

SURGICALLY INDUCED ASTIGMATISM AFTER IMPLANTATION OF FOLDABLE AND NON-FOLDABLE LENSES IN CATARACT SURGERY BY PHACOEMULSIFICATION

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ABSTRACT: This prospective comparative study included 300 matched patients of different grades of senile cataract. All of them willfully underwent phacoemulsification at the hands of a single experienced surgeon, performing with a single and individual technique {Woodcutter's technique¹}; half of them were implanted with a foldable intraocular lens and the other half with a non-foldable PMMA intraocular lens. All the patients undergoing phacoemulsification had an improvement in vision. There was no statistically significant difference in the surgically induced astigmatism after implanting foldable or non-foldable IOL.

KEYWORDS: Phacoemulsification, Cataract surgery, Foldable IOL, Non foldable phaco IOL, Astigmatism, Keratometry, Woodcutter's technique.

INTRODUCTION: Phacoemulsification devised by Charles Kelman, MD, in early 1966² has reduced the trauma to the eye and has improved the stability to the corneal shape. Introduction of the foldable intraocular lens by Dr. Mazzocca,³ allows us to take full advantage of the small incision of phacoemulsification. This prospective comparative study included 300 matched patients of different grades of senile cataract. All of them willfully underwent phacoemulsification at the hands of a single experienced surgeon, performing with a single and individual technique {Woodcutter's technique¹}; half of them were implanted with a foldable intraocular lens and the other half with a non-foldable PMMA intraocular lens. The study aimed at calculating and comparing surgically induced astigmatism after implantation of foldable and non-foldable intraocular lenses.

MATERIALS AND METHODS: This prospective, hospital based comparative study of 300 matched patients of senile cataract of various grades, operated by single phacoemulsification technique by a single experienced surgeon was carried out at Mahatme Eye Bank and Eye Hospital, Nagpur, India between May 2004 and May 2005 after ethical committee's approval.

The patients were divided into 2 groups, first group of 150 being implanted with a foldable {poly-HEMA} and the other 150 patients being implanted with a non-foldable rigid PMMA intraocular lens.

Sample size was calculated by considering confidence interval of 90% at 5% significance.

INCLUSION CRITERIA: Patients with operable senile cataract of all grades.

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EXCLUSION CRITERIA: Patients having any of the following were excluded from the study.

- Congenital, traumatic or complicated cataract.
- Pre-existing glaucoma {primary or secondary}.
- Subluxation or pseudoexfoliation.
- Pre-existing corneal pathology.
- Uveitis.
- High myopia with degenerative changes.
- Posterior segment pathology, mainly diabetic or hypertensive retinopathy or macular pathology.
- Blind opposite eye.

PREOPERATIVE OPHTHALMIC EVALUATION: Included.

- a. Visual acuity:
 1. Unaided.
 2. Best corrected.
 3. With spectacles.
- b. Intraocular pressure with {Perkin's} applanation tonometer.
- c. Detailed slit lamp biomicroscopic examination of the eye.
- d. Detailed fundus examination with the aid of a direct and indirect ophthalmoscopes and a 90 Dioptre lens.
- e. Retinoscopy.
- f. Patency of the lacrimal system {syrringing}.
- g. Keratometry with the aid of auto-keratometer.
- h. IOL power calculation and axial length by A-scan using SRK-II formula.

POSTOPERATIVE EVALUATION WAS DONE:

1. Prior to discharge.
2. Second postoperative day.
3. At end of 1 week.
4. At end of 1 month.
5. At the end of 6 weeks.

Spectacle correction was given at end of a week and surgically induced astigmatism calculated at the end of 6 weeks by Vector analysis as described by Jaffe and Clayman.⁴

OBSERVATIONS: Table 1 shows the variety of cataracts included in the study group. Posterior subcapsular cataracts were the most common and nuclear sclerosis of grade three was the next common in frequency in both the groups. Only two cases of hypermature cataract were included, one in either group was found.

GRADE	Cataract	Foldable	Percent	Non Foldable	Percent	TOTAL
1	NS1	3	2.00	1	0.67	4
2	NS2	20	13.33	30	20.00	50

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3	NS3	24	16.00	21	14.00	45
4	PSC	29	19.33	42	28.00	71
5	PPC	9	6.00	6	4.00	15
6	MAT	17	11.33	13	8.67	30
7	NS1+PSC	4	2.67	3	2.00	7
8	NS2+PSC	25	16.67	7	4.67	32
9	NS3+PSC	4	2.67	5	3.33	9
10	NS+PPC	5	3.33	1	0.67	6
11	ASC+NS	1	0.67	1	0.67	2
12	HMSC	1	0.67	1	0.67	2
13	NS4	3	2.00	10	6.67	13
14	NS+CC	2	1.33	1	0.67	3
15	NMSC	3	2.00	6	4.00	9
16	PSC+PPC	0	0.00	2	1.33	2

Table 1: DISTRIBUTION OF VARIOUS TYPES OF CATARACT IN THE TWO GROUPS

Postop astigmatism	Foldable	Non-Foldable	TOTAL
ZERO	1	0	1
upto 0.5	22	8	30
0.51-1.00	64	40	104
1.01-1.5	44	47	91
1.51-2.00	16	34	50
>2.00	3	21	24
TOTAL	150	150	

Table 2: POSTOPERATIVE ASTIGMATISM ON KERATOMETRY

The above table 2 of postoperative astigmatism on keratometry was analysed by Graph-pad prism in following manner.

FISHER'S EXACT TEST			
P value	P<0.0001		
P value summary	***		
One or two sided	Two sided		
Statistically significant? (alpha < 0.05)	Yes		
STRENGTH OF ASSOCIATION			
Relative risk	2.258		
99% confidence interval	1.329 to 3.836		
Odds ratio	3.992		
99% confidence interval	1.851 to 8.609		

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Data Analysed	Foldable Group	Non-Foldable Group	Total
Less than 1.5	131	95	226
More than 1.5	19	55	74
Total	150	150	300

When calculated on keratometry alone, 131 patients in the foldable group and 95 patients in the non-foldable group showed a postoperative astigmatism of less than 1.5. On the other hand, 19 patients in the foldable group and 55 patients in the non-foldable group showed a postoperative astigmatism of more than 1.5. This difference in the values for the two groups was statistically significant at $p < 0.0001$ by applying Fisher's exact test.

Surgically induced Astigmatism	Foldable group	Non-Foldable group	TOTAL
Upto 0.5	50	42	92
0.51-1.00	63	65	128
1.01-1.5	27	33	60
1.51-2.00	10	8	18
>2.00	0	2	2
SIA	Foldable	Non-Foldable	TOTAL
less than 1.5	140	140	
more than 1.5	10	10	

Table 3: SURGICALLY INDUCED ASTIGMATISM ON VECTOR ANALYSIS

The values for the surgically induced astigmatism for the two groups were identical when divided further into two categories of less than or more than 1.5. Thus, we could infer that there was no statistically significant difference in the surgically induced astigmatism whether a foldable poly-HEMA or a rigid PMMA intraocular lens is implanted following phacoemulsification.

Astigmatism on acceptance of refraction	Foldable	Non Foldable	TOTAL
Zero	63	52	115
upto 0.5	31	30	61
0.75-1	37	44	81
1.25-1.5	15	15	30
>1.5	4	9	13

Table 4: POSTOPERATIVE ACCEPTANCE OF ASTIGMATIC CORRECTION

The above table 4 of postoperative acceptance of astigmatic correction was analysed by Graph-pad prism in following manner.

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FISHER'S EXACT TEST			
P value	0.256		
P value summary	NS		
One or two sided	Two sided		
Statistically significant? (alpha < 0.05)	NO		
STRENGTH OF ASSOCIATION			
Relative risk	1.653		
95% confidence interval	0.7256 to 3.767		
Odds ratio	2.33		
95% confidence interval	0.7013 to 7.740		
Data Analysed	Foldable Group	Non-Foldable Group	Total
Less than 1.5	146	141	287
More than 1.5	4	9	13
Total	150	150	300

There was no statistically significant difference in the acceptance of astigmatism shown by patients of either group ($p = 0.256$). In the foldable group 146 patients accepted an astigmatic correction of less than 1.5 and 4 patients showed an acceptance of more than 1.5.

On the other side, in the non-foldable group, 141 patients accepted an astigmatic correction of less than 1.5 and 9 patients accepted a value of more than 1.5.

DISCUSSION: Postoperative astigmatism calculated solely on keratometric readings showed that astigmatism was present in both these groups. Maximum number of eyes, 64 patients from the foldable and 40 from the non-foldable group, had astigmatism within the range of 0.51-1.00 D. The non-foldable group showed an increase in the number of patients with astigmatism beyond 1.00 D. This may be explained by the larger corneal incision (5.20mm) for implanting a non-foldable lens of size 5.25mm. The keratometric difference postoperatively was analyzed using Fisher's exact test, at a confidence interval of 95% and it was found to be significant at $p < 0.05$. It showed the relative risk of developing astigmatism of 1.883 if a non-foldable lens was implanted.

Surgically induced astigmatism (SIA) calculated by vector analysis showed no statistically significant difference between the two groups. 140 patients in either groups had an SIA of < 1.5 D and 10 patients in either groups had SIA of > 1.5 D. This effect may just be because the temporal incision is away from the visual axis and it is on the steeper meridian as compared to the superior incision. John Merriam C. et al⁵ in their study of the effect of incisions for cataract surgery on the corneal curvature have inferred that there was significant change in the corneal curvature when the incision was taken on the temporal clear cornea.

Postoperative keratometry in both the groups showed astigmatism in all the patients. Statistical analysis by Fisher two paired test also showed statistically significant difference in the astigmatism between the two groups at $p < 0.0001$. When patients were refracted after 10 days of surgery, 63 patients in the foldable group and 52 patients in the non-foldable group did not accept

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any cylindrical correction. 52 patients in the foldable group and 59 patients in the non-foldable group accepted a cylindrical correction of 0.75-1.5 D. No patient required a high cylindrical acceptance.

CONCLUSION: Consistent and reproducible outcome can be obtained after phacoemulsification in all grades of cataract by a single technique. There was no statistically significant difference in the astigmatism after implantation of foldable and non-foldable lenses. This study opens the doors to explore the feasibility of using non-foldable lenses in phacoemulsification as a cost effective technique for community eye care programs.

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