Original Article

Comparison of Pre and Postoperative Astigmatism after Cataract Extraction by Phacoemulsification through a 3.2 MM Clear Corneal Superotemporal Incision

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Purpose: To evaluate the difference between pre and postoperative astigmatism in patients undergoing cataract extraction by phacoemulsification with intraocular lens implantation through 3.2 mm superotemporal clear corneal incision.

Material and Methods: A prospective study was performed on 144 eyes of 132 patients. They were operated upon for cataract between 12/01/2007 and 31/12/2012 by a single eye surgeon at a private set up. Follow up period was from 6 month to five years (mean 33 months). The patients included in this study, underwent cataract surgery by phacoemulsification through 3.2 mm superotemporal clear corneal incision. Their mean age at the time of surgery was 50.5 years (range: 25 to 76 years). They were divided into two groups depending upon, "With the Rule" (Group A) or "Against the Rule"(Group B), pre operative astigmatism.

Results: Before surgery, mean astigmatism in group A patients was -0.83 D (Diopter) and in those of group B was -0.76 D. After the surgery, mean astigmatism in group A patients was -1.10 D and in those of group B was -1.10 D. The mean increase in astigmatism post operatively in the two groups was 0.27 D and 0.34 D respectively.

Conclusion: Superotemporal clear corneal incision of 3.2 mm size is favourable in terms of wound stability and the final optical outcome. When followed up over a long time, the post operative astigmatism approaches almost the preoperative value although there may be a negligible increase in it.

Key words: Astigmatism, Phacoemulsification, Intraocular lens.

Phacoemulsification, and foldable IOLs, have made cataract surgery through a small incision possible[1-3]. Rapid and stable optical recovery is achieved by preventing significant changes in corneal curvature. The smaller incision size induces less postoperative astigmatism.[1,4,5] The clear corneal incision technique was introduced by Fine. This has lead to increased safety, decreased pain, inflammation and surgically induced astigmatism (SIA).[6]

A positive SIA (horizontal positive cylinder) means "against the rule" change while a negative SIA (horizontal negative cylinder) signifies a "with the rule" change.[14]

Visual outcome after cataract surgery is significantly affected by the preexisting astigmatism and the one induced by the surgery itself. Usually, in young people cornea is steepest in its vertical meridian, i.e. AWR (horizontal negative cylinder). With the advancing age there is a shift to ATR astigmatism (horizontal positive cylinder). In cataract age group we mostly find ATR astigmatism.

Modern techniques in cataract surgery aim to achieve optimum uncorrected visual acuity (UCVA). Different sites and sizes of incisions have been tried to reduce pre-existing astigmatism which adds to the total post operative astigmatism. A small incision leads to less astigmatism postoperatively.[2,7-11] Mostly superior or temporal approaches are preferred by the surgeons. When the preoperative corneal astigmatism is significant, incision can be placed on the steeper corneal meridian (parallel to negative cylinder or on the positive cylinder axis) to reduce overall postoperative astigmatism. Surgically induced astigmatism with small incision surgery is significantly lower if incision is placed posteriorly nearer to the limbus[12]. The size, shape, and place of the incision influence surgically induced astigmatism. It has an important bearing on the corneal stability[13].

A medium sized (3.2 mm) superotemporal clear corneal incision has the advantage of its size and site. This size does not allow the wound lips to undergo unnecessary stretching, while injecting the IOL, avoiding increase and change in axis of the preoperative astigmatism[14]. The superotemporal site of the incision in the oblique meridian, in fact, has a positive effect on both types of astigmatisms as the steepest meridians are not usually exactly at 180 or 90 degrees[15], rather these lie in between and have a relative vertical or relative horizontal positions as we have considered in our study.

Generally, a clear corneal incision placed superotemporally leads to smaller postoperative astigmatism by flattening the horizontal corneal axis. This has an advantage as ATR astigmatism is common in older age group[16].

Another factor, which can influence the expected out come is axis in which the IOL haptics are placed. If the IOL haptics are placed at 180°, pre-existing WTR astigmatism can be reduced and vice versa[17]. These days toric intraocular lenses can reduce preexisting astigmatism quite effectively[18]. Femtosecond laser assisted cataract surgery further promises better incision morphology and stability thereby reducing chances of post operative astigmatism[19].

MATERIAL AND METHODS

A retrospective study was performed on 144 eyes of 132 patients. They were operated upon for cataract with intraocular lens implantation from 12 Jan 2007 to 31 Dec 2012 with a follow up period of 6 month to five years (mean 33 months). The patients underwent cataract surgery by phacoemulsification through 3.2 mm superotemporal clear corneal incision (approx. 0.5mm central to the limbus). At the time of surgery their mean age was 50.5 years (range: 25 to 76 years). They were divided into two groups depending upon, "With the Rule" (Group A) or "Against the Rule" (Group B). In group A, mean astigmatism before surgery was - 0.83 D while it was -0.76 D in group B.

WTR astigmatism (negative cylinder in the horizontal axis) was considered to be the one in the meridian between 60 and 120 degrees and ATR (negative cylinder in the vertical axis) in the meridian between 1 and 30 degrees and 150 and 180 degrees. Astigmatism other than these was classified as oblique.

The patients with oblique or irregular astigmatism were not included in the study. Similarly the patient who had undergone filtration, refractive or pterygium excision surgery or had corneal scaring and opacities, very high or irregular preoperative astigmatism, were also not included in this study.

Intraocular lens calculations were performed using A-scan ultrasonography (Quantel Medical 11 M Hz) for axial length measurements and keratometry using Topcon KR 8800 digital autokerato-refractometer. After administering peribulbar local anaesthesia with 2% lignocane with 1:200,000 adrenaline, in all the cases a clear corneal superotemporal (10-11 clock) incision (approx 0.50 mm central to the limbus) was made using a 3.2 mm true cut keratome. A continuous curvilinear capsulorhexis was performed with cystitome. Phacoemulsifation was performed using system (Ammerican Optics Inc.) machine with 19 Ga 30 degree tip. All patients implanted with single piece, foldable acrylic IOL with an optical diameter of 6.0 mm (total diameter of 13.0mm), placed in the capsular bag.

All patients were treated postoperatively with a combination of dexamethasone 0.1 % and tobramycin 0.3%, three hourly for the first week and then six and eight hourly over the three subsequent weeks. Topical ofloxacin was given 6 hourly for 1 week postoperatively.

Follow up for evaluation of astigmatism was performed on Topcon KR 8800 autokerato-refracto-meter from three months onwards after surgery.

RESULTS

Mean preoperative astigmatism in group A (45 patients) was - 0.83 and in group B (99 patients) was -

0.76 (Table 1). In group A and and B, the mean and median postoperative astigmatism were -1.10 and 0.75 diopters respectively. The mean increase in astigmatism post operatively in the two groups was 0.27 and 0.34 and the median increase was 0.50 and 0.25 diopters respectively over 6 months to 5 years follow up (Table 1-3). This showed a slight shift toward WTR astigmatism post operatively. In group A, 15 (33.33%) cases showed an increase in astigmatism while 9 (20%) remained unchanged, 9 (20%) converted to ATR astigmatism, 6 (13.33%) neutralized and 6 (13.33%) experienced a decrease in WTR astigmatism. In group B, 60 (62.50%) cases showed an increase in astigmatism while 9 (9.37%) remained unchanged, 12 (12.50%) converted to WTR astigmatism, 3 (3.12%) neutralized and 12 (12.50%) experienced a decrease in ATR astigmatism (Table 4). In group A 24 (53.33%) eyes showed a clockwise shift in the axis (median 11 degrees) and 9 (20%) eyes showed an anti-clockwise shift (median 20 degrees). In group B 27 (28.12%) eyes showed a clockwise shift in the axis (median 14 degrees) and 51(53.12%) eyes

Table 1: Preoperative State of Astigmatism

	Total Eyes n (%)	Total Astigmatism (Diopters)	Mean Astigmatism (Diopters)	Median Astigmatism (Diopters)
ATR Astigmatism (Group B)	99 (68.75)	78.00	0.76	0.75
WTR Astigmatism (Group A)	45 (31.25)	37.50	0.83	0.75

Table 2: Post-Surgery State of Astigmatism

	Total Eyes n (%)	Total Astigmatism (Diopters)	Mean Astigmatism (Diopters)	Median Astigmatism (Diopters)
ATR Astigmatism (B)	90 (62.50)	99.75	1.10	1.00
WTR Astigmatism (A)	24 (16.67)	27.00	1.10	1.25
Neutralized	30 (20.83)			

Table 3: Difference in Pre/Post Surgery Mean Astigmatism

	Pre Surgery Mean / Median Astigmatism	Post Surgery Mean / Median Astigmatism	Difference
ATR Astigmatism (B)	0.76 / 0.75	1.10 / 1.00	0.34 / 0.25
WTR Astigmatism (A)	0.83 / 0.75	1.10 / 1.25	0.27 / 0.50

Table 4: Detail of changes in Post Surgery Astigmatism. (Number of Cases = n)

	Increased n (%)	Unchanged n (%)	Converted ATR → WTR WTR → ATR	Neutralized n (%)	Decreased n (%)
ATR (n = 99)	60 (60.60)	9 (9.09)	12 (12.12)	6 (6.06)	12 (12.12)
WTR (n = 45)	15 (33.33)	9 (20)	9 (20)	6 (13.33)	6 (13.33)

Table 5: Shift of Axis (Clockwise / Anticlockwise)

	Clockwise Shift			Anticlockwise Shift		
	No. of Patients n (%)	Mean	Median	No. of Patients n (%)	Mean	Median
ATR n = 96	27 (28.12)	14.77 degrees	14.0 degrees	51 (53.12)	17.64 degrees	07 degrees
WTR n = 45	24 (53.33)	26.11 degrees	08 degrees	9 (20)	18 degrees	20 degrees

showed an anti-clockwise shift (median 7 degrees) (Table 5). The rest did not show any shift.

DISCUSSION

In our study we have found that a superotemporal (10-11 O' clock) 3.2 mm incision hardly causes any astigmatism or induces any significant change in the existing preoperative astigmatism, i.e. less than 0.50 diopters generally, when followed over a longer period of time. This correlates with a similar study carried out by S C Moon et al[14]. However the median value showed a slightly more shift on the WTR side (Table 2&3).

Regarding the toric shift, most of the cases in group A showed a clockwise shift (median 7 degrees) while in group A the trend was opposite (median shift 8 degrees) in most of the cases (Table 5). This shift is not very significant during refraction and prescription of glasses. Less number of cases in both the groups showed wider shift (14-20 degrees). This concluded a minor overall change in the keratometric readings although the incision was made through the clear cornea.

Our patients showed a slight shift towards higher median WTR astigmatism with the passage of time. Different studies have demonstrated flattening of the cornea along the incisional meridian[14]. This leads to WTR astigmatic changes with a temporal incision[20,21], comparable with the results of our study.

In a similar study where keratometric analysis of corneal astigmatism was done after surgery and a comparison was done between two groups undergoing phacoemulsification through supero-temporal corneal incision and superior scleral incision. The former did not increase keratometric corneal astigmatism more than the one by superior scleral incision after three months of operation[22].

The incision length and location have a bearing on the changes in the horizontal and vertical meridians of the cornea after cataract surgery. This study was also affected by these two factors. This fact is also supported by two other similar studies; small temporal incisions induced less change than superior incisions[14,23].

CONCLUSION

Superotemporal, 3.2 mm clear corneal incision is quite stable and does not significantly increase post operative astigmatism when followed up over a long (several months to years) period of time. This size and site of the incision have also proved to be superior to smaller or larger and superior or scleral incisions respectively.

One limitation of this study was that 27 patients did not return for follow up at their designated times.

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