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Comparison of astigmatism before and after phacoemulsification and extracapsular cataract extraction

Rabia Saeed
Optometrist, Ophthalmology Department, Aziz fatimah Hospital, Lahore, Pakistan

Abstract
Objective: To compare astigmatism before and after phacoemulsification and extra capsular cataract extraction technique.
Method: It was a hospital-based cross-sectional study conducted at Aziz Fatimah hospital Faisalabad during Oct 2019 to May 2020. A sample size of 80 eyes having cataract, age 41 to 70 years was including in this study. Slit lamp examination was performed to check corneal and conjunctival health. After eye examination astigmatism was measured before and after the cataract surgery by using autorefractometer or by monitoring the keratometry readings
Result: The astigmatism was measured with Keratometer before and after the cataract surgery. Phaco was found to be clinically superior to the ECCE. The means and the standard deviation of phaco post op astigmatism was .7860 ±.48880 and ECCE post op astigmatism was 3.6310±1.96236 which indicated that the degree of astigmatism increases after extra capsular cataract extraction technique. Astigmatism after phacoemulsification was significantly less frequent and a higher proportion achieved an unaided visual acuity.
Conclusion: Phacoemulsification is clinically better than extracapsular cataract extraction (ECCE). Corneal astigmatism was almost similar in two groups prior to surgery but after the cataract surgery the astigmatism significantly decreased after phacoemulsification groups at 2 weeks follow-up, the significant level between the posts operatively phaco astigmatism and post operatively ECCE astigmatism is .00 which indicates that the phaco technique is highly significant. None of the eye in phacoemulsification group requires removal of sutures for higher corneal astigmatism. Thus, surgical incision affects the vision and cause astigmatism.

Keywords: Autorefractometer, extracapsular cataract extraction (ECCE), phacoemulsification, K readings, surgically induced astigmatism (SIA)

Introduction

Astigmatism is an imperfection in the curvature of eye's cornea or lens. Normally, the Cornea and lens are smooth and curved equally in all directions. This helps to focus light rays sharply onto the retina. In astigmatism there is blur or distorted vision at near and distances. Cataract surgery has undergone various advances since it was evolved from ancient couching to the modern phacoemulsification cataract surgery. Surgically induced astigmatism is one of the most common complications after cataract surgery. The introduction of suture less corneal incision has gained increasing popularity worldwide, because it offers several advantages over the traditional sutured limbal incision and scleral tunnel. A clear corneal incision has the benefit of being bloodless and having an easy approach, but surgically induced astigmatism (SIA) is still a concern [1]. Cataract surgery with implantation of an intraocular lens (IOL) is the most common surgical procedure. Over the past years, surgical technique has evolved from standard extracapsular to micro incision without suture. These progresses have allowed cataract surgery to be a less invasive procedure, with better and more predictable refractive results. So that, most patients have increased expectations about cataract surgery result [2]. Standard extracapsular cataract extraction (ECCE) involves the removal of a part of anterior capsule, manual expression of the nucleus through a large corneo-scleral incision (9-10 mm) and aspiration of cortex, leaving behind the intact posterior capsule. The intraocular lens is inserted between the anterior and posterior capsule. Since the wound is large and sutures are put to close it, there is some amount of astigmatism after healing and thus, visual improvement takes longer time following cataract. Phaco is the most common technique of cataract surgery. It involves the use of a machine with an ultrasonic hand piece equipped with a titanium or steel tip. The tip vibrates at ultrasonic frequency and the lens material is emulsified. Fragmentation into smaller pieces makes emulsification easier as well as the aspiration of cortical material. After the Phacoemulsification of the lens nucleus, a dual irrigation-aspiration probe is used to aspirate out the remaining peripheral cortical materials. The surgery is performed through a small cornea scleral wound (2.2-3.2 mm). The intraocular lens is folded and inserted using a lens injector through the small wound. Due to the small size of the wound and two-level openings in the wound, no suture is required. The healing process of wound is fast and the rehabilitation time is less. There is very little astigmatism and thus, visual improvement is faster allowing the patient to return to work within the weeks [3]. With increasing age, the horizontal corneal meridian becomes more curved than the vertical meridian leading to or increasing existing against-the-rule (ATR) astigmatism. Thus, there is an ATR shift in astigmatism with age. Placing an incision on the vertical meridian (superior approach) for a cataract patient with preoperative ATR astigmatism may cause further flattening of the already flatter vertical meridian and a

corresponding steepening to the same degree of the already steeper horizontal meridian leading to high postoperative corneal astigmatism. Hence, the choice of the location of incision for these groups of patients is important [4].

Methodology

This was cross sectional study conducted at Aziz Fatimah Hospital Faisalabad during October 2018 to May 2019. 80 patients were included in this study of the age group between 41-70 years by convenient sampling technique. Patients of both the gender having cataract with mild (0.5-0.75DC) degree pre op corneal astigmatism were included. Patients with lid deformity (entropion and ectropion), corneal opacity, pterygium, uveitis, retinal diseases and glaucoma were excluded. This study involved the structural Performa having some measurements to predict the pre and post-surgical astigmatism. Slit lamp examination was performed to check the corneal and conjuctival health. Autorefractometer plus Keratometer used to measure the astigmatism. Data was analyzed using SPSS 20.0 software.

Results

A total number of 80 subjects were included in a study. Individuals were categorized into 3 groups 40-50 years, 51-60 years, and 61-70 years. There were 20 patients (25.0%) between the 41-50 age groups, 23 patients (28.8%) were between the age group 51-60 and 37 patients (46.3%) were between the age group of 61-70 years. This variation in graph indicated that the frequency of cataract increases with age. The frequency of Male were 30(37.5) and female were 50(62.5). The value of astigmatism was measured in 4 categories i.e normal, low degree, moderate degree and high degree. Normal value of astigmatism is consider less than 1, low value ranges from 1-2 degree, moderate value ranges from 2-4 degree and high value is greater than 4 degree. Normal value of astigmatism was observed pre operatively in 19 individuals while post operatively this value increases upto 31 individuals. 15 individuals had low value of astigmatism pre operatively while this value decreases upto 9 individuals post operatively and individuals had moderate degree of astigmatism pre operatively eliminates post operatively in individuals undergone phacoemulsification technique. This indicates that astigmatic error decreases after phacoemulsification technique.

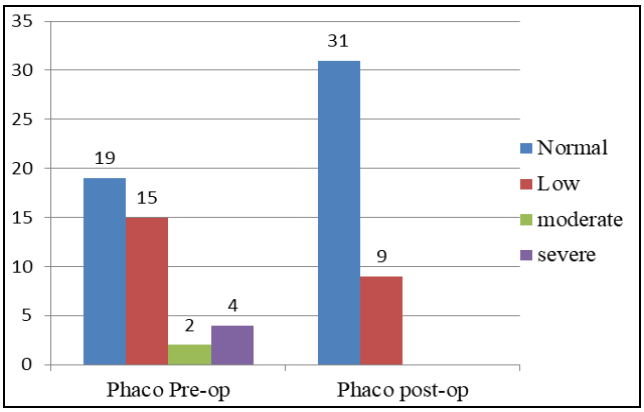

Fig 1: phaco pre op astigmatism and phaco post op astigmatism

In individual undergone Extra capsular cataract extraction Normal value of astigmatism were observed in 14 individuals pre operatively while no patients have normal value of astigmatism post operatively, 19 patients shows the low value of astigmatism pre operatively which decrease to 8 postoperatively, 5 patients have moderate value of astigmatism pre operatively which increase up to 19 patients postoperatively and 2 patients have severe astigmatism which increase up to 13 patients postoperatively. This indicates that the value of astigmatism increases after ECCE technique. The results of this study show that the phacoemulsification leads to a better and more stable visual acuity due to negligible post-surgical astigmatism.

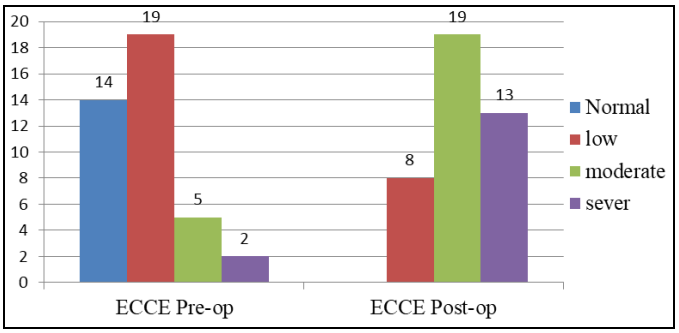

Fig 2: ECCE pre op astigmatism and ECCE post op astigmatism

Out of total 80 individuals 40 individuals undergone phacoemulsification technique and 40 individuals undergone ECCE technique. Sample paired t- test was applied to analyze the association between phacoemulsification and ECCE in two pairs. Ist pair consist of phaco pre op and phaco post op astigmatism while the 2nd pair consists of ECCE pre op and post op astigmatism.

Table 1: Descriptive statistics phaco and ECCE pre op and post op astigmatism

	Mean	N	Std. deviation	Std. error mean
Pair 1				
Phaco pre op astigmatism	1.3190	40	.79160	.12516
Phaco post op astigmatism	.7860	40	.48880	.07729
Pair 2				
ECCE pre op astigmatism	1.5743	40	.90099	.14246
ECCE post op astigmatism	3.6310	40	1.962326	.31028

The mean and standard deviation of pre and post op phaco astigmatism was 1.3190±0.79160 and 0.7860±.48880 respectively which indicate that the astigmatism reduced after the phaco emulsification technique. And pre and post ECCE astigmatism was 1.5743 ± .90099 pre operatively and 3.6310±1.96236 post operatively shows that the astigmatism increases after the extra capsular cataract extraction due to sutures. The mean and standard deviation increases from ECCE pre op to ECCE post op which indicates that the astigmatic error increases in ECCE and decreases in phacoemulsification technique. The correlation between phaco pre and post op astigmatism and ECCE pre and post op astigmatism and the significant level in phaco pre and post operatively is 0.000 and pre and post operatively in ECCE is 0.001 which indicates phaco is more superior to ECCE. The value of astigmatism decreases post operatively in phacoemulsification while the value of astigmatism increases post operatively in extracapsular cataract extraction. This shows that the phaco technique is more reliable and clinically superior to ECCE.

Table 2: Correlation of astigmatism between pre and post phacoemulsification and ECCE

	N	Correlations	Sig.
Pair 1 phaco pre op astigmatism & Phaco post op astigmatism	40	.803	.000
Pair 2 ECCE pre op astigmatism & ECCE post op astigmatism	40	.490	.001

ANOVA test was applied to check the association post operatively in phacoemulsification and extracapsular cataract extraction.

Table 3: Descriptive statistic of post phaco and ECCE astigmatism

	N	Mean	Std. deviation	Std. error
Phaco post op astigmatism	40	.7860	.48880	.07729
ECCE post op astigmatism	40	3.6310	1.96236	.3101028
Total	80	2.2085	2.01696	.22550

This table shows that the means and the standard deviation of phaco post op astigmatism as .7860 ±.48880 and ECCE post op astigmatism as 3.6310±1.96236 which indicated that the degree of astigmatism increases after extra capsular cataract extraction technique. The astigmatism after phacoemulsification is minimum or negligible.

Table 4

Data	Sum of squares	Df	mean square	F	Sig.
Between groups	161.881	1	161.881	79.164	.000
Within Groups	159.501	78	2.045		
Total	321.381	79			

This table shows that the significant level between the post operatively phaco astigmatism and post operatively ECCE astigmatism is .00 which indicates that the phaco technique is highly significant. Thus the phacoemulsification technique is more reliable and superior to extra capsular cataract extraction.

Discussion

Astigmatism is an imperfection in the curvature of eye's cornea or lens. Normally, the cornea and lens are smooth and curved equally in all directions. This helps to focus light rays sharply onto the retina. In astigmatism there is blur or distorted vision at near and far distances. Cataract surgery has undergone various advances since it was evolved from ancient couching to the modern phacoemulsification cataract. Surgically induced astigmatism (SIA) remains one of the most common complications. Cataract surgery with implantation of an intraocular lens (IOL) is the most common surgical procedure. Over the past years, surgical technique has evolved from standard extracapsular to micro incision without suture. Standard ECCE involves the removal of a part of anterior capsule, manual expression of the nucleus through a large corneoscleral incision (9-10 mm) and aspiration of cortex, leaving behind the intact posterior capsule. The intraocular lens is inserted between the anterior and posterior capsule. Phaco is the most common technique of cataract surgery performed under local anaesthesia. It involves the use of a machine with an ultrasonic hand piece equipped with a titanium or steel tip. The surgery is performed through a small corneoscleral wound (2.2-3.2 mm). The intraocular lens is folded and inserted using a lens injector through the small wound. Due to the small size of the wound and two level openings in the wound, no suture is required. The healing process of wound is fast and the rehabilitation time is less. There is no/very little astigmatism and thus, visual improvement is faster. Veronica *et al.* (2016) investigated the changes of cataract induced astigmatism caused by the incision after cataract surgery may be calculated to improve IOL toric power calculation and achieve better visual outcome. SIA could be determined as the difference between preoperative and postoperative keratometry [5].Results of study by veronica agreed with our results in such a way that corneal incision causes the astigmatism and phacoemulsification require smaller incision with the less post-surgical astigmatism. A study was conducted by on the effect of incision size on early postoperative visual rehabilitation after cataract surgery and intraocular lens implantation 151cataract patients were randomly assigned intraocular lens intraocular lens inserted through 3.5 mm incision 5×6 mm oval optic lens inserted through 5.6 mm incision at one week postoperatively follow up, 62 % of 3.5 mm incision cases had uncorrected visual acuity of 20/40, 33 % of 5.5 mm and 43% of 6.5 mm incision cases. The 3.5mm incision case had significant less total keratometric cylinder than other cases all the postoperative examination and less surgically induced cylinder at two days and one week post operatively. The 5.5 mm and 6.5 mm cases did not differ significantly in visual acuity or astigmatism at any examination[6]. This study favors to my study strongly.

Conclusion

Phacoemulsification is clinically superior to ECCE. Phaco require a smaller incision with the expected advantages of less post-surgical astigmatism, corneal astigmatism is almost similar in two groups prior to surgery. The mean keratometric cylinder which is similar in to groups pre-operatively was significantly less in phaco than in the conventional ECCE groups at 2 weeks follow up, the means and the standard deviation of phaco post op astigmatism was .7860 ±.48880 and ECCE post op astigmatism was 3.6310±1.96236 which indicated that the degree of astigmatism increases after extra capsular cataract extraction

technique, the significant level between the posts operatively phaco astigmatism and post operatively ECCE astigmatism is .00 which indicates that the phaco technique is highly significant. None of the eye in phacoemulsification group requires removal of sutures for higher corneal astigmatism. Thus, surgical incision affects the vision and cause astigmatism.

Acknowledgments
None

Conflict of Interest
There is no conflict of interest.

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