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Outcome of Best Corrected Visual Acuity Following Surgically Induced Astigmatism in Manual Small Incision Cataract Surgery

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Abstract

Background: *Age related cataract remains the major cause of blindness throughout the world but the huge backlog exists mostly in the developing world. Manual small incision cataract surgery is the most common surgeries performed worldwide especially in developing countries like India. The aim of Cataract surgery is to provide best possible and early visual outcome. The advantages of MSICS as a low cost "equally effective" technique, makes it an alternative, especially in an unequally developed country like India*

Material and Methods: *The study was conducted in the Department of Ophthalmology, M.G.M Medical College and L.S.K Hospital, Kishanganj, Bihar. Patients were screened from Ophthalmology Outpatient Department, selected and then admitted in the eye ward of M.G.M Medical College and L.S.K Hospital for undergoing surgery during the period, 1st July 2014 to 30th June 2016. Their visual acuity (Snellen's chart) and keratometry (in Diopters) recorded pre-operatively and postoperatively on 1st day, 2nd week, 6th week and 3rd month visit. Visual acuity less than 1/60 was tested in terms of finger counting, hand movement and perception of light and projection of rays. The study was conducted on a total of 204 patients divided into two groups by the type of incision(frown, linear) and length of incision(6.5mm, 7mm, 7.5mm)*

Result: *Majority of the eyes achieved a postoperative uncorrected visual acuity of 6/24 or better by the end of 2nd week. It was 86.15% (176 out of 204 eyes) at 2nd week, 84.61% (173 out of 204) at 6th week and 90.76% (185 out of 204). Eyes with an uncorrected visual acuity of 6/9 or better was 24.61% (50 out of 204) at 2nd week, 29.23% (60 out of 204) at 6th week and 46.15% (60 out of 204). 57.57% of patients in the Frown Group achieved best corrected visual acuity (BCVA) of 6/9 or better as compared to 50% from the Linear Group whereas 37.5% of patients in the Linear Group achieved BCVA 6/12 to 6/24 as compared 33.33% from the Frown Group.*

The Linear Incision Group consisted 100 eyes of 100 patients of which 54 were males and 46 were females. The age group ranges from 35 to 70 years with a mean age of 52.31 years whereas Frown Incision Group consisted of 104 eyes of 104 patients of which 52 were males and 52 were females. The age group ranged from 32 to 69 years with a mean age of 53.75 years. The age difference between the Linear and Frown group was found to be statistically insignificant ($p>0.05$)

Conclusion: *The conclusions reached in this study are that best corrected visual acuity at the end of 6 weeks was found to be about 6/9 compared to initial first postoperative day 1 where it was found to be 6/36 or 6/60.Best corrected visual acuity remained almost constant after 6 weeks postoperatively and at the end of our study at 3 months.*

Keywords: *visual acuity, surgically induced astigmatism.*

Introduction

Age related cataract remains the major cause of blindness throughout the world but the huge backlog exists mostly in the developing world [1]. According to WHO, 285 million people are estimated to be visually impaired worldwide: 39 million are blind and 246 million have low vision. India is now home to the world's largest number of blind people. Of the 37 million people across the globe who are blind, over 15 million are from India. In India alone 3.8 million people become blind from cataract every year [2] as against 2.7 million cataracts done every year [3]. The aim of Cataract surgery is to provide best possible and early visual outcome. The advantages of MSICS as a low cost "equally effective" technique, makes it an alternative, especially in an unequally developed country like India [4].

Ever since astigmatism was reported after surgery, it has intrigued surgeons for over a century and has remained one of the major obstacles to achieving of the goal of rapid and stable visual rehabilitation. Attention has now shifted to optical results. Present day surgeons aim at minimizing postoperative astigmatism so as to provide clear, strain free vision. Astigmatism is due to error of curvature refractive index, or decentration of lens[5]. By convention, with-the-rule astigmatism (WTRA) has its meridian with the least radius of curvature (steepest) or greatest refracting power in a vertical meridian; against-the-rule astigmatism (ATRA) is the converse, with the curvature of least radius or most refractive power in horizontal meridian. Surgically Induced Astigmatism (SIA) in its immediate post-operative state present as WTRA, but later shifts to ATRA. Thus the astigmatism that we see after cataract surgery is variable and depends on a number of factors, most of them related to the incision viz size, site, method of preparation and closure of the surgical wound. Surgically induced astigmatism also depends on operative and postoperative manipulation, sutures (if used) and time elapsed since surgery. India is signatory to the World Health Organization resolution on Vision 2020: The right to sight. Efforts of all stakeholders have concentrated on increasing the number of cataract surgeries performed in India, but the impact of these efforts on the elimination of avoidable blindness is unknown. The World Health Organization (WHO) definition of blindness is a visual acuity of less than 3/60 (20/200, 0.05), and low vision is less than 6/18 (20/50, 0.3) in the better eye with the best correction.

This is an endeavour to study Manual Small Incision Cataract Surgery in relation to visual rehabilitation and also to ascertain the effect of different types of scleral incisions upon postoperative astigmatism.

Aims & Objectives

The present study is aimed at performing a scan and keratometry pre-operatively and post-operatively in patients who will be undergoing cataract operation and will be present in operation theatre. Aim is to minimize post-operative astigmatism so as to provide clear, strain-free vision.

The objectives of the study are:

- To find out the best corrected visual acuity following surgically induced astigmatism in manual small incision cataract surgery.
- To compare post-operative induced corneal astigmatism in small incision cataract surgery using different types of incision (frown, straight) varying in their incision length(6.5mm, 7mm, 7.5mm).

Materials & Methods

The study was conducted in the Department of Ophthalmology, M.G.M Medical College and L.S.K Hospital, Kishanganj, Bihar. Patients were screened from Ophthalmology Outpatient Department, selected and then admitted in the eye ward of M.G.M Medical College and L.S.K Hospital for undergoing surgery during the period, 1st July 2014 to 30th June 2016.

Criteria of selection were as follows:

- Immature cataract in one or both eyes with vision less than or equal to 6/24 in the affected eye.
- Mature cataract.

- Age more than 30 years.
- Patients with age related uncomplicated cataract.

Exclusion criteria consisted of patients with – Glaucoma, uveitis, traumatic cataract, congenital cataract < 30 year of age, scleral thinning, keratoconus, diseases of cornea, e.g. dystrophy, degeneration, dry eye, any active ocular disease, immune-compromised patient, diabetes mellitus, prior intra-ocular surgery, e.g., Filtering bleb, patient those were lost to follow-up, presence of collagen vascular disease, patients showing astigmatism in 70-110 and 160-20 degree axes during refraction were selected. Others were excluded., cases requiring sutures to close the tunnel.

Patients were primarily divided into two major groups and operated upon by two different types of incision (Linear, Frown) and each major group of patients operated upon with three different length (6.5 mm, 7 mm and 7.5 mm) of incision.

Surgery was done by different surgeons.

6.5 mm of incision was used in posterior subcapsular cataract, posterior cortical cataract, early immature cataract, advanced immature cataract

- mm of incision was used in hyper-mature cataract, advanced immature cataract.
- mm of incision was used in nuclear cataract (Black Cataract), intumescent cataract, mixed cataract, cortical mature cataract.

Clinical Assessment of Patients

Detailed assessment of the patients was carried out and the findings were documented. In all the patients general examination and systemic examination were carried out. Examination of the eyes in diffuse light, slit lamp biomicroscopy, direct and indirect ophthalmoscopy was done. Intraocular Pressure was measured with the Schiotz Tonometer. Each patient underwent syringing to rule out nasolacrimal duct obstruction. SRK-II formula was used to calculate the intraocular lens power with the help of keratometry and A-scan Biometry data. Their visual acuity (Snellen's chart) and keratometry (in Diopters) recorded pre-operatively and postoperatively on 1st day, 2nd week, 6th week and 3rd month visit. Visual acuity less than 1/60 was tested in terms of finger counting, hand movement and perception of light and projection of rays.

Study Design

The eyes were divided into two major Groups (I and II) according to the type of incision applied.

Group- I

Eyes in this group received a Linear incision. This group consisted of 100 patients and they were divided into two subgroups on the basis of the length of incision:

Subgroup A	Incision size 6.5 mm
Subgroup B	Incision size 7.0 mm
Subgroup C	Incision size 7.5 mm

Group – II

Eyes in this group received a Frown incision. This group consisted of 104 patients and they were divided into two subgroups on the basis of the length (chord) of the incision:

Subgroup A	Incision size 6.5 mm
Subgroup B	Incision size 7.0 mm
Subgroup C	Incision size 7.5 mm

All 204 patients, divided into 2 groups (Group I, Group II) and study underwent preoperative and postoperative keratometry at Day1, 2nd week, 6th week and 12th week after surgery. Only the induced astigmatism at the end of 12 postoperative weeks is being mentioned. Induced Astigmatism assessed by Keratometer where,

- K_1 or preoperative keratometric astigmatism.
- K_3 or postoperative keratometric astigmatism after 12weeks of surgery.
- K_2 or surgically induced astigmatism 12 weeks after surgery which is the difference of K_3 from K_1.

Surgically Induced Astigmatism (SIA) or K_2

his was the difference between the preoperative and postoperative keratometric astigmatism at first day, second and sixth week and third month.

$$K_2 = K_3 - K_1$$

Results

Visual Acuity

The uncorrected visual acuity was recorded preoperatively and at different postoperative intervals up to 3rd month. The data is given below:

VISION	PRE-OP		DAY 1		WK 2		WK 6		MTH 3	
	L	F	L	F	L	F	L	F	L	F
6/9 OR BETTER	-	-	5	8	7	9	9	10	13	17
6/12 – 6/24	3	5	18	17	20	20	19	17	16	13
6/36 – 6/60	9	4	6	5	5	4	3	5	3	3
5/60 - FCCF	12	12	3	3	-	-	1	1	-	-
HM / PL +ve	8	12	-	-	-	-	-	-	-	-
TOTAL	32	33	32	33	32	33	32	33	32	33

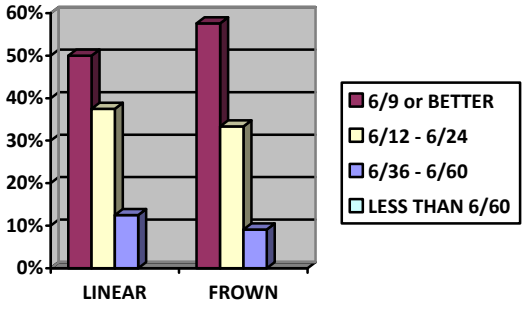
L: Linear; F: Frown; FCCF: Finger Counting close to Face
HM: Hand Movement; PL+ve: Perception of Light present

Majority of the eyes achieved a postoperative uncorrected visual acuity of 6/24 or better by the end of 2nd week. It was 86.15% (176 out of 204 eyes) at 2nd week, 84.61% (173 out of 204) at 6th week and 90.76% (185 out of 204). Eyes with an uncorrected visual acuity of 6/9 or better was 24.61% (50 out of 204) at 2nd week, 29.23% (60 out of 204) at 6th week and 46.15% (60 out of 204).

Refraction and glass correction was given at the end of 6th postoperative week. The following table shows the Best Corrected Visual Acuity (BCVA) achieved at 6th postoperative week.

Table 1: BCVA achieved at 6th postoperative week

BCVA	LINEAR	FROWN
6/9 or BETTER	50(50%)	59(57.57%)
6/12 – 6/24	37(37.5%)	34(33.33%)
6/36 – 6/60	13(12.5%)	11(9.09%)
LESS THAN 6/60	---	---



Graph 1: Best Corrected visual acuity at 6th week

From the above table and figure it is evident

- 57.57% of patients in the Frown Group achieved best corrected visual acuity (BCVA) of 6/9 or better as compared to 50% from the Linear Group.
- 37.5% of patients in the Linear Group achieved BCVA 6/12 to 6/24 as compared 33.33% from the Frown Group.

Age and Sex Distribution

The Linear Incision Group consisted 100 eyes of 100 patients of which 54 were males and 46 were females. The age group ranges from 35 to 70 years with a mean age of 52.31 years.

The Frown Incision Group consisted of 104 eyes of 104 patients of which 52 were males and 52 were females. The age group ranged from 32 to 69 years with a mean age of 53.75 years.

The age difference between the Linear and Frown group was found to be statistically insignificant ($p>0.05$)

3rd postoperative month

The pattern and magnitude of postoperative astigmatism at the 3rd month is as follows:

Table 2: Type of Astigmatism at 3rd Postoperative Month

TYPE OF ASTIGMATISM	FROWN			LINEAR		
	6.5mm (n=64)	7.0mm (n=14)	7.5mm (n=26)	6.5mm (n=62)	7.0mm (n=14)	7.5mm (n=24)
ZERO	2	2	-	-	-	-
WTR ASTGM.	32	8	12	38	4	12
ATR ASTGM.	30	4	14	24	10	12

From the table it is seen that (50%) 52 out of 104 eyes in the Frown Group had postoperative WTRA compared to (54%) 54 out of 100 eyes in the Linear Group

In the Frown Group (46.15%) 48 out of 104 cases showed postoperative ATRA compared to (46%) 46 out of 100 eyes in the Linear Group.

Change in the Pattern of Astigmatism

The pattern of keratometric astigmatism in the early postoperative period showed majority (52.82%) of eyes with WTRA. The 2nd postoperative week showed a mild change within the trend with an increase in the percentage of ATRA. This change in the type of astigmatism continued till the third postoperative month, and is stated in the Table and Figure below:

Table: Type of Astigmatism in Different Postoperative Period

Period	WTRA	ATRA
Day 1	58.82%	37.25%
Week 2	57.84%	36.27%
Week 6	27.45%	69.60%
Month 3	51.96%	46.07%

Table 3: Showing Measure Astigmatism (M.A) and Surgically Induced Astigmatism (S.I.A) of the Frown and Linear Group

Follow Up	Frown		Linear	
	M.A	S.I.A	M.A	S.I.A
Pre-op	0.99	-	1.20	-
Day 1	1.57	0.85	1.28	0.85
Week 2	1.67	0.97	1.08	0.68
Week 6	1.51	1.03	1.56	1.24
Month 3	1.39	1.00	1.21	1.05

All values in Diopters

Discussion

The number of eyes achieving a postoperative uncorrected visual acuity of 6/24 or better in this study was similar between the 2nd week (86.14%), 6th week (84.61%) and 3rd month (90.74%). It is evident that majority of patients achieved good uncorrected vision as early as 2nd week and the percentage was comparable till the 3rd postoperative month implying early stabilisation and maintenance. Oshika *et al.,* (1998) reported an uncorrected visual acuity of 6/12 or better in 65.4% and 78.4% of the eyes undergoing phacoemulsification through a 5.5 mm sutureless Linear sclerocorneal incision at the end of 2nd week and 3rd month[6].

Uusitalo et al., and Tarkkanen et al., (1998) reported that 89.5% of their eyes achieving 6/12 or better (best corrected) at the end of 4 months in their series of 216 eyes undergoing phacoemulsification through a 4.0 mm incision.[7]

Zawar et al., and Gogate et al., in their study on 2000 eyes undergoing manual SICS found that 93.4% of eyes achieved a final BCVA better than 6/12 at 6wk postoperatively[8]. Rohatgi *et al*., found 93.3% of patients had BCVA of 6/18 or better at 8wk after SICS with central frown incision[9].

Venkatesh *et al.,* reported that UCVA of 6/18 or better was achieved in 87.6% of eyes in the PHACO group and 82% of eyes in the MSICS group by 6 weeks postoperatively[10]. The corresponding BCVA of 6/18 or better was achieved in 99% from the PHACO group and 98.2% from the MSICS group by 6 weeks postoperatively. It has slight similarity with our study as BCVA at 6 weeks in our study was found to be 6/24 or better in 87.5% cases of Linear group and 90.9% cases of Frown group.

Conclusion

The conclusions reached in this study are:

a) Best corrected visual acuity at the end of 6 weeks was found to be about 6/9 compared to initial first postoperative day 1 where it was found to be 6/36 or 6/60.

b) Best corrected visual acuity remained almost constant after 6 weeks postoperatively and at the end of our study at 3 months.

c) Larger incisions induce more astigmatism than smaller one.

d) Straight incisions induce greater astigmatism; chance of induced astigmatism is greater with Straight incision and lesser with Frown.

e) Astigmatism induced by Straight and Frown incisions do not differ when length of incision is 7.5 mm or more.

f) Larger incisions are associated with less complication.

g) Different sclera incisions with regard to shape and size have no effect on final visual acuity. Incision within a range of 7mm do not show significant differences in postoperative astigmatism.

h) Postoperative astigmatism stabilises after the second week.

The benefits of small incision cataract surgery can be obtained with the present technique with a few instruments and relatively less expensive viscoelastic material while avoiding the high cost and complexities of phacoemulsification. Modification of the manual technique is possible thus allowing room for changes as per surgeon's need and infrastructure available.

Although phacoemulsification is becoming increasingly popular, planned manual ECCE is still the procedure for the masses. Manual SICS can replace the conventional ECCE method and achieve postoperative results comparable to

phacoemulsification in the long run. In a country like ours, where the economics involved with any procedure is always an important factor, Manual Small Incision Cataract Surgery has an important role to play in eradicating curable blindness among the masses.

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