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Original Research Article

A Study to Assess the Astigmatism Before and after Cataract Surgery using Short Incisions, Specifically Comparing the Outcomes of Superior and Temporal Incisions as Well as Phacoemulsification Surgery

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Abstract

Aim: The aim of the present study was to evaluate the preoperative and post-operative astigmatism in small incision non-phaco cataract surgery from superior and temporal incision and phacosurgery

Methods: The current investigation was carried out at the Department of Ophthalmology, IGIMS, Patna, Bihar, India over a duration of one year. A total of 100 patients were chosen for the investigation. All patients received manual small incision cataract surgery (MSICS), with 50 patients undergoing superior scleral incision, 50 patients undergoing superotemporal incision, and the remaining 50 patients undergoing phacosurgery. All individuals were assessed and treated at the same medical facility, and they received post-operative care as outpatients at the same hospital.

Results: A randomized comparison of astigmatism at postoperative follow-ups after superior (SI), superotemporal scleral incision (STI), and Phacosurgery in manual small incision cataract surgery in 100 patients, 50 each incision. In this study, 74% of MSICS patients in both groups had visual acuity less than 6/60, whereas 26% had it more than 6/60. In this study, 18 (36%) WTR astigmatism patients underwent SI, 17 (34%) STI, and 16 (32%), while 22 (44%) ATR astigmatism patients underwent SI, 46% STI, and 24 (48%) Phacosurgery.

Conclusion: This study demonstrates that sutureless superotemporal scleral incision causes less post-operative astigmatism than superior and phacosurgery. Superotemporal incision causes with-the-rule astigmatism in most cases postoperatively and can neutralize against-the-rule astigmatism in most elderly cataract patients, while superior scleral incision causes mostly against-the-rule.

Keywords: MSICS, Surgically Induced Astigmatism (SIA), Superior scleral incision, phacosurgery

Introduction

Contemporary cataract surgery focuses on quickly restoring vision and achieving the highest possible uncorrected visual acuity (UCVA) while minimizing astigmatism after the operation. [1] Despite the advancements in surgical procedures that enable quick visual recovery, surgically induced astigmatism (SIA) continues to be a prevalent barrier to reaching optimal uncorrected visual acuity (UCVA). The average surgically induced astigmatism (SIA) resulting from traditional manual small incision cataract surgery (SICS) typically falls within the range of 1.00 to 3.00 diopters (D), with the specific value depending on the size of the incision. [2]

According to Miller [3], astigmatism is a refractive problem where a point of light cannot be focused into a clear image on the retina using a corrective spherical lens. Surgically induced astigmatism (SIA) has been extensively examined in recent years. A vector is a quantity that possesses both magnitude and direction. [4] Postoperative astigmatism can occur as a result of factors such as the size, location, and kind of incision made during surgery, as well as the positioning of the lens.

More than 60% of patients scheduled for cataract surgery had pre-existing astigmatism. [5] Girard and Hoffman were the pioneers who coined the term "scleral tunnel incision" to describe the posterior

incision technique. They were also the first to perform the incision from a somewhat corneal position. [6] Recent advancements in sutureless procedures have eliminated the need for several sclero-corneal stitches and instead utilize small incisions in the self-sealing scleral tunnel. These advancements not only provide self-sealability but also provide astigmatic neutrality. [7,8] For any wound that is leaking, it is possible to use either 10-0 nylon or vicryl suture to create a single horizontal stitch. [9] Currently, surgeons have a preference for initiating the incision in the vascular area, namely on the sclera, due to its stability and fast healing process. The selection of the incision site is based on factors such as the wound's ability to heal quickly and its capability to correct astigmatism. The healing process of the site is influenced by factors such as the kind of conjunctival flap (fornix based or limbal based) and the presence of sutures. [10]

The superotemporal scleral incision (STI) provides several advantages compared to a superior incision. It allows for greater access to the incisions and provides better visibility of intraocular structures. Additionally, the location of the incision farthest from the visual axis results in less endothelial damage. The STI is particularly advantageous in terms of astigmatism, as it typically induces with-the-rule astigmatism in most cases. This incision is also beneficial for elderly patients with cataracts, as they often have pre-existing against-the-rule (ATR) astigmatism. Furthermore, by avoiding a superior rectus bridle suture, the STI helps prevent postoperative ptosis. [11] During surgery, using a superotemporal incision provides better access to the surgical site compared to working across the brow. Additionally, the existence of a lateral central angle right below the incision allows for natural drainage of fluid. The superotemporal incision effectively counteracts the effects of gravity and eyelid drag on the wound, which is not the case with a superior incision. Superior scleral incision (SI) is beneficial for patients who have preoperative with-the-rule (WTR) astigmatism. The location of the incision, whether it is on the sclera, cornea, or at the front or back of the limbus, results in a separation of tissues that leads to a flattening along the incision line and a steepening in the direction perpendicular to it. [12]

The objective of this study was to assess the astigmatism before and after cataract surgery using short incisions, specifically comparing the outcomes of superior and temporal incisions as well as phacoemulsification surgery.

Methods

The present study was conducted in the Department of Ophthalmology, IGIMS, Patna, Bihar, India for the period of one year. 100 patients were selected in the study. All the patients underwent manual small incision cataract surgery (MSICS), 50 with superior scleral incision, 50 with superotemporal incision and rest of the 50 with phacosurgery. All were evaluated and managed in the same hospital and they underwent post-operative follow up as outpatient in the same.

Inclusion Criteria

1. Age related senile cataract.

2. No associated ocular disorders like previous ocular surgeries, history of trauma, glaucoma etc.

3. No associated systemic disorders.

4. Patients who were posted for manual small incision cataract surgery.

Exclusion Criteria

1. Age below 40 and above 90 years.

2. Corneal surface irregularities.

3. Associated ocular disorders.

4. Combined surgical procedures at the time of surgery like trabeculectomy, pterygium excision.

5. Previous ocular surgeries.

6. With systemic connective tissue disorders.

7. Inability to give informed consent.

8. Congenital and developmental cataract.

Pre-operatively detailed history regarding ocular and systemic complains if any along with drug and family history were taken followed by general physical and systemic examination. Visual acuity was recorded for both distance and near, both unaided and aided (if applicable) along with detailed anterior segment examination under slit lamp biomicroscopy. Posterior segment was examined with both direct and indirect ophthalmoscopy along with intraocular pressure with Schiotz tonometer and lacrimal syringing before posting for surgery. Necessary investigations were done, physician fitness obtained and the patients were started on oral and topical antibiotics one day prior to surgery. Xylocaine test dose was given one day before surgery too.

All 100 cases underwent manual small incision cataract surgery with PCIOL implantation. Among them, 50 underwent MSICS with superior scleral incision whereas rest 50 with superotemporal scleral incision. Pre-operative mydriasis was achieved using tropicamide 0.5% and phenylephrine 5% eye drops along with flurbiprofen 0.03% eye drop. After preparing the eye for surgery, peribulbar anaesthesia was given. In half of the patients, a straight scleral incision of about 6.5 mm was placed 2 mm behind the limbus using 11 no. B.P. blade. Dissection of sclerocorneal tunnel was done by crescent blade upto 1 mm inside the cornea. Whereas, in remaining 50 patients, fornix based conjunctival lap was taken

from 12 o'clock to 3 o'clock, following which 6.5 mm scleral straight incision was placed in the same region around 1-1.5 mm posterior to limbus and sideport was made 3 o'clock hours away from the main port. Remaining steps are done similarly in all 100 cases according to conventional MSICS procedure. Intraoperative complications if any were managed accordingly.

A detailed post-operative examination was done on 1st day, 7th day, 2nd week and 4th week. Cases with 70-110 degree axes are considered as WTR astigmatism, cases with 160-20 degree were considered ATR astigmatism and other than these axes were excluded from study.

Results

Table 1: Sex distribution

Sex	SI	STI	Phacosurgery
Male	26	26	28
Female	24	24	22
Total	50	50	50

A randomized comparative study of astigmatism at postoperative follow ups following superior (SI), superotemporal scleral incision (STI) and Phacosurgery in manual small incision cataract surgery in total 100 patients with 50 each with each incision at Darbhanga Medical College and Hospital, Darbhanga, Bihar, India was done at a period of one year.

Table 2: Pre-operative visual activity

Visual Activity	SI	STI	Phacosurgery	Total
PL + - CF	10	5	10	25
CF ½ m – CF 3 m	10	15	15	40
CF 3.5 m – CF 5.5 m	15	16	15	46
> 6/60	15	14	10	39
Total	50	50	50	150

In the present study, it was found that 74% of the patients of both groups who underwent MSICS had visual acuity less than 6/60, whereas rest 26% had visual acuity more than 6/60.

Table 3: Pre-operative astigmatism

Type of astigmatism	SI	STI	Phacosurgery	%
WTR	18 (36%)	17 (34%)	16 (32%)	51 (34%)
ATR	22 (44%)	23 (46%)	24 (48%)	69 (46%)
NA	10 (20%)	10 (20%)	10 (20%)	30 (20%)

In this study, it is seen that 18(36%) patients who had WTR astigmatism underwent SI, 17 (34%) underwent STI and Phacosurgery 16 (32%), whereas 22 (44%) patients of those who had ATR astigmatism underwent SI, 46% underwent STI and 24 (48%) underwent Phacosurgery.

Table 4: Pre and Post-operative astigmatism in superior and superotemporal scleral incision

Type of incision	Pre-operative astigmatism	Post-operative change in stigmatism	PODay 1	PODay 7	PO-2nd week	PO-4th week
SI	**WTR (18)**	Increased	12	7	7	8
		Decreased	2	9	10	9
		Same	4	2	1	1
	ATR (21)	Increased	18	13	12	14
		Decreased	2	4	5	4
		Same	1	4	4	3
	NA (11)	WTR	2	2	2	4
		ATR	9	9	9	7
		Same	0	0	0	0
STI	**WTR (18)**	Increased	10	12	14	14
		Decreased	6	5	3	3
		Same	2	1	1	1
	ATR (21)	Increased	10	3	5	4
		Decreased	10	18	15	15

		Same	1	0	1	2
	NA (11)	WTR	6	8	9	9
		ATR	5	3	2	2
		Same	0	0	0	0
Phacosurgery	**WTR (19)**	Increased	10	12	14	14
		Decreased	6	5	4	4
		Same	3	2	1	1
	ATR (20)	Increased	10	2	4	3
		Decreased	10	18	14	15
		Same	0	0	2	2
	NA (11)	WTR	6	8	8	9
		ATR	5	3	3	2
		Same	0	0	0	0

In this study, it is seen that out of 18 patients with preoperative WTR astigmatism who underwent SI, 12(66.66%) had increased while 2 (11.11%) had decreased and only 4 (22.23%) had same amount of WTR astigmatism 1st postoperative day. On 7th day, only 7 (55.56%) patients had increased while 8 (50%) had decresased WTR astigmatism. By 2nd and 4th week postoperatively, number of patients with increased WTR astigmatism remained almost same whereas, number of patients with decreased astigmatism increased drastically in comparison to the 1st from 2 (11.11%) to 9 (50%).

STI group shows that on 1st post-operative day, out of 18 patients who had WTR astigmatism pre-operatively, 10 (52.63%) had increased but 6 (31.58%) had decreased amount of astigmatism while for only 2 patients no variation was there. On 7th post-operative day, it is seen that the number of patients with increased astigmatism increased slightly from 10 to 12, with a gradual decrease in the number of patients with reduced astigmatism from 6 to 5. Thus it is seen that in SI group the number of patients with postoperative decreased pre-existing WTR astigmatism was more than that of the STI group.

Phacosurgery group shows that on 1st post-operative day, out of 19 patients who had WTR astigmatism pre-operatively, 10 (52.63%) had increased but 6 (31.58%) had decreased amount of astigmatism while for only 3 patients no variation was there. On 7th post-operative day, it is seen that the number of patients with increased astigmatism increased slightly from 10 to 18, with a gradual decrease in the number of patients with reduced astigmatism from 6 to 4. By 2nd and 4th week, the number of patients with increased and reduced WTR astigmatism became constant to 14 (73.68%) and 4 (21.05%) respectively.

Discussion

While phacoemulsification remains the more advanced and technically superior method of cataract surgery, it is not always appropriate either from a cost perspective or the density of the cataracts involved. [13] MSICS is the first choice alternative to phacoemulsification- retains most of the advantages of “phacoemulsification” giving visual results equivalent to phacoemulsification at a lower cost and it is the surgery for the masses and appropriate for a developing country. The surgery is cheap, fast, safe and easy to learn and needs fewer resources. However, the larger incision used induces greater astigmatism than phacoemul sification. [14] High astigmatism is an important cause of poor uncorrected visual acuity after cataract surgery. [15]

The curvilinear incision parallel to limbus being out of this funnel is unstable whereas straight incisions are less out of this funnel and thus they are more stable than curvilinear incision which creates a potential for wound slide and ATR drift in astigmatism in case of curvilinear incision. Frown incision falls totally within this funnel with its margin moving away from the cornea thus making it a stable incision and stabilizes the astigmatism to a greater range. [16] But in both frown and Chevron inverted V incision, it is difficult to convert the incision to ECCE in case of emergency. [17]

Superotemporal incision also provide other advatages like better wound strength due to minimal separational force of lid pressure and gravity, preservation of functioning filter bleb in previous glaucoma surgery. It is preferred in deeply seated eyes and eyes with coloboma iris. This incision site also causes less central corneal endothelial loss. [18] Thus an obvious approach is to reduce the change of astigmatic shift by an incision which is small, away from the cornea, either straight or frown shaped to stay within astigmatically neutral zone, multiplanar and one that can be left unsutured. Also wounds with a square configuration are considered desirable. [19]

The result of this study is consistent with previous reports [20,21] that, temporal incision induces small amount of WTR astigmatism and gives early visual rehabilitation to the patients within 6 weeks. This could be due to the fact that temporal location is farther from the visual axis than superior location and any flattening due to wound is less likely to affect the corneal curvature at the visual axis. When

the incision is located superiorly, both gravity and eyelid blink tend to create a drag on the incision. These factors are neutralized well with temporally placed incision because the incision is parallel to the vector of forces. [22]

Visual acuity didn't improve significantly on 1st day in both groups whereas by 1 week, visual acuity improved in more number of cases in superotemporal incision than the other group which by 4th week the difference increased drastically with more satisfactory improvement with superotemporal incision. In superotemporal incision group, minimal WTR astigmatism and early rehabilitation of visual recovery could be due to location of the incision away from the visual axis and steepening of the vertical meridian unlike superior incision.

Superotemporal incision causes minimal WTR astigmatism whereas SI group had majority of ATR astigmatism. Besides, superotemporal incision can neutralize ATR astigmatism which is advantageous since most elderly cataract patients had preoperative ATR astigmatism. Besides, the average astigmatism in SI group is higher and majority of them being ATR type than that of STI group in which majority of them are having WTR astigmatism.

Conclusion

Modifying the location, sutureless, self-healing incision can lessen or eliminate post-operative astigmatism, a typical cataract surgery consequence. Incisions temporally, superotemp -orally, or phacosurgerically can reduce high ATR astigmatism and improve vision. This study demonstrates that sutureless superotemporal scleral incision causes less post-operative astigmatism than superior and phacosurgery. Superotemporal incision causes with-the-rule astigmatism in most cases postoperatively and can neutralize against-the-rule astigmatism in most elderly cataract patients, while superior scleral incision causes against-the-rule astigmatism in most.

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