



Study of Surgically Induced Astigmatism after phacoemulsification at Northern Railway Central Hospital

Authors

Dr Neetu Gagneja¹, Dr O. P. Anand², Dr Jasiya Ishtiaq³, Dr Vivek Gagneja⁴,
Dr S.K Chaudhary⁵, Mohd Rameez Ganie⁶

¹Senior Resident LBS Hospital Delhi

²HOD & chief Eye Surgeon, Northern Railway Central Hospital, New Delhi

³Registrar ophthalmology, SKIMS Medical College, Srinagar

⁴Director & chief Eye surgeon, Vivek Eye Hospital, Sirsa

⁵Senior DMO Eye, Northern Railway Central Hospital, Delhi

⁶Registrar ophthalmology, SKIMS Medical College, Srinagar

Corresponding Author

Dr Neetu Gagneja

Senior Resident LBS Hospital Delhi

Abstract

Introduction: Surgically induced astigmatism is the difference between preoperative and postoperative astigmatism.

Aims: To study surgically induced astigmatism after phacoemulsification cataract surgery performed for age related cataract.

Materials and Methods: A clinical study was done to evaluate the surgically induced astigmatism after phacoemulsification with superior clear corneal incisions with foldable intra ocular lens implantation in Northern Railway Central Hospital New Delhi. A total of 100 patients, who fulfilled the inclusion criteria were taken. All cases underwent phacoemulsification with foldable intra ocular lens implantation, where superior clear corneal incision was used. Keratometric readings were taken preoperatively as well as on 1st day, 1 week, and 6th week post-operatively. Surgically induced astigmatism was calculated by SIA Calculator.

Results: Amount of average SIA on 1st day was 0.98D ±0.36, subsequently on 7th day average SIA was 0.81D ±0.31 and the average surgically induced astigmatism at 6th week was 0.79D ±0.24; there was no gross difference on 7th day and 6th week. Superior clear corneal incision induced against the rule astigmatism (59%); 20% of patient showed WTR astigmatism and 21% of patients showed oblique astigmatism post-operatively.

Conclusion: Phacoemulsification seems to achieve the goal of minimizing surgically induced astigmatism.

Keywords: Surgically induced astigmatism, Phacoemulsification, age related cataract.

Introduction

For the practicing doctor, nothing is more important than the well being of his patients. In the field of cataract this well being means not only removal of the diseased lens, but also the

subsequent visual rehabilitation. From the earliest forms of cataract surgery where the aphakic state was considered an improvement over the presence of cataract, the level of sophistication has gradually risen as the trends

for cataract surgery evolve around the world; the emphasis is shifting more & more towards optical results.

Over the years cataract surgery has undergone & is undergoing continuous refinements. The task of keeping abreast of the dynamic changes in cataract surgery is nearly indescribable¹. Due to the evolution in cataract surgery, the goal of surgery has changed from one of "Restoration of Sight" to that of "Early Restoration of Visual Acuity". The visual rehabilitation improved drastically with Intraocular lens (IOL) implantation but astigmatism induced by surgery limited optical results.

The most important variables for surgically induced astigmatism in a patient are incision, its size, site, placement of sutures and type of suture material used. Phacoemulsification is today the most popular method worldwide & has now virtually replaced all other techniques in most countries. This technique requires small incision & surgery is sutureless².

In the present study an attempt has been made to study surgically induced astigmatism, after phacoemulsification cataract surgery performed for age related cataracts.

Aims and Objectives

To study surgically induced astigmatism after phacoemulsification cataract surgery performed for age related cataract.

Materials and Methods

The study was a prospective study to evaluate the surgically induced astigmatism after phacoemulsification surgery. Target population consisted of patients who visited Ophthalmology department of N.R.C.H New Delhi-01 between March '09 to March '11 with visually significant age related cataract for phacoemulsification surgery. A total of 100 Patients were enrolled, 96 patients were present for regular follow up and were examined at day one, day seven & at sixth week. All eyes underwent standard phacoemulsification cataract surgery.

Inclusion criteria were patient with senile cataract, age 40 yrs or above of either sex and healthy eye except cataract. Patients with diabetes mellitus and hypertension were excluded as were patients with various ocular abnormalities like Severe external eye disease, Complicated cataract, Corneal degeneration, opacities, dystrophies, Any previous Intraocular or corneal surgery, High myopia (>-5D), high hypermetropia (>+5), Uveitis, Iris abnormalities, Glaucoma, Traumatic cataract, Underlying collagen vascular disease, Any organic retinal lesion leading to decreased vision, Astigmatism >1.5D.

Pre Operative Evaluation

- 1) Detailed history and clinical examination.
- 2) Visual acuity, uncorrected (UCVA) and best corrected (BCVA) was measured by Snellen's chart.
- 3) Diffuse torch light examination was done to rule out any gross abnormality.
- 4) Slit lamp bio-microscopy was performed to see any abnormality in tear film and cornea, to look for anterior chamber depth and to find out the type of cataractous lens.
- 5) Intra ocular pressure (IOP) was measured by noncontact tonometer.
- 6) Detailed fundus examination was performed with direct and indirect ophthalmoscope.
- 7) Keratometry was done by auto keratometer
- 8) Axial length of the eye was measured using Contact A-scan.

Follow Up

Patients were called on day one, day seven, and at sixth week for follow up. On each visit patients were examined thoroughly on slit-lamp, their visual acuity and keratometry findings were recorded. Surgically induced astigmatism was calculated by SIA calculator on all follow-up visits.

Results

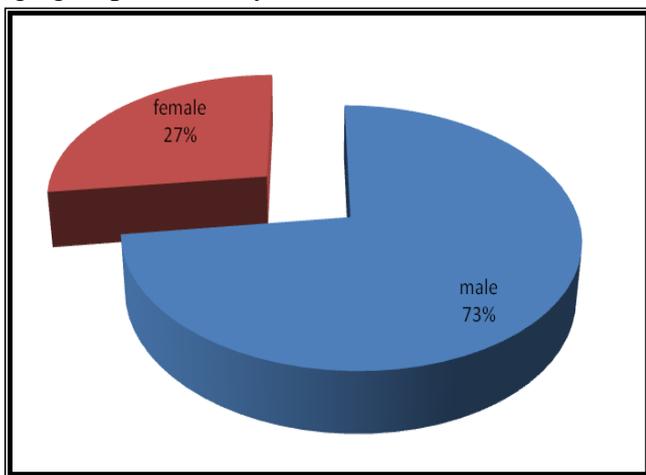
A total 100 eyes of 100 patients who underwent superior clear corneal phacoemulsification with

foldable intraocular lens implantation were enrolled for the study. Of the 100 patients, 96 patients were present for regular follow ups as per schedule and four patients were from distant places who failed to attend hospital despite best efforts, thus 96 patients were included in the study group.

Table 1: Age Distribution

Age Range(years)	No. Of cases	Percentage (%age)
41-50	1	1.04
51-60	42	43.75
61-70	33	34.37
71-80	20	20.83
Total	96	100

Out of 96 patients, majority (43.75%) were in the age group of 51-60 yrs



Graph 1: Sex Distribution

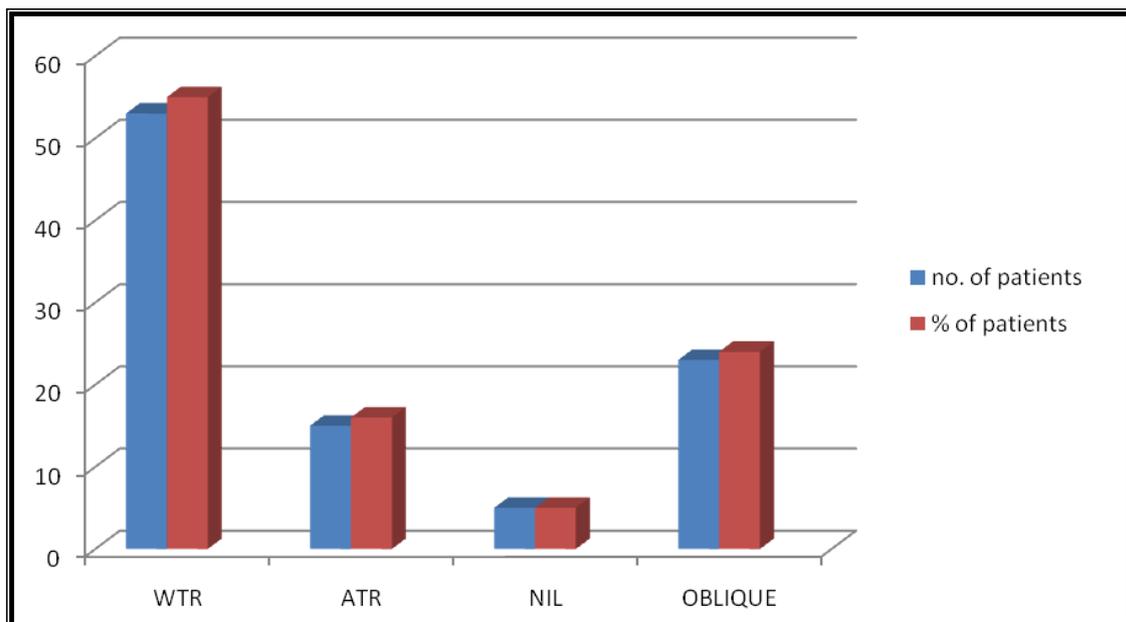
Table 2: Preoperative Visual Acuity

Visual Acuity	No. Of cases	Percentage
6/18-6/60	70	72.91
<6/60- CF 3metres	14	14.58
CF 2 metres – HM	8	8.33
PL + PR	4	4.16
Total	96	100

Table 3: Range of pre-operative astigmatism

Range of astigmatism	No. of patients	% of patients
Up to 0.5	32	33
0.51-1	43	45
1.1 to 1.5	21	22
>1.5	0	0
total	96	

32 patients (33%) had range of up to 0.5D, 43 patients (45%) had range between 0.51 to 1D, 21 patients (22%) had range between 1.1 to 1.5D and none of patients had astigmatism more than 1.5 D.



Graph 2: Pre-operative Astigmatism

Out of 96 patients majority patients (55%) had WTR astigmatism followed by 15 patients (16%) having ATR astigmatism, 23 patients (24%) with

oblique astigmatism and only 5 patients had no astigmatism.

Table 4: Comparison of type of astigmatism

Type of astigmatism	Pre operative (no. of patients)	1 st day (no. of patients)	7 th day (no. of patients)	6 wk (no. of patients)
WTR	53	22*	28*	19*
ATR	15	54*	44*	57*
Nil	5	Nil	Nil	Nil
Oblique	23	20**	24**	20**
Total	96	96	96	96

* p <0.001 Very highly significant when compared with preoperative

** p >0.05 Not Significant when compared with preoperative

In preoperative period majority patients (55%) had WTR astigmatism followed by 15 patients (16%) having ATR astigmatism, 23 patients (24%) with oblique astigmatism. However at postoperative day 1,7and 6th week majority of the patients had ATR astigmatism. On comparing the patients with WTR astigmatism in preoperative

and postoperative day 1,7and 6th week, p-value was <0.001 which is highly significant. Similarly on comparing the patients with ATR astigmatism in preoperative and postoperative day 1,7and 6th week, p-value was <0.001 which is highly significant.

Table 5: Comparison of SIA

Range	1 st day (N=96)	7 th day (N=96)	6 wk (N=96)
0.25 – 0.5	28	22	22*
0.51 – 1	31	48	73**
1.1 – 1.5	36	26	1**
1.51 – 2	1	Nil	Nil
>2.25	Nil	Nil	Nil

* p >0.05 Not Significant when compared with Ist day

** p <0.001 Very highly significant when compared with Ist day

At day 1, 36 (37.5 %) of the patients had SIA in the range of 1.1-1.5 followed by 31(32.29%) patients with SIA in range of 0.51-1. However at day 7 and 6th week majority (50% and 76.04 %) of the patients had SIA in the range of 0.51-1. On comparing the patients having SIA in range of

0.5-1 at day 1 and at 6th week p-value was found to be <0.001 which is highly significant. Similarly on doing the comparison the patients having SIA in range of 1.1-1.5 at day 1 and at 6th week p-value was found to be <0.001 which is highly significant.

Table 6: Comparison of Post-operative Visual Acuity (UCVA)

Range of UCVA	Day 1	Day 7	6 week
3/60 to 4/60	0	0	0
6/60 to 6/24	0	0	0
>6/24 to 6/12	84	73	0
>6/12 to 6/6	12	23	96
Total	96	96	96

No patient had visual acuity between 3/60 to 6/24 till 6th week of assessment. However at day1 and 7, maximum number (87.5% and 76.04%) of patients had visual acuity between >6/24 to 6/12. On

assessment at 6th week all patients were found to have visual acuity between >6/12 to 6/6.

Discussion

The goal of modern cataract surgery is to minimize corneal shape changes postoperatively and this requires an exact evaluation of astigmatism after surgery. This study demonstrated the long term effect on corneal astigmatism of superior incision of 2.8mm in phacoemulsification with foldable intraocular lens in bag.

The majority of patients in our study were in the age group of 51-60 yrs followed by patients in age group of 61-70 yrs (34.37%) and 20.83% patients were of age group 71-80 yrs. Out of 96 patients included in the study group, 70 (73%) were males and 26 (27%) cases were females. The fact of including male patients more is because of institutional organization; lot of employees less than 60 years of age group are bound to under go compulsory periodical medical examination.

Of the 96 patients in this study 55% had pre-operative with the rule astigmatism, 16% had against the rule astigmatism and 24% had oblique astigmatism. 5% had no astigmatism pre-operatively. A study conducted by Ninn Pedersen K (1997) proved that the most important predisposing factor for rapid changes in the postoperative astigmatism were large preoperative astigmatism, young age and preoperative intraocular pressure³. Another study by Anders N, et al (1997) confirmed that age and preoperative astigmatism were found to influence induced astigmatism significantly.⁴

Postoperative astigmatism after cataract surgery is of ATR type which is caused by flattening of the corneal meridian at right angles to the direction of the incision. Also sutured corneal wound steepens and incision area flattens. When incision is taken closer to the steeper axis, preoperative astigmatism reduces and if incision is taken on the steeper axis the astigmatism totally neutralizes whereas preexisting astigmatism with steeper cornea and incision taken on opposite axis – postoperative astigmatism increases.⁵ In this study postoperative astigmatism is ATR type in 57(59%)cases and WTR type in 19 (20%) patients and oblique astigmatism found in 20 (21%) cases i.e.

patients with superior clear corneal incision shows ATR (59%) type of postoperative astigmatism.

In this study we compared postoperative induced astigmatism between 1st day, 7th day & 6th week. At day one, 36 (37.5%)of patients had SIA in the range of 1.1 to 1.5 followed by 31(32.29%) patients with SIA in range of 0.51-1 & 28(29%) patients had SIA in range of 0.25 to 0.5 & one patient had SIA from 1.51 to 2. However at day 7, 48(50%) of patients had SIA in range of 0.51 to 1, 26(27%) patients had SIA in range of 1.1 to 1.5 & 22(23%) patients had SIA in range of 0.25 to 0.5. At 6 wks 73 (76%) patients had SIA in range of 0.51 to 1, 22(23%) had SIA in range of 0.25 to 0.5 and only one patient had SIA in range of 1.1 to 1.5. By knowing a preexisting astigmatism, one can reduce postoperative astigmatism by selecting a appropriate incision i.e. astigmatism is decreased by taking incision closure to steeper cornea and neutralized by taking incision on steeper area.

Giorgio Beltrame et al⁶ (2001) compared astigmatic and topographic changes induced by different oblique incisions i.e. total of 168 eyes (60 eyes – 3.5 mm clear corneal incision, 54 eyes – 5.5 mm sutured clear corneal incision, 54 eyes – 5.5 mm scleral incision) They assessed postoperative astigmatism and topographical changes in these patients. Wound-related flattening was seen at the incision site in all group which was less significant in scleral tunnel group and more with 5.5 mm clear corneal incision group. Steepening effect at opposite axis observed by these authors was higher in 5.5 mm clear corneal incision group and least in scleral tunnel group. At 6 weeks 22(23%) patients had SIA in range of 0.25 to 0.5D and 73(76 %) patients had SIA in range of 0.51 – 1D & 1% had surgically induced astigmatism in range of 1.1 – 1.5 D and none of the patient had SIA in range of 1.51 to 2 D & more. Of these most of the patients, 59% developed an ATR type of astigmatism with a mean of 0.75D and 20% developed WTR with a mean of 0.93D. And 21% had oblique surgically induced astigmatism with mean of 0.69D. Xie L,

Zang Y and Cao J (1995) in their study of 34 cases of phacoemulsification proved that the postoperative astigmatism showed a tendency of change from WTR shifting to ATR⁷. Azar DT, Stark WJ, Dodick J, Khoury JM, Vitale S, Enger G, Reed C⁸(1997) proved in their study of 131 patients treated with phacoemulsification with three-, one-, and no sutures that sutureless group had the greatest proportion of patients with significant ATR shift and lowest with significant WTR shift.

Roman S and Ullern M (1997) studied astigmatism caused by superior and temporal corneal incisions i.e. sixty eyes underwent cataract surgery- 30 in Group A with superior corneal incision and Group B consisted of 30 patients with temporal clear corneal incision. Incision was placed according to the preoperative astigmatism i.e. superior in case of with the rule astigmatism. They found that surgically induced astigmatism is against the rule for a superior location and with the rule for temporally located incision. They concluded that superior corneal incisions rarely allows to reach a minimum postoperative astigmatism as with a temporal location⁹.

Conclusion

Phacoemulsification seems to achieve the goal of minimizing surgically induced astigmatism. Superior clear corneal incision induced against the rule astigmatism (59%); 20% of patient showed WTR astigmatism and 21% of patients showed oblique astigmatism post-operatively. Amount of average SIA on 1st day was 0.98D \pm 0.36, subsequently on 7th day average SIA was 0.81D \pm 0.31 and the average surgically induced astigmatism at 6th week was 0.79D \pm 0.24.

Bibliography

1. Harry B Grabow. Indication for lens surgery and different techniques. Mayron Yanoff, Jay S Duker, eds. Ophthalmology. Mosby, St. Louis 2004; 320.
2. Parson's, Lens. Parson's diseases of the eye Parson's, New delhi 20th ed. 20th ed. 2007p-264.
3. Ninn Pederson K. Cataract patients in a defined Swedish population 1986-90, VIII postoperative astigmatism, intraocular pressure and visual acuity. Acta Ophthalmol Scand 1997; 75:558-68.
4. Anders N, et al. Factors modifying postoperative astigmatism after no stitch cataract surgery. Ophthalmology 1997; 94(1):6-11.
5. Agarwal A. Corneal topography in cataract surgery. Chapter 4 in 'Phacoemulsification, laser cataract surgery and foldable IOLS. Sunita Agarwal et al. New Delhi; Jaypee Brothers, 1998; 23-33pp.
6. Giorgio Beltrame MD, Maria I, Salvetat MD, Marzio Chizzolini MD. Corneal topographic changes induced by different oblique cataract incisions. J Cataract Refract Surg 2001;27(5);720-27.
7. Xie L, Zang Y and Cao J. A preliminary report of small incision cataract surgery by phacoemulsification. Chung Hua Yen Ko Tsa Chih 1995; 31:330-2.
8. Azar DT, stark wj, dodick j et al. Prospective, randomized vector analysis of astigmatism after three one and no-suture phacoemulsification. J Cataract Refract Surg 1997; 23:1164-73.
9. Roman S, Ullern M. Astigmatism caused by superior and temporal corneal incisions in cataract surgery. J Fr Ophthalmol 1997; 20:277-83.