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Original article:

Comparision of keratometric astigmatism by phacoemulsification in superior scleral tunnel incision versus temporal clear corneal incision

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Abstract-

Introduction: Aim of this study was to study mean keratometric astigmatism postoperatively in patients undergoing phacoemulsification of either superior scleral tunnel incision or a temporal clear corneal incision.

Material and Method- A hospital based comparative observational study of 40 eyes with uncomplicated senile cataract was done. The study group was randomly divided into two groups of 20 patients in each group. Each patient underwent phacoemulsification with foldable posterior chamber intraocular lens implantation (PCIOL) either with superior scleral tunnel incision or temporal clear corneal incision. Patients history, pre-operative keratometry reading using Baush and Lomb keratometer . During Postoperative follow up, keratometric readings were recorded on postoperative Day 7th and 1 month. Amplititude of surgical induced astigmatism (SIA) was calculated using SIA calculation software version 2.1. Statistical analysis software namely SYSTAT version 12 (By Cranes software, Bangalore) was used to analyze the data to compare postsurgical changes.

Result: Mean SIA in Temporal clear corneal incision was significantly less as compare to superior scleral tunnel incision after 1 month postoperative.

At 1 month postoperatively out of 20 patients in superior scleral tunnel incision 14 had ATR astigmatism ,6 had WTR astigmatism, while that in temporal clear corneal incision ,8 had ATR astigmatism and 6 had WTR astigmatism and – 6 had neutralization of preexisting astigmatism.

Conclusion: This study shows that temporal clear corneal incision by phacoemulsification, produces less SIA compare to superior scleral incision by phacoemulsification. ATR which is common in old age was reduced in temporal clear corneal incision but increased in superior scleral tunnel incision.

Keywords: phacoemulsification, Clear corneal incison, Scleral tunnel incision, WTR, SIA

INTRODUCTION:

Vision undergoes many physiological changes due to process of ageing. Cataract is the most common. Cataract is defined as the opacification of the crystalline lens or its capsule. It is the chief cause of avoidable blindness in India and throughout the world. Cataract induced blindness which is treatable accounts for 62.6% of blindness in India[2]. It is estimated that about 3.8 million people develop visually disabling cataracts every year[2]. Surgery is the only definitive treatment for it.

Most important goal of cataract surgery is to provide early visual rehabilitation and good unaided visual acuity. It has undergone a commendable revolution from 17th century practice of couching at the time of Sushrutha to

Intracapsular cataract extraction, extracapsular cataract extraction, small incision cataract surgery and phacoemulsification. Phacoemulsification is the recent technique of cataract surgery. The advent of this surgery by an ultrasonically activated probe inserted into the cataractous crystalline lens was pioneered by Kelman in 1967.[3] It is a procedure where the nucleus is ultrasonically fragmented and aspirated by a small incision. It has been opted as the surgery of choice due to better patient compliance, earlier stabilization of refraction, improved visual acuity, minimal post-operative astigmatism and minimal complications.

Phacoemulsification is a technique of using ultrasound energy to emulsify the cataractous lens .It uses a probe with piezo electric crystals that vibrate at a frequency between 27,000-60,000 HZ. The nucleus is emulsified and the remaining cortex is aspirated with a bimanual irrigation aspiration system following which an intraocular lens can be implanted.

Refractive aspect of cataract surgery has gained lot of advancement. The phacoemulsification leads to reduced amount of surgical induced astigmatism with better and the faster wound stability and less time required for visual rehabilitation. Phacoemulsification surgery does not require sutures which helps in reducing astigmatism.

There are two commonly used techniques-phacoemulsification by clear corneal incision and phacoemulsification by scleral tunnel incision. Recently preference has been shifted from scleral tunnel incision to clear corneal incision.

MATERIALS AND METHODS:

Prospective, observational and comparative hospital based study involving 40 eyes of 40 patients undergoing phacoemulsification with foldable posterior chamber intraocular lens(PCIOL) implantation between September 2016 to July 2018. Ethical committee approval was taken before starting the study.A written informed consent was taken from all patients undergoing phacoemulsificaion.

INCLUSION CRITERIA

All patients of age 50 years & above of either sex with senile cataract undergoing phacoemulsification at tertiary eye centre.

EXCLUSION CRITERIA

Patients with congenital & developmental cataract.

Complicated cataract .

Pre existing corneal opacity, uveitis, glaucoma & macular degeneration which independently cause limitation of vision.

Posterior segment anomalies.

. All the patients underwent the following pre-operative evaluation and complete eye examination including a full history of any previous ocular disease or surgery, examination by both direct and indirect ophthalmoscopy, visual acuity recording by Snellen’s chart, Applanation tonometry, Keratometry, A scan with intraocular lens power calculation by SRK-2 formula and detailed slit lamp examination.

All patients were put on oral Tab Ciprofloxacin 500mg twice daily, and Ciprofloxacin 0.3% eye drops hourly one day prior to surgery. Preoperatively pupils were dilated with Tropicamide 0.8% with Phenylephrine 0.5% or 1% drops along with Flurbiprofen 0.03% drops. Informed and written consent was taken from all patients. Sensitivity to local anesthetics was tested with lignocaine test dose. All surgeries were done under peribular anesthesia.

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The patients were randomly divided into two groups:

Group A: Phacoemulsification with superior scleral tunnel incision - 20 patients

Group B: Phacoemulsification with temporal clear corneal incision- 20 patients

In group A- 2.8 mm scleral triplanar incision was made in superior temporal quadrant 1to1.5mm posterior to limbus. In group B- 2.8mm triplanar clear corneal incision was made in superior temporal quadrant 1mm anterior to anatomical limbus.

The procedure in both the groups was followed by phacoemulsification with implantation of foldable intraocular lens. Postoperatively patients were put on topical steroids and antibiotics for 4 to 6 weeks with gradual tapering. Tablet ciprofloxacin 500mg were given for 5 days.

Following phacoemulsification with clear corneal/scleral tunnel, patients were evaluated postoperatively for keratometry and complications if any was recorded in each patient postoperatively on 7th day, first month. Postoperative astigmatism was evaluated by Bausch and Lomb keratometry readings. Amount of astigmatism was calculated using SIA calculator.

RESULT:

In this study 40 eyes of 40 patients statisfying all inclusion and exclusion criteria were included. These patient were randomly divided into two group. Group A had 20 patients undergoing phacoemulsification with PCIOL implantation with superior scleral tunnel incision and Group B had 20 patients with PCIOL implantation with temporal clear corneal incision.

Table No.1: Age and sex wise distribution in Superior Scleral Tunnel Incision and Temporal Clear Corneal Incisionin phacoemulsification

SIA	**At day 7**	**At 1 Month**
	Mean ± SD	**Mean ± SD**
Superior Scleral Tunnel Incision (n=30)	0.75±0.41	0.60±0.33
Temporal Clear Corneal Incision (n=30)	0.40±0.33	0.33±0.25

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Table No.2: Comparison of mean values of SIA at preoperative examination in Superior Scleral Tunnel Incision and Temporal Clear Corneal Incisionin phacoemulsification:

Superior Scleral Tunnel Incision			**Temporal Clear Corneal Incision**		
Male	**Female**	**Total**	**Male**	**Female**	**Total**
5	2	**7**	3	2	**5**
2	9	**11**	5	5	**10**
0	2	**2**	2	3	**5**
7	**13**	**20**	**10**	**10**	**20**

Table No.3: Comparison , Kh, Kv, and SIA from Day 7 to 1 Month examination in Superior Scleral Tunnel Incision and Temporal Clear Corneal Incision in phacoemulsification

Parameters	**Superior Scleral Tunnel Incision**			**Temporal Clear Corneal Incision**		
	Day 7	**1 Month**	**Student's**	**Day 7**	**1 Month**	**Student's**
	Mean ± SD	**Mean ± SD**	**Paired 't' test value and significance**	**Mean ± SD**	**Mean ± SD**	**Paired 't' test value and significance**
Kh	44.62±1.23	44.85±1.95	t=0.98, p=0.17, not significant	44.63±1.25	44.53±1.18	t=0.27, p=0.81, not significant
Kv	44.26±1.29	43.83±1.77	t=0.82, p=0.11, not significant	44.57±1.25	44.51±1.27	t=0.99, p=0.78. not significant
SIA	0.75±0.41	0.60±0.33	t=1.99, p=0.001, significant	0.40±0.33	0.33±0.25	t=12.39, p=0.001, significant

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RANGE(D)	DAY 7		1 MONTH	
	NO. OF PATIENTS	%	NO. OF PATIENTS	%
O.25-0.50	10	77.5	11	82.5
0.51-0.75	6	12.5	6	12.5
0.76-1.00	4	10	3	5
TOTAL	20	100	20	100

TABLE 4: POST-OPERATIVE ASTIGMATISM IN GROUP A (SCLERAL TUNNEL INCISION GROUP)

RANGE(D)	Day 7		1 MONTH	
	NO. OF PATIENTS	%	NO. OF PATIENTS	%
O.25-0.50	9	70	13	77.5
0.51-0.75	8	20	6	17.5
0.76-1.00	3	10	1	5
TOTAL	20	100	20	100

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TABLE 5: POST OPERATIVE ASTIGMATISM IN GROUP B (CLEAR CORNEAL INCISION GROUP)

Table 4: comparision of type of astigmatism in Group A and Group B

Type	Superior Scleral Tunnel Incision			Temporal Clear Corneal Incision		
	Preoperative	Day 7	1 Month	Preoperative	Day 7	1 Month
ATR	10	15	14	12	10	8
WTR	10	5	6	8	5	6
NIL	0	0	0	0	5	6
TOTAL	20	20	20	20	20	20

DISCUSSION

Cornea contributes almost 2/3rd of the refractive power of the eye. The full thickness incision made in the cornea can differentially affect the curvature of the cornea to varying amount, in different meridians. The site, size and types of the incision are the major determinants for this change.

Every corneal incision will induce some degree of astigmatic change, depending on the location, architecture and width. Because of the natural asymmetry present in the anterior segment anatomy, the superior limbus is closer to the visual axis than the temporal limbus and it has more of an astigmatic effect given the same size incision. If a typical temporal incision induces 0.5 D of flattening at that meridian, then expect the superior incision to cause as much as 1 D of flattening at its axis. This is one of the reasons why temporally placed incisions are often preferred for cataract surgery.

Postoperative astigmatism depends primarily on the size, architecture and location of the incision. Self-sealing tunnel incisions do not induce corneal changes caused by sutures. Thus the incisions are more than a port of access to the anterior chamber. It is the most important step during surgery affecting ocular integrity and corneal stability.

The last two decades have seen a rapid advancement in cataract wound architecture. With advancements in technology of cataract surgery there has been a gradual trend toward smaller incisions, moving from superior sclera to temporal clear corneal incison, in an attempt to reduce intraoperative complications and postoperative astigmatism.[5]

The patients were randomly divided into two groups of 20 patients each (group A-superior scleral tunnel incision and group B –clear corneal incision). After detailed preoperative evaluation, phacoemulsification with foldable IOL implantation was performed.

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keratometry and complications if any were recorded in each patient postoperatively on7th POD, first month . Pre and postoperative astigmatism was evaluated by Bausch and Lomb keratometry readings. SIA was calculated using SIA calculator 2.1. Statistical analysis was applied to compare the effects of postoperative astigmatism. Complications if any in between the two groups were also studied.

This study was done to compare the effects of clear corneal versus scleral tunnel incison on post-operative astigmatism.

Group B showed a significant decrease in the number of patients having ATR astigmatism from 12 pre-operatively to 10 (50%) on POD 7 and 8 at 1month postoperative. There was an increase in the number of patients having WTR astigmatism from 8 pre-operatively to 5 on POD 7 and 6 at 1 month postoperative . 5 (16.66%) patients showed neutralisation of pre-existing astigmatism on 7th POD while this number further increased to 6 at 1 month post-operatively.

In our study on POD 7- 10 patients in Group A had astigmatism between (0.25–0.5) compare to 9 patients in Group B, While 6 patients in Group A had astigmatism between (0.51-0.75) compare to 8 patients in Group B, 4 patients in Group A had astigmatism between (0.75-1.0) compare to 3 patients in Group B on keratometry.

On post-operative 1 month - 11 patients had astigmatism between (0.25-0.50) compare to 13 patients in Group B, while 6 patients in Group A and Group B had astigmatism between (0.50-0.75) , 3 patients in Group A had astigmatism between (0.75-1.0) compare to 1 in Group B. This showed that there was minimal SIA in temporal clear corneal incision after 1 month.

In a study done by He Y, Zhu S, Chen M, Li D[10] showed that the changes of corneal astigmatic diopter in Groups A(clear corneal temporal incision) and B(Scleral tunnel temporal incison) after 3month postop from keratometric reading were 1.04 + 0.76 and 0.94 + 0.27, respectively (P = .84 >.05), which showed no statistical significant difference.[9] In our study we reported postoperative astigmatism after 1 months in both the groups A(superior scleral tunnel incision) were 0.75±0.33(p=0.001),while in Group B(clear corneal incision) were 0.33±0.25 which showed statistical significance.

In a study done by Olsen T, Johansen MD, Bek T, Hjortdal J[11] showed that postoperative astigmatism (vector analysis, keratometry) was 1.41 D ± 0.66 (SD) and 0.55 ± 0.31 D in the corneal incision group and the scleral incision group, respectively (P < .01).[10]

A study performed by Bilinska et al[12] evaluated the astigmatic effect of scleral tunnel incisions and clear corneal incisions in adults. The lowest mean postoperative corneal astigmatism was achieved in the group with the superotemporal clear corneal incision. This study demonstrated that clear corneal incisions induce less astigmatism than scleral tunnel incisions. In our study we found that there was significant statistical change in postoperative astigmatism in between the two groups (t=1.99, p=0.001, significant)

In a study done by Oshima Y, Tsujikawd K, Oh A, Harino S[8] showed that mean scalar shift of keratometric cylinder in the corneal incision group was 1.19 diopters (D) at 2 days postoperatively, 0.86 D at 1 week, and 0.56 D at 3 months and in the scleral incision group, 1.09 D at 2 days, 0.76 D at 1 week, and 0.65 D at 3 months.[7] In our study we found that mean postoperative corneal astigmatism in Group A on 7st day postoperative was 0.75±0.41, while that in Group B was 0.40±0.33 .

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At 1 month postoperative in Group A was 0.60±0.41 compare to 0.33±0.25 in GroupB with statistical significance of P=0.001.

In a study done by Einollahi[13] B et al showed that scleral tunnel incision is better than clear corneal incision in minimizing postoperative astigmatism.[12]

Susie et al[14] in their analysis of postoperative corneal astigmatism after phacoemulsification through a clear corneal incision, concluded that the mean postoperative corneal astigmatism was 0.23 D.

CONCLUSIONS:

Significant statistical difference was found in post-operative astigmatism after a 1month follow up period in between the two groups.

Surgical induced astigmatism was not much significant at postop day 7 between two groups

Surgical induced astigmatism (SIA) was found to be statistically less in temporal clear corneal incision then superior scleral tunnel incision after post operative 1 month.

Thus this study shows temporal clear corneal incision to better than superior scleral tunnel incision.

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