopathic) astigmatism is frequent, with up to 95% of eyes having detectable astigmatism. It is estimated that approximately 70% of the general cataract population has at least 1.00 D of astigmatism, and approximately 33% of patients undergoing cataract surgery are eligible for treatment of pre-existing astigmatism³. Today, cataract surgery is regarded as a refractive surgery, aiming pseudophakic emmetropia, which makes eliminating corneal astigmatism critical⁴. Toric IOLs now provide the opportunity to correct corneal astigmatism, offering patients with pre-existing astigmatism optimal distance vision without the use of spectacles or

contact lenses with a cylindrical correction. Furthermore, the recent introduction of multifocal toric IOLs offers patient with pre-existent corneal astigmatism the opportunity not only to achieve spectacle independence for distance vision, but also for near and intermediate visual acuities⁵. A toric intraocular lens is a modification of a standard intraocular lens (used in almost all cataract surgery) that has the needed astigmatism correction built into the lens. It must be ordered or inventoried specifically for the degree of astigmatism to be corrected. The lens is implanted inside the eye in a very exact orientation so as to line up the corrective power of the lens in the exact clock hour needed to correct the astigmatism^{6,7}. Toric IOLs (Figure 1) usually do a very good job at correcting astigmatism and allow the patient to be less dependent on spectacles. However, patients' outcomes depend on accurate corneal astigmatism measurement, accurate marking of corneal meridians and angle of alignment, and accurate and stable IOL alignment.

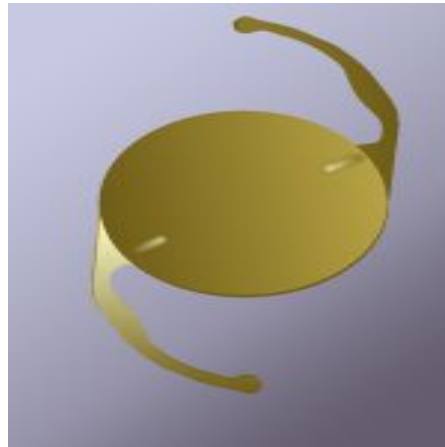


Figure 1. Toric IOL

The Toric IOL is a lens with different optical power and focal length in two orientations perpendicular to each other. One of the lens surfaces is cylindrical shaped and the other one is spherical. Patients with minimum 1.25D cylinder and eligible for phacoemulsification were considered for Toric IOL¹². Determination of the optimal IOL toricity can be performed using a calculation program provided by the manufacturer. The cylindrical power of the toric IOL should be chosen based on the total corneal astigmatism, taking into consideration anterior corneal astigmatism, posterior corneal astigmatism, and SIA. Another factor to consider is the impact of effective lens position and of the spherocylindrical power of the IOL on the effective cylinder power of the IOL at the corneal plane. Effective toricity of the IOL diminishes with increasing anterior chamber depth and lower IOL spherical power. The Holladay IOL Consultant Program and the Tecnis Toric Calculator take this into account in its calculation of toric IOL power. Furthermore, when choosing the IOL toricity, it is desirable to leave patients with slight with-the-rule astigmatism, due to the normal tendency for astigmatism to drift against-the-rule with advancing age. Thus, leaving this slight with-the-rule astigmatism prolongs the period of time in which the patient's corneal astigmatism is compensated by the toric IOL. Toric IOL power calculation is done before toric IOL implantation with the help of the websites - www.acrysoftoriccalculator.com. Before toric IOL implantation surgery, it is strongly recommended to make reference marking with the slit lamp, as it will help the surgeon to mark the axis accurately to avoid any errors. The final axis marking is done on table. The reference marking is very important as 1° IOL rotation results in loss of 3.3% of IOL cylinder power. The aims and objective of the study were to estimate the functional results in term of Best corrected visual acuity (BCVA) after one month of Acrysof toric intraocular lens implantation, to estimate the refractive results after one month of Acrysof toric intraocular lens implantation and to do a comparative analysis of Toric Intraocular Lens outcomes in various groups of astigmatism.

MATERIALS AND METHODS

Thirty two pseudophakic Eyes of 32 patients who underwent phacoemulsification with Acrysof Toric intraocular lens implantation in our hospital between November 2014 and April 2015 in our hospitals, were included in this retrospective study. Both male and female patients were considered. All the cases included in this study underwent uneventful phacoemulsification without any intra-operative or post operative complication. Phacoemulsification was performed with Acrysof Toric Intraocular Lens Implantation. All surgery was done by the same surgeon. The reference marking was done on slit lamp and axis marking was don on the table (Figure 2 and 3)



Figure 2. Axis marking for Toric IOL implantation

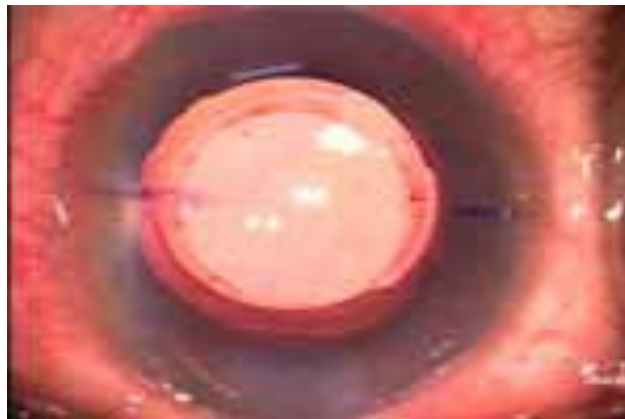


Figure 3. Axis marking with implanted Toric IOL

All patients having any existing ocular disease that affects vision were excluded. Being a retrospective analysis we selected only uneventful surgeries for inclusion in the study to rule out post-operative visual diminution due to operative complications becoming a confounding factor. Patients with any other ocular disease that affects vision like pre-existing glaucoma, uveitis, retinal disorders, squint, were excluded. Complete clinical history of the patients was taken from the case report and EMR. Before surgery, all patients underwent a complete eye

examinations including assessment of visual acuity (unaided and best corrected), intraocular pressure by Non Contact Tonometer, Slit Lamp Examination, Fundus Examination, Syringing for Duct patency, Keratometric Readings (automated and manual) with IOL Master and Manual Keratometer, ECG etc.. and also laboratory blood tests to rule out diabetes. Their pre-operative visual acuity was determined with Snellen's chart, following which Binocular vision was tested and the refractive error was assessed. Diagnosis of Cataract was confirmed by Slit Lamp Examination and Corneal Astigmatism was calculated from the Keratometric reading obtained from Keratometry. Patients were followed up routinely at 1week, 2week, and 1month follow up. For data analysis, post-operative refraction at 1month was considered. All the data's was collected in an excel data base (MS Office 2007, Microsoft, red mond WA) and analyzed with Graph pad Statistical Calculator Version 16, SPSS for windows. Descriptive statistics and Paired sample TTEST with 2 tail distribution was done. P value less than 0.001 is considered statistically significant.

RESULTS

As far as the functional outcomes (Table 1 and 2) are concerned, it is observed that 17(54%) out of 32 patients gained uncorrected visual acuity 6/6 post operatively while none of the patients have 6/6 pre operatively. Pre operatively 25% of patients had best corrected visual acuity 6/9 whereas 90% of the patients gained BCVA 6/6 post operatively. The mean of the number of lines gained of pre BCVA to post UCVA is 4.14 ± 3.89 lines and of pre BCVA to post BCVA is 4.25 ± 3.62 lines. It is found that 60% patients gained 0.00 UCVA in LogMAR units post operatively and 97% of the 32 patients gained 0.00 BCVA in LogMAR units post operatively. Table 1 shows the comparison of pre operative and post operative visual acuity. There is a statistically significant improvement. $P < 0.001$. The mean of pre operative BCVA is 0.339 ± 0.335 and in post UCVA the mean is 0.083 ± 0.108 . The table 2 shows statistically significant ($P < 0.0001$) improvement in BCVA. The mean of pre BCVA is 0.339 ± 0.3335 and the mean of post BCVA is 0.0055 ± 0.031 with a standard error of difference of 0.059. It is observed that 54% of the patients gained Plano refractive error post operatively. (Chart 1).

With respect to the refractive results, pre operatively the mean of spherical equivalent is $-0.87 \pm 2.60D$ but post operatively the mean is $-0.21 \pm 0.29D$ (Table 3). In case of refractive results, the mean post operative spherical equivalent was $-0.21 \pm 0.29D$ (P value: 0.08005) which is statistically not significant and the mean change in total refractive astigmatism value was $-0.34 \pm 0.39D$ ($P < 0.001$) which is extremely statistically significant.

All the cases had an improved post operative BCVA following Toric IOL in irrespective of the types of astigmatism. However on comparing the refractive outcomes in different types of astigmatism namely WTR, ATR, and OA, it was found that there was no statistically significant difference even though it shows that maximum outcomes gained in with the rule astigmatism (Table 4).

TABLE-1 – Functional outcome (Improvement in Log MAR visual acuity, Pre Op BCVA : Post Op UCVA)

SL NO.		PRE BCVA	POST UCVA
1	MEAN	0.339	0.083
2	SD	0.335	0.108
3	MEDIAN	0.176	0
4	MAX	1.47	0.301
5	MIN	0	0
6	RANGE	1.47	0.301
7	P VALUE	0.00024	

SL NO.		PRE BCVA	POST BCVA
1	MEAN	0.339	0.0055
2	SD	0.335	0.031
3	MEDIAN	0.176	0
4	MAX	1.47	0.176
5	MIN	0	0
6	RANGE	1.47	0.176
7	P VALUE	0.0001	

Table 2. Functional outcome (Improvement in Log MAR visual acuity, Pre Op BCVA : Post Op BCVA)

CHART-1 Comparison of Pre Op and Post Op refractive error – Spherical Equivalent.

SL NO.		SPHERICAL EQUIVALENT (PRE OPERATIVE)	SPHERICAL EQUIVALENT (POST OPERATIVE)
1	MEAN	-0.87	-0.21
2	SD	2.60	0.29
3	MEDIAN	-0.75	0.00
4	MAX	4.75	0.00
5	MIN	-6.25	-1.25
6	RANGE	11.00	1.25
7	P VALUE	0.08005	

TABLE-3 – Refractive outcome (Statistics of Pre Op and Post Op Refraction - Spherical Equivalent)

Table 4. Refractive outcome of Toric IOL implantation in different types of astigmatism

SL NO.	REFRACTIVE OUTCOME	ASTIGMATIC TYPES		
		WITH THE RULE	AGAINST THE RULE	OBLIQUE
1	PLANO	11	6	0
2	DECREASED	8	3	4

DISCUSSION

The functional results are expressed in LogMAR visual acuities units and the patients experienced a mean BCVA gain of 0.0055 ± 0.031 lines (P value: 0.0001) post operatively with respect to pre BCVA. Comparing the pre BCVA versus post UCVA the improvement was of 0.083 ± 0.0108 lines (P value: 0.00024) and the above results shows it is extremely statistically significant. In case of refractive results, the mean post operative spherical equivalent was $-0.21 \pm 0.29D$ (P value: 0.08005) which is statistically not significant and the mean change in total refractive astigmatism value was $-0.34 \pm 0.39D$ ($P < 0.001$) which is extremely statistically significant. Finally the comparative analysis of visual outcomes in various types of astigmatism namely With the Rule (WTR), Against the Rule (ATR), and Oblique astigmatism (OA) was done and almost all the cases gained an improved post operative BCVA following toric Intraocular Lens implantation irrespective of the types of astigmatism. However on comparing the visual outcomes in various types of astigmatism namely WTR, ATR, OA it was found that there was no statistically significant difference in the visual outcomes (P value: 0.0816). Even though from the results seems that the maximum outcome gained in WTR and almost 60% gained a Plano ref error post operatively and the minimum outcome gained in OA where none of the patients gained Plano refraction post operatively. Statistically speaking, in our study the implantation of Toric Intraocular Lens is a predictable way of reducing refractive astigmatism and to gain functional results in terms of BCVA. This is comparable with quite a few previous studies. A study conducted by Ouchi M¹⁸ on Acrysof Toric intraocular lens for correction of preoperative astigmatism in patients having cataract surgery shows that the mean distant UCVA increased significantly from 0.80 to 0.20, residual refractive astigmatism decreased significantly from 2.02 D to 0.67 D and in my study the mean distant UCVA increased significantly from 0.339 to 0.083, refractive astigmatism decreased significantly from -1.33D to -0.34D and they conclude that Acrysof Toric IOL implantation is a predictable, safe and effective method to correct preexisting corneal astigmatism in patients having cataract phacoemulsification. A pseudophakic eye after Acrysof Toric IOL implantation with low residual ATR myopic astigmatism is beneficial for obtaining a better uncorrected near and distant visual acuities but in my study the visual outcome in various types of astigmatism namely WTR, ATR, OA shows no statistically significant difference. Similarly, a study conducted by Novis C¹⁹ found that implantation of the Toric Intraocular lens during cataract surgery was efficient and safe in correcting high amount of corneal astigmatism which suits the conclusion of my study also. A study conducted by Agresta B²⁰ on AcrySof toric intraocular lens implantation shows that the mean BCVA gain was of 1.9 ± 1.67 LogMAR lines and in my study the mean BCVA gain was of 0.0055 ± 0.031 lines (P value: 0.0001). Comparing the pre operative BCVA versus post operative UCVA in their study, the improvement was of 0.89 ± 2 LogMAR lines and in my study the pre operative BCVA versus post operative UCVA, the improvement was of 0.083 ± 0.108 lines (P value: 0.00024). In their study the postoperative refractive astigmatism was $-0.37 \pm 0.37D$ and in my study the post operative refractive astigmatism was $-0.34 \pm 0.39D$ (P value: 0.03) which is extremely statistically significant. Their conclusion was that the implantation of Toric Intraocular Lens in patients with pre existing corneal astigmatism higher than 0.75D is a safe, predictable and effective way of reducing refractive astigmatism in patients undergoing cataract surgery.

CONCLUSION


The implantation of toric IOL in patients with pre existing corneal astigmatism higher than 0.75 D is a safe, predictable and effective way of reducing refractive astigmatism in patients undergoing cataract surgery. Implantation of Toric Intra ocular Lens for patients having corneal astigmatism gives extremely statistically significant visual acuity improvement even in case of post operative UCVA. In the comparative analysis of visual outcomes in various types of astigmatism, all the cases had a improved post operative BCVA following Toric IOL in irrespective of the types of astigmatism. However considering the small sample size and retrospective nature of the study further clinical studies are needed to still validate the above.

Financial disclosures: NIL

REFERENCES

1. Sun X, Vicary D, Montgomery P, Griffiths M. Toric intraocular lenses for correcting astigmatism in 130 eyes. *Ophthalmology*. 2000;107(9):1776-1781.
2. Horn J. Status of toric intraocular lenses. *Current Opinion in Ophthalmology*. 2007;18(1):58-61.
3. Mendicute J, Irigoyen C, Ruiz M, Illarramendi I, Ferrer-Blasco T, Montés-Micás R. Toric intraocular lens versus opposite clear corneal incisions to correct astigmatism in eyes having cataract surgery. *Journal of Cataract & Refractive Surgery*. 2009;35(3):451-458.
4. Titiyal J, Agarwal T, Jhanji V. Toric intraocular lens versus opposite clear corneal incisions to correct astigmatism in eyes having cataract surgery. *Journal of Cataract & Refractive Surgery*. 2009;35(10):1834-1835.
5. Mingo-Botán D, Muñoz-Negrete F, Won Kim H, Morcillo-Laiz R, Rebolledo G, Oblanca N. Comparison of toric intraocular lenses and peripheral corneal relaxing incisions to treat astigmatism during cataract surgery. *Journal of Cataract & Refractive Surgery*. 2010;36(10):1700-1708.
6. ĄŹwiłtek B, Michalska-Maćecka K, Dorecka M, Romaniuk D, Romaniuk W. Results of the AcrySof Toric intraocular lenses implantation. *Med Sci Monit*. 2012;18(1):PI1-PI4.
7. Agresta B, Knorz M, Donatti C, Jackson D. Visual acuity improvements after implantation of toric intraocular lenses in cataract patients with astigmatism: a systematic review. *BMC Ophthalmology*. 2012;12(1):41.
8. Visser N, Ruíz-Mesa R, Pastor F, Bauer N, Nuijts R, Montés-Micás R. Cataract surgery with toric intraocular lens implantation in patients with high corneal astigmatism. *Journal of Cataract & Refractive Surgery*. 2011;37(8):1403-1410.
9. Visser N, Bauer N, Nuijts R. Residual Astigmatism Following Toric Intraocular Lens Implantation Related to Pupil Size. *Journal of Refractive Surgery*. 2012;28(10):729-732.
10. Tehrani M, Dick H. Incisional Keratotomy to Toric Intraocular Lenses: An Overview of the Correction of Astigmatism in Cataract and Refractive Surgery. *International Ophthalmology Clinics*. 2003;43(3):43-52.
11. Poll J, Wang L, Koch D, Weikert M. Correction of Astigmatism During Cataract Surgery: Toric Intraocular Lens Compared to Peripheral Corneal Relaxing Incisions. *Journal of Refractive Surgery*. 2010;.
12. Hirschschall N, Gangwani V, Crnej A, Koshy J, Maurino V, Findl O. Correction of moderate corneal astigmatism during cataract surgery: Toric intraocular lens versus peripheral corneal relaxing incisions. *Journal of Cataract & Refractive Surgery*. 2014;40(3):354-361.
13. Ouchi M, Kinoshita S. AcrySof IQ Toric IOL Implantation Combined With Limbal Relaxing Incision During Cataract Surgery for Eyes With Astigmatism >2.50 D. *Journal of Refractive Surgery*. 2011;27(9):643-647.
14. Novis C. Astigmatism and toric intraocular lenses. *Current Opinion in Ophthalmology*. 2000;11(1):47-50.
15. Agresta B, Knorz M, Donatti C, Jackson D. Visual acuity improvements after implantation of toric intraocular lenses in cataract patients with astigmatism: a systematic review. *BMC Ophthalmology*. 2012;12(1):41.

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