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COMPARATIVE EVALUATION OF SURGICALLY INDUCED ASTIGMATISM FOLLOWING BLUMENTHAL VERSUS FROWN CORNEOSCLERAL TUNNEL INCISION IN MSICS (MANUAL SMALL INCISION CATARACT SURGERY)

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ABSTRACT

Background: Cataract surgery is aimed at providing early visual rehabilitation and good vision. MSICS has added advantage over phacoemulsification of being done in every cataract type along with being cost-effective, stable, consistent, successful in visual recovery, safe, less technology-dependent, short-duration, and sutureless.

Aim: The present study was conducted to comparatively evaluate astigmatism induced surgically following Blumenthal versus Frown corneoscleral tunnel incision in MSICS.

Methods: The study included 88 subjects from both genders divided into 2 groups of 44 subjects each via odd and even numbers where Group A subjects underwent MSICS with Blumenthal Corneoscleral incision and Group B subjects with Frown Corneoscleral incision. Follow-up of all subjects was done at 1 day, 1, 4, and 6 weeks postoperatively where the assessment was done with Keratometry, fundoscopy, slit-lamp biomicroscopy and vision.

Results: Mean best-corrected visual acuity was higher in Group B (Frown incision) compared to Group A with Blumenthal incision with respective values of 0.630±0.210 and 0.691±0.229. However, this difference was statistically non-significant with p=0.199. In the group, The mean astigmatism was continuously increasing till the 3rd week and then it decreased. But there were no statistically significant differences were found between different time intervals (P=0.453). In group B it was gradually increasing till 3rd week and after 6th week it slightly reduced. A statistically significant difference was found between time intervals (P=0.026). Mean visual acuity, preoperatively, was statistically non-significant between the two groups with respective values of 0.191±0.408 and 0.123±0.136 respectively for Group A and B (p=0.297). On postoperative day1, 1st week, 3rd week, and 6th week the visual acuity between the two groups was statistically non-significant with respective p-values of 0.402, 0.387, 0.227, and 0.087

Conclusion: The present study concludes that in MSICS, both Frown and Blumenthal corneoscleral incisions have minimal astigmatism and best-corrected visual acuity postoperatively. However, surgically induced astigmatism has a non-significant difference in the two study groups. Hence, both the incisions can be used for cataract management;

however, the Blumenthal incision is better for big nuclei and hard cataracts compared to the Frown incision.

Keywords: Blumenthal incision, Cataract, Frown incision, manual small incision cataract surgery, surgically induced astigmatism

INTRODUCTION

The most common cause of curable blindness globally is Cataracts with an incidence of nearly 48% as reported by WHO (World Health Organization). Nearly 51% of blindness in India is by Cataracts making approximately 4 million subjects blind every year, and 10 million operable cases are in India, whereas, only 5 million cataract surgeries are being done in India every year. The incidence of blindness can be markedly reduced by mass cataract surgeries. Earlier, cataract was managed with extracapsular surgery, however, it resulted in more astigmatism. Phacoemulsification is another method that is not done in developing countries for mass cataract surgeries owing to it being expensive. Owing to the high prevalence of cataracts, it is usually treated by organizing camps. However, phacoemulsification cannot be done in camps as they are expensive making MSICS (manual small incision cataract surgery) as treatment of choice for cataracts.[1]

Cataract surgery is aimed at providing early visual rehabilitation and good vision. MSICS has added advantage over phacoemulsification of being done in every cataract type along with being cost-effective, stable, consistent, successful in visual recovery, safe, less technology-dependent, short-duration, and sutureless. However, a few disadvantages associated with MSICS are more surgically induced astigmatism and larger incision compared to phacoemulsification. The factors affecting surgically induced astigmatism are wound construction, age, pre-existing astigmatism, configuration, site, and size of the incision.[2] Major role in MSICS is placed by wound construction based on endothelium condition, astigmatism, nucleus hardness, and technique type. Pre-existing astigmatism can be balanced by a change in the incision site. As the force generated by superiorly placed incision due to drag by eyelid blinking and gravity is balanced by incisions placed temporally as it is parallel to force vector.[3]

Different incisions are being described for cataract surgery. Reduction in surgically induced astigmatism can be achieved by placing an incision on the steep meridian axis which balances pre-existing astigmatism or by a temporal approach for neutralizing astigmatism.[4] Frown incision by Singer suggested that curving away of incision from corneal limbus can minimize wound slide against its drift in astigmatism where 6-7mm incision is made nearly 1.5mm away from limbus increasing surface area, causing less postoperative astigmatism, and more wound stability. Another Blumenthal incision utilizes a straight incision with cuts at each end increasing tunnel space for easy delivery of the nucleus.[5] The present study was conducted to comparatively evaluate astigmatism induced surgically following Blumenthal versus Frown corneoscleral tunnel incision in MSICS.

MATERIALS AND METHODS

The present prospective, randomized comparative study was conducted at People's Hospital, Department of Ophthalmology, Peoples College of medical science, and research center Bhanpur, and Bhopal (M.P.) after obtaining clearance from the concerned Ethical committee. The study included 88 subjects from both genders divided into 2 groups of 44 subjects each

via odd and even numbers where Group A subjects underwent MSICS with Blumenthal Corneoscleral incision and Group B subjects with Frown Corneoscleral incision. After explaining the detailed study design, informed consent was taken from each subject in both written and verbal form.

The inclusion criteria for the study were subjects of age 50 years or more having bilateral o unilateral uncomplicated senile cataract, and were willing to study participation. The exclusion criteria were subjects with previous ocular surgery history including pterygium excision, squint, glaucoma surgery, or scleral tear repair, Preoperatively, against the rule astigmatism, pterygium, corneal pathology, and complicated, traumatic, or glaucomatous cataract.

After the final inclusion of the study subjects, detailed history was recorded along with demographics including age, occupation, gender, and cataract history. Preoperatively, the ocular examination was conducted to assess disease that may affect visual outcome. The tests conducted were Best-corrected visual activity using Snellen's chart[6], IOP (intraocular pressure), lacrimal patency, slit-lamp examination, lenticular opacity grading using LOCS III, fundus examination, corneal curvature, and IOL (intraocular) length power.

After routine blood and biochemical investigations, subjects were placed for MSICS and IOL implantation following the assessment of cataract type, corneoscleral incision type, incision length, and pre-existing astigmatism. 3 days before surgery, all subjects were given topical antibiotic eye drop qid along with 2 stat Diamox 250 mg to decrease preoperative IOP. Preoperatively, adequate mydriasis was achieved by tropicamide 0.5% ± phynilephrine 5% and flurbiprofen 0.03% eye drop every 15 minutes for one hour to prevent intraoperative miosis.

All the surgeries in a group were performed by a single surgeon expert in the field. The surgery was performed using standard surgical protocols under peribulbar anesthesia of 5-8cc; lignocaine 2%, bupivacain0.5% along with hyaluronidase 5 IU/ml. After eye preparation, a fornix-based conjunctival flap was made after the application of speculum and insertion of superior rectus bridle suture. Superior tunnel corneal incision was made for cataract including external scleral incision with either Blumenthal[7]/frown[8] corneoscleral incision, sclero-corneal tunnel, side-port entry, anterior capsulotomy, hydro dissection and hydro delineation, nucleus management, cortical matter aspiration, non-foldable PMMA IOL, and filling of balanced salt solution. The superior rectus suture was then removed. Subconjunctival injections of Dexamethasone and Gentamycin were given, and the eye was patched after applying antibiotic ointment.

Postoperatively, all the subjects of both groups were given 200mg of Ofloxacin for 5 days and diclofenac for 3 days. Topical 1% Prednisolone acetate was given every 2 hours for 72 hours followed by tapering over 6 weeks. For the initial 15 days, 0.5% moxifloxacin was given for 15 days. For 6 weeks, eye ointment chlorocol-H HS, flurbiprofen TDS, and homatropine 0.5% were also given.

Follow-up of all subjects was done at 1 day, 1, 4, and 6 weeks postoperatively where the assessment was done with Keratometry, fundoscopy, slit-lamp biomicroscopy, and vision. Postoperative and intraoperative complications were also noted. Refraction was checked on the 45th day and spectacles were prescribed. SIA (surgically induced astigmatism) was

assessed by subtracting subtraction of power of astigmatism before Apreop, from that after surgery Bpostop.

SIA subtraction = Bpostop _ Apreop

Grade of astigmatism was taken from the postoperative change in corneal curvature following straight and frown sclera incision cataract surgery[9 (69)]

The collected data were subjected to statistical evaluation using SPSS version 20, Chicago Inc., USA. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at $p<0.05$. The tests used were Chi-square, student t-test, ANOVA, Spearman's correlation, and Turkey post-hoc analysis.

RESULTS

The majority of the study subjects were in the age range of 50-90 years and mean age of 64.49±9.98 years. There were 46 males and 42 females in the present study. On assessing the mean visual acuity pre and post-operatively at different time-interval among groups A and B, preoperatively, it was statistically non-significant between the two groups with respective values of 0.191±0.408 and 0.123±0.136 respectively for Group A and B (p=0.297). On postoperative day1, 1st week, 3rd week, and 6th week the visual acuity between the two groups was statistically non-significant with respective p-values of 0.402, 0.387, 0.227, and 0.087 at different time intervals as shown in Table 1.

The mean best-corrected visual acuity was higher in Group B (Frown incision) compared to Group A with Blumenthal incision with respective values of 0.630±0.210 and 0.691±0.229. However, this difference was statistically non-significant with p=0.199 (Table 2).

For the assessment of Astigmatism grades pre and post-operatively at different time-interval among groups A and B, Grade I astigmatism was present in both groups and grade V astigmatism was present in the least no of the patients. Only preoperatively statistically significant difference was present between group A & B (P=0.001) while after operation at all time intervals there was no statistically significant difference between group A & B In Relation To [i.r.t] Astigmatism Grade (Table 3).

In the group, The mean astigmatism was continuously increasing till the 3rd week and then it decreased. But there were no statistically significant differences were found between different time intervals (P=0.453). In group B it was gradually increasing till 3rd week and after 6th week it slightly reduced. A statistically significant difference was found between time intervals (P=0.026) as shown in Table 4.

On Turkey's post hoc analysis for intergroup comparison among the group subjects in relation to [I.R.T.] astigmatism, mean difference in Astigmatism on Pre vs Post 1st day, Pre vs Post 1st week, Pre vs Post 3rd day, Pre vs Post 6th week, Post 1st day vs Post 1st week, Post 1st day vs Post 3rd week, Post 1st day vs Post 6th week, Post 1st week vs Post 3rd week, Post 1st week vs Post 6th week, and Post 3rd week vs Post 6th week respectively was 0.051, 0.040, 0.068, 0.119, 0.011, 0.017, 0.170, 0.028, 0.159, and 0.188. The respective p-values were 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 0.981, 1.000, 1.000, and 2.00 (Table 5).

DISCUSSION

The influence of cataract surgery incision on astigmatism is known for more than a century now. Compared to phacoemulsification, MSICS is less technology-dependent, less expensive, effective visual rehabilitation, and safe as suggested by Tejedor J et al[9] in 2005. Visual

outcomes and Astigmatism compared from Frown and Blumenthal incision were compared by the previous studies of Haldipurkar SS et al[10] in 2009. The present study assessed 88 subjects having senile cataract where both Frown and Blumenthal incisions were able to achieve minimal astigmatism and good visual outcomes.

The present study showed that SIA increased in 1st week and then gradually decreased. Preoperatively mean SIA was 0.789±0.488 in group A which was increased to 0.840±0.788 in the 1st week then it reduced up to 0.670±0.580 in the 6th week. Similarly in group B preoperative mean SIA was 0.608 ± 0.506 which was increased to 0.835±0.690 in the 1st week and then reduced up to 0.840 ± 0.522 in the 6th week. But in the all-time interval, there was no statistically significant difference was observed between groups A & B (p=0.151). These results were consistent with the results of Fukuda S et al[11] in 2011 where authors reported that SIA is not a static value; it is high immediately after surgery and decreases over time. Stromal hydration can increase the amount of SIA, and this effect can last up to 1 week post-operatively.

In the present study, SIA was 0.670±0.580D in group A patients and 0.840±0.522D patients in group B at the 6th week, however, a statistically non-significant difference was observed between both groups (P=0.151). These findings were in agreement with the studies of Jauhari et al[12] in 2014 where authors reported a mean SIA of -0.96±0.71D with superior scleral frown incision group at four weeks postoperatively. Gokhale et al 2005 have found mean astigmatism in MSICS with superior frown incision to be 1.28 D at 29 degrees. Also, Raimagiya et al[13] in 2015 found at the end of three months mean surgically induced astigmatism was 1.09D in the straight scleral incision group and 0.90D in the frown scleral incision group which was much lesser than in the straight group.

The study results also showed that the study magnitude of postoperative astigmatism was nearly equal in both groups at the end of the 6th week which was 0.0- 0.5D in 54.5% and 38.6% in the Blumenthal and Frown group respectively, which was statically not significant (p= 0.258). Jauhari et al[12] in 2014 found in the frown incision group, maximum patients (57.9%) showed induced astigmatism of less than 1 D. These results were following the studies of Randeri et al[14] in 2008 found that central frown incision has reported induced astigmatism of less than 1 D in only 28.57% patients, with maximum patients (42.85%) had SIA between 1.25-2 D. Another study of Raimagiya et al[13] in 2015 found that in straight group maximum patients showed 1.1-2.0 D of SIA and in Frown group showed 0.6-1.0 D SIA at the end of three months. The high SIA in this study may help to neutralize a pre-existing the rule astigmatism (WTR) of 2D, and to reduce significant WTR astigmatism of > 2 D using a superior incision. Also, Radwan et al[15] in 2011 reported preoperative corneal with the rule (WTR) astigmatism (around 2 D) can be reduced by superior incision.

CONCLUSION

Within its limitations, the present study concludes that in MSICS, both Frown and Blumenthal corneoscleral incisions have minimal astigmatism and best-corrected visual acuity postoperatively. However, surgically induced astigmatism has a non-significant difference in the two study groups. Hence, both the incisions can be used for cataract management; however, the Blumenthal incision is better for big nuclei and hard cataracts compared to the Frown incision. The present study had a few limitations including a smaller

sample size and short monitoring period. Universal acceptance is not associated with Blumenthal incision owing to its large incision. Also, ease of performing and learning frown incision is low, however, SIA has made its choice among ophthalmic surgeons.

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TABLES

Time interval	Group A (Blumenthal) (Mean ± S. D)	Group B (Frown) (Mean ± S. D)	Student 't' Test Value	p-value
Preoperatively	0.191±0.408	0.123±0.136	1.0488	0.297
Post Operatively 1st Day	0.250±0.135	0.270±0.130	0.843	0.402
Post-Operatively 1st week	0.372±0.152	0.400±0.151	0.869	0.387
Post Operatively 3rd Week	0.540±0.208	0.500±0.146	1.218	0.227
Post Operatively 6th Week	0.660±0.240	0.580±0.128	1.729	0.087

Table 1: Mean visual acuity pre and postoperatively at different time-interval among groups A and B

Mean BCVA	Best-corrected visual acuity (Mean ± S. D)	Student 't' Test Value	p-value
Group A (Blumenthal)	0.691±0.229	1.293	0.199
Group B (Frown)	0.630±0.210		

Table 2: Mean best-corrected visual acuity among groups A and B

Astigmatism	Preoperatively				
	Astigmatism and Grade				
	0.0-0.5 D 1	0.6-1.0 D 2	1.1=1.5 D 3	1.6-2.0 D 4	2.1-2.5 D 5
Group A (Blumenthal)	2(4.5%)	32(72.7%)	7(15.9%)	2(4.5%)	1(2.3%)
Group B (Frown)	29(65.9%)	10(22.7%)	2(4.5%)	3(6.8%)	0(0.0%)
Chi-square value	**39.018**				
	Postoperative Day 1				
Group A (Blumenthal)	20(45.5%)	11(25.0%)	5(11.4%)	6(13.6%)	2(4.5%)
Group B (Frown)	21(47.7%)	11(25.0%)	6(13.6%)	4(9.1%)	2(4.5%)
Chi-square value	**0.515**				
p-value	**0.972**				
	Postoperative 1st week				
Group A (Blumenthal)	25(56.8%)	7(15.9%)	4(9.1%)	5(11.4%)	3(6.8%)
Group B (Frown)	24(54.5%)	10(22.7%)	7(15.9%)	2(4.5%)	1(2.3%)
Chi-square value	**3.654**				
p-value	**0.455**				
	Postoperative 3rd week				
Group A (Blumenthal)	19(43.2%)	13(29.5%)	6(13.6%)	5(11.4%)	1(2.3%)
Group B (Frown)	14(31.8%)	16(36.4%)	8(18.2%)	4(9.1%)	2(4.5%)
Chi-square value	**1.798**				
p-value	**0.773**				
	Postoperative 6th week				
Group A (Blumenthal)	24(54.5%)	12(27.3%)	6(13.6%)	1(2.3%)	1(2.3%)
Group B (Frown)	17(38.6%)	14(31.8%)	8(18.2%)	5(11.4%)	0(0.0%)
Chi-square value	5.301				
p-value	0.258				

Table 3: Astigmatism grade pre and postoperatively at different time-interval among groups A and B

Astigmatism	**Group A (Blumenthal) (Mean ± S. D)**	**Group B (Frown) (Mean ± S. D)**
Preoperatively	0.789±0.488	0.608±0.506
Post Operatively 1st Day	0.840±0.788	0.835±0.690
Post-Operatively 1st week	0.829±0.865	0.681±0.613
Post Operatively 3rd Week	0.858±0.647	0.960±0.662
Post Operatively 6th Week	0.670±0.580	0.840±0.522
ANOVA F-value	0.850	3.249
p-value	0.453	0.026

Table 4: Mean Astigmatism pre and postoperatively at different time-interval among groups A and B

Time Interval	**Mean difference in Astigmatism**	**p-value**
Pre vs Post 1st day	0.051	1.000
Pre vs Post 1st week	0.040	1.000
Pre vs Post 3rd day	0.068	1.000
Pre vs Post 6th week	0.119	1.000
Post 1st day vs Post 1st week	0.011	1.000
Post 1st day vs Post 3rd week	0.017	1.000
Post 1st day vs Post 6th week	0.170	0.981
Post 1st week vs Post 3rd week	0.028	1.000
Post 1st week vs Post 6th week	0.159	1.000
Post 3rd week vs Post 6th week	0.188	0.200

Table 5: Turkey's post hoc analysis for intergroup comparison among the group a subjects in relation to [I.R.T.] astigmatism