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A clinical study of 6mm sutureless clear corneal incision in pre-existing astigmatism of 1D-2D in manual small incision cataract surgery

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Abstract

Aim: To evaluate the effect of 6mm sutureless clear corneal incision on pre-existing astigmatism of 1D-2D and to compare outcome of superior and temporal incisions, in manual small incision cataract surgery (SICS).

Methods: A prospective interventional study was conducted from January 2015 to July 2015 on 80 patients who underwent manual SICS, with pre-existing astigmatism of 1D-2D on keratometry. A 6mm superior or temporal sutureless clear corneal incision was made along the steep axis. Postoperative follow up was done on 1st, 3rd and 6th week and keratometry values noted in each visit. Final refraction and correction noted at the end of 6 weeks

Results: Out of 80 patients, 71 had 1D-1.5 D and 9 had 1.5D-2D astigmatism. The mean pre-operative astigmatism was 1.228D±0.32D.

Among 62 cases of with-the rule astigmatism, full correction after surgery was noted in 37 patients (59.67%), partial correction in 19 (30.64%), no change in 6(10%). Among 18 cases of against-the rule astigmatism, 11 had full correction (61.11%) and 6 had partial correction (33.33%) and remained unchanged in 1(5.5%). So the mean post-operative astigmatism was found to be 0.43D±0.35. The astigmatic difference between pre-operative and post-operative astigmatism was found to be statistically significant. (P-value 0.0001).

Peaking of pupil was noted in 3 patients and iris prolapse in two patients, accounting for minor complications in 6.7%. No other complications were observed till 6 weeks.

Conclusion: A 6mm sutureless clear corneal incision on steep axis is an economical and effective way of reducing pre-existing astigmatism of 1D-2D in manual SICS.

Keywords: Astigmatic correction, Clear corneal incision, Manual small incision cataract surgery, Post-operative astigmatism.

Introduction

Curvatural alterations of cornea after cataract surgery is a well-documented finding. Over this, there is a wide variability in prevalence of pre-existing corneal astigmatism. The amount of alteration induced surgically is dependent on various factors including – refractive astigmatism, corneal astigmatism, type, location and depth of incision, location relative to the limbus, suture technique and material and so on (Simon et al 2005). These alterations when channelized for a particular case in consideration with pre-existing astigmatism can be a curative measure towards a better post-operative visual outcome.

Cataract surgery induces variable degrees of corneal astigmatism (Bar-Sela et al 2006). Various factors that can affect post-operative astigmatism: incision size, shape and location. Keratometry, topography, and refraction, provide useful information regarding the astigmatic status of patients (Comez et al 2012). When considering cataract surgery in its refractive aspect, pre-existing astigmatism draws a significant attention. Different approaches of correction of pre-existing astigmatism include-keratotomy, toric intraocular lens (IOL) implantation, opposite clear corneal incision (OCCI) and limbal relaxing incisions or corneal relaxing incisions (Khan et al 2014). With this advent, modern cataract surgery can be considered as a refractive procedure aiming at emmetropia. So cataract surgery should be planned not only induce less astigmatism but to nullify the pre-existing astigmatism as much as possible.

Clear corneal incision is a major breakthrough in phacoemulsification surgery. This clear corneal incision when placed on steep axis can flatten the cornea in that meridian resulting in correction of pre-existing astigmatism. The same concept, if utilized for small incision cataract surgery can prove to be more economical in developing countries.

With this background, this study was conducted to evaluate the effect of sutureless clear corneal incision on pre-existing with-the rule and against-the astigmatism of 1D-2D and to compare the outcome of superior and temporal sutureless clear corneal incisions in manual small incision cataract surgery.

Materials and Methods

A prospective interventional study was conducted at Department of Ophthalmology, Hassan institute of medical sciences, Hassan. Study sample included 80 eyes of 80 patients who were divided into two groups. GROUPA-with the rule astigmatism (WTR) and GROUP B- against the rule (ATR) astigmatism.

Sampling technique was non-probability consecutive sampling. The study was conducted for duration of 7 months between January 2015 to July 2015. The study adhered to the declaration of Helsinki and was approved from Institutional Ethical Committee, Hassan Institute of Medical Sciences, Hassan, for ethical clearance.

Inclusion and exclusion criteria: All patients with age related immature cataract with pre-existing astigmatism and their keratometry showing either with-the rule or against-the rule astigmatism of 1D-2D were included in the study.

Patients having irregular or oblique astigmatism or astigmatism due to pterygium, hyper mature cataract, corneal opacity, high intraocular pressure, previous history of any surgery in same eye and those having traumatic or complicated cataract were excluded from the study.

Procedure: Patients fulfilling inclusion and exclusion criteria were included in the study. Patients were explained about the pre-existing condition of the eye, details of the procedure and probable complications in their local language and an informed consent of the patients and their attenders was taken.

Each patient underwent a routine ophthalmological work-up that included- vision testing for near and distant vision, slit-lamp examination for anterior segment evaluation, intraocular pressure measurement, tropicamide dilatation followed by refraction and fundoscopy.

Patients were posted for cataract surgery after ascertaining physician fitness. Preoperative data collection included manifest refraction and keratometric astigmatism with a single Bausch & Lomb Keratometer to assess the type and degree of astigmatism.

Surgical technique: All surgeries were performed by a single experienced surgeon under peribulbar anesthesia with 2.5ml lignocaine with adrenaline and 2.5ml bupivacaine with hyaluronidase. An initial triplanar clear corneal incision of 2.8mm was made 1 mm anterior to limbus with 2.8 mm 45degree bevel-up keratome. The location of incision was superior in group A and temporal in group B along the steep meridian of cornea. Side port was made at 3-o clock position in group A and 6-0 clock position in group-B. After viscoelastic material was injected, a continuous curvilinear capsulorrhexis and hydro dissection made. Clear corneal incision was then extended upto 6mm and nucleus delivered using sandwich technique. Aspiration of cortex done and capsular bag refilled with viscoelastic solution. Posterior chamber Intraocular Lens was implanted in the capsular bag. Viscoelastic material was removed and anterior chamber formed and wound hydrated. At the end of the surgery, an air bubble was injected into the anterior chamber to maintain the stability.

Follow up and statistics: Postoperatively, patients in both the groups were treated with antibiotic-steroid combination, 10 times a day for 1 week and tapered over a span of six weeks and NSAID eye drops 4 times a day for 6 weeks. Results were analyzed pertaining to the respective groups.

Patients were followed up postoperatively on day-1, 1st week, after 3 weeks and 6weeks .In each follow up slit-lamp evaluation, keratometry, visual acuity and refraction were noted. In addition, wound stability and signs of infection were assessed. Assessment of effect on astigmatism was done at the end of 6 weeks after objective and subjective refraction.

All the data were recorded in a pre-designed proforma.

Statistical analysis was done using SPSS software and paired T-test was applied. Results were analyzed as mean, standard deviation and percentages. P-value of <0.05 was considered significant.

Observations and Results

Table 1: Categorization of Patients

Astigmatism		Groups	
1D-1.5D	71	Group-A (with the rule)	62
1.5D-2D	9	Group-B (against the rule)	18

Out of 80 patients 71 had pre-existing astigmatism ranging from 1D-1.5D and 9 patients had astigmatism of 1.5D -2D. There were 62 patients in group A (with the rule astigmatism) and 18 patients were in group-B(against the rule) [Table 1]. Results were analyzed under following headings [Table 2].

Table 2: Criteria for result analysis

Post-Operative K-Reading	Post-Operative Cylindrical Prescription	Analyzed Result
No astigmatism	Not Prescribed	Fully corrected pre-existing astigmatism
Residual astigmatism of 0.5D	Prescribed	Partially corrected pre-existing astigmatism
No change from pre-operative K-Reading	Prescribed	No change

In patients in Group –A of with-the rule astigmatism, 37 patients had full correction accounting to 59.67%, 19 had partial correction (30.64%) and 6 patients (10%) had no correction [Fig. 1, Table 3].

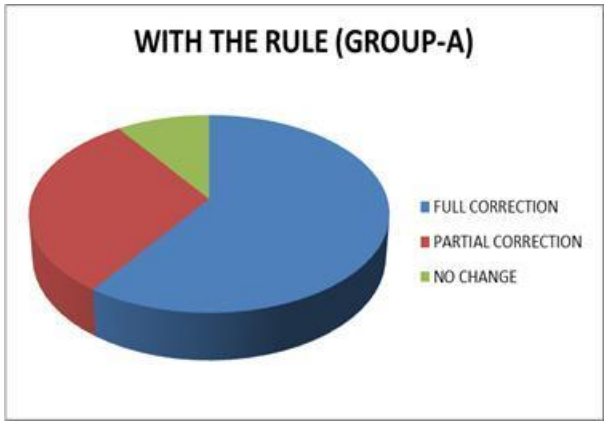

Fig. 1: Pie chart showing astigmatic change in group-A

Table 3: Results of Group-A

Group-A	Full Correction	Partial Correction	No Change
No. of Patients	37	19	6
Percentages	59.67%	30.64%	10%

In patients in Group –B of against-the rule astigmatism, 11patients had full correction accounting to 61.11%, 6 had partial correction (33.3%) and 1 patient (5.5%) had no change from their pre-existing astigmatism. [Fig. 2, Table 4].

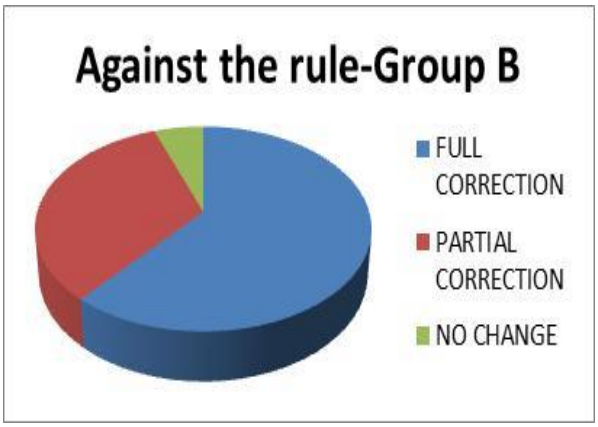

Fig. 2: Pie chart showing astigmatic change in group-B

Table 4: Results of Group-B

Group-A	Full Correction	Partial Correction	No Change
No. of Patients	11	6	1
Percentages	61.11%	33.33%	5.5%

The mean pre-operative astigmatism is 1.288 D±0.33 among 80 patients [Table 5]. In both the groups there was full correction of astigmatism almost upto 60%, a partial correction in upto 30% and rest 10% remained uncorrected. None of the patients had worsening or alteration in axis of pre-existing astigmatism. The mean post-operative astigmatism noted was 0.43D ±0.35. By applying paired T-test, a statistically significant astigmatic correction was noted following surgery with P-value being 0.0001.

Table 5: Comparison of pre-operative & post-operative astigmatism

Astigmatism	Pre-operative	Post-Operative
0-0.5D	0	48
0.5-1D	0	25
1-1.5D	81	7
1.5-2D	9	0
Total	80	80
Mean astigmatism	1.28	0.43

3 patients had peaking of pupil and 2 patients had iris prolapse. Out of 3 patients with peaking of pupil 2 was with the rule astigmatism {group-A} with superior clear corneal incision and one was against –the rule astigmatism {Group-B}. Iris prolapse was noted in 2 patients with superior incision at 1st week postoperative follow-up which was sutured eventually. Their final astigmatic status - was partially corrected in one patient and another had no change without any evidence of worsening of pre-existing astigmatism. No cases of post-operative endophthalmitis were reported.

On comparing both the groups, almost similar amount of improvement is seen. Their comparison and magnitude of change is represented in paired graph [Fig. 3].

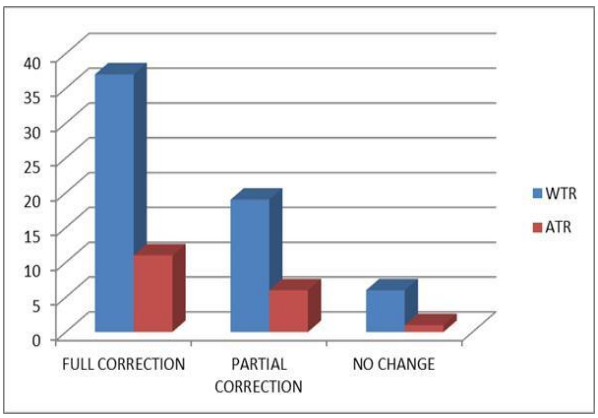

Fig. 3: Comparison of astigmatic change in two groups

Discussion

Improved spherical and astigmatic outcomes are now well-recognized benefits of modern small incision cataract surgery. It is suggested that a corneal incision placed along the steep corneal meridian might induce flattening along that meridian. Applying this concept we aimed at correcting the astigmatism ranging from 1D-2D

by extending the triplanar clear corneal incision upto 6mm and leaving the wound sutureless. As per our literature search, there are few studies that approves sutureless clear corneal incision upto 3.5mm, but this is the only study that shows positive outcome by extension of clear corneal incision upto 6mm in both superior and temporal meridians. We have observed that, with a proper triplanar self-sealing wound construction technique it is possible to correct astigmatism in a very economical way.

Rao et al (2002) compared the effect of correction of astigmatism by extending the 3.5 mm incision upto 5.5mm temporal clear corneal incision and opines that by enlarging the size of the standard (2.8 to 3.5 mm) temporal clear corneal cataract incision; pre-existing against-the-rule astigmatism was reduced significantly. Various experts also reported that surgically induced astigmatism values with small incisions were between 0.6D-1D induced by 3.5 and 4mm incisions (Simon et al 2005). We, in our study, used this principle on manual small incision cataract surgery in which, our temporal incision results are in concordance with the above study, In continuum, creating 6mm incision on superior axis would also correct astigmatism of 1D-2D.

Correction of pre-existing astigmatism simultaneously with cataract surgery is attempted nowadays. (Bar-Sela et al 2006). A 2003 survey also suggests that routine astigmatism surgery combined with cataract surgery is uncommon accounting only upto 10% (Bradley et al 2006). This method of incisional astigmatic surgery combining with routine cataract surgery can prove effective under all settings if carried out meticulously.

We compared the mean pre-operative astigmatism with mean postoperative astigmatism which showed significant reduction of approximately 0.5D-1 D. This effect reflects that, when an incision is planned pre-operatively, apart from reducing the surgically induced astigmatism we can also correct the pre-existing astigmatic error. Hence without multi-focal IOLs or additional corneal surgeries, a clear corneal incision with proper wound construction can effectively reduce astigmatism even in settings where only manual SICS facility is available.

Peripheral corneal relaxing incisions and toric intraocular lenses are used for higher degrees of astigmatism (Zyol et al 2012). Poll JT et al (2011) concluded that toric IOL and peripheral relaxing incision on cornea can be effectively combined with cataract surgery/ phacoemulsification with toric IOLs being more favoured in higher degree of astigmatism (Poll et al 2011, Carvalho et al 2007). So incisional astigmatic correction including our clear corneal incision can be used in mild-moderate degrees of astigmatism which supports the aim and observations of our study.

The study by Tejedor and Murube (2005) opines that the meridian of the incision has an important effect on the astigmatic state of the postoperative eye. Ammar M. et al (2014) in their review describes the advantages and disadvantages of clear corneal incision. The corneal entry avoids conjunctival trauma, cauterization, and tunnel creation with a reduction in surgical time, as fewer steps are required. They can lower the induced astigmatism and also tailor the incision according to pre-existing astigmatism with a faster visual recovery. Xie et al. (2001) demonstrated that a clear corneal incision placed on the steepest meridian significantly reduced postoperative astigmatism.

Nagaki et al. (2003) gives a statistically increased risk of infections with clear corneal incisions (0.29%) compared with sclerocorneal incisions (0.05%). The explained theories for more frequent post cataract endophthalmitis with sutureless clear corneal incisions are centered on the stability of the surgical wound (Rao et al 2002) and also attributed by lack of conjunctival covering along with difficulty in constructing a stable, self-sealing incision in the cornea compared with the sclera. Sutures or tissue adhesives can be used however May et al (2012) further concludes the superiority of a well-constructed unsutured two-step clear corneal incision over sutured clear corneal incisions. In our study a well-constructed triplanar clear corneal incision was the reason for wound stability and the study proves it to be effective without even a single reported case of endophthalmitis.

Temporal incisions may have reduced astigmatic effect because of farther location of temporal limbus from visual axis and an additional effect exerted from eyelid (Comez et al 2012). Our observations show equal improvement in both superior and temporal incisions.

The study is in concordance with previous results that clear corneal incisions flatten the corresponding axis. Our study is unique from previous studies, being conducted in manual SICS and sutureless clear corneal incision extended upto 6mm.The drawback of our study was, less sample in group-B which would have led to better result analysis.

Conclusion

A well-constructed sutureless triplanar clear corneal incision upto 6mm in manual small incision cataract surgery can correct pre-existing astigmatism of 1D-2D. This is an effective and economical way of correction of mild-moderate pre-existing astigmatism.

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