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Original Article

A Study Of Incision Width Changes And Surgically Induced Astigmatism After Foldable Iol Implantation In Phacoemulsification

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ABSTRACT

Phacoemulsification is usually performed through 2.8mm clear corneal incision, the outer diameter for standard phaco tip along with the silicon irrigation sleeve is designed to fit snugly into the incision without producing undue stretch or distortion. During the foldable IOL implantation, the barrel of the injector cartridge can cause distortion of clear corneal incision, this will have an impact on postoperative astigmatism and wound healing

To study the change in width of the clear corneal incision after incision creation and after IOL implantation and to study SIA caused by the distortion of the incision

This is a prospective observational study involving 130 patients diagnosed to have cataracts not more than grade III. Phacoemulsification with foldable PCIOL was done in all the patients and clear corneal incision width was measured at two-level at the outer lip and inner lip of the incision. Patients were examined on day 1,15 and day 30 for astigmatism and SIA was calculated.

In this study, there was a change of 0.2mm in the inner lip of the incision in about 50% of the patients. 8% of the patients had a change of 0.3 mm, 36% had a change of 0.1 mm and 6% had no change, when we compared the outer lip 2% had a change of 0.1mm, 15% had a change of 0.3mm, 53% had a change of 0.2mm, 17% had a change of 0.1mm, 13% had no change.

The IOL injector can cause distortion and stretch of the clear corneal incision which may lead to difficulty in sealing of clear corneal incision and sometimes unpredictable surgically induced astigmatism.

Keywords*: Phacoemulsification, cataract surgery, cataract surgery, grade IV or hypermature.*

INTRODUCTION

In the late 80s, the use of IOL in cataract surgery became widespread acceptance with the development of techniques of phacoemulsification by Dr Charles Kelman in 1968 and further improvement and modification of the technique which eventually led to a reduction in the size of cataract incision from 12mm to 3.2mm and further down to 2.8 mm. This reduction in the size of cataract incision necessitates the importance of new IOL, its material, and model which can pass through this small incision, which leads to the development of the injector system.

Phacoemulsification is usually performed through 2.8mm incision via a superior/ temporal approach. The incision is constructed in such a manner that there is no distortion or extension of an incision during phacoemulsification. The outer diameter for a standard phaco tip varies from 0.9 to 1 mm and along with the silicon irrigation sleeve it is designed to fit snugly into the incision without producing undue stretch or distortion. During the foldable IOL implantation, the barrel of the injector cartridge has an outer diameter varying from 1.9 to 2.65 mm which usually results in distortion of clear corneal incision, this will have an impact on postoperative astigmatism and wound healing.

In this prospective study, we intend to document the size of the clear corneal incision after the incision creation, at the end of the phacoemulsification, immediately after the implantation of the IOL, and to study the impact of this on surgically induced astigmatism.

METHODOLOGY

This is a prospective observational study involving 130 patients who have been diagnosed to have cataracts in either of the eyes and fits under inclusion criteria of age above 40 years having cataract not more than grade III and exclusion criteria of the small non-dilating pupil, grade IV or hypermature cataract, pseudoexfoliation, pterygia, peripheral corneal thinning, acute ocular infection, corneal opacities, uncontrolled glaucoma. This study was conducted in the tertiary care center, Chengalpattu district from November 2019 to May 2021 after getting institute ethical committee clearance. Before cataract surgery patient underwent detailed ocular examination and slit-lamp examinations to rule out any other ocular disease. Pre-operative Visual Acuity, refraction, and keratometry readings were performed. Slit-lamp examination for grading cataract, fundus examination using a 90D lens was done. Intraocular pressure was recorded using Goldmann's Applanation tonometer. Lacrimal syringing was done for all the cases. Astigmatism readings were taken by auto keratometer (Unicos-800K), A-scan biometry (Appascan) was done in all cases using SRK -II formula IOL power was calculated,

After the preoperative workup, the patients were posted for phacoemulsification after taking informed consent. During surgery the size of the incision was measured using Appasamy incision gauge (AA2102) at the following stages of the surgery i) after the incision creation ii) at the end of the phacoemulsification iii) immediately after the implantation of the IOL and any stretch and change at the incision site was noted, effective phacoemulsification time was recorded, Measurement was made at two-level at the outer lip and inner lip of the incision.

Postoperative patients were examined on day 1,15 and day 30, postoperative visual acuity, automated keratometry value for astigmatism and SIA were calculated using Warren hill's calculator.

The data collected were entered in an Excel sheet, statistical analysis was done by SPSS version 23 using descriptive statistics, chi-square, paired and unpaired t-test, and Pearson correlation coefficient test for parameters with 5% level of significance and 95% confidence interval.

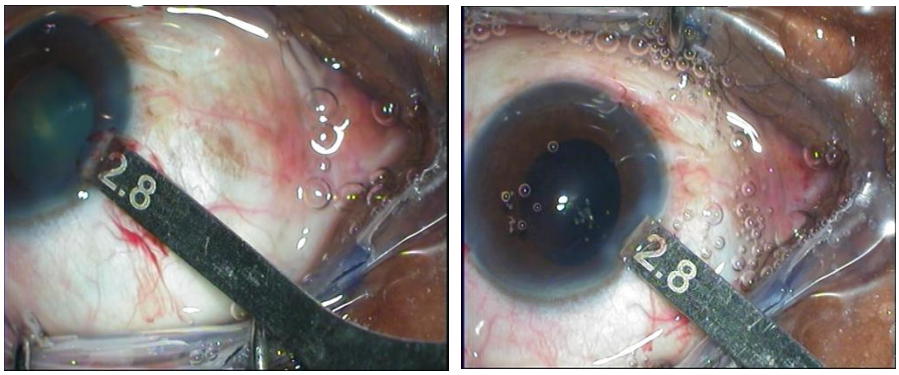
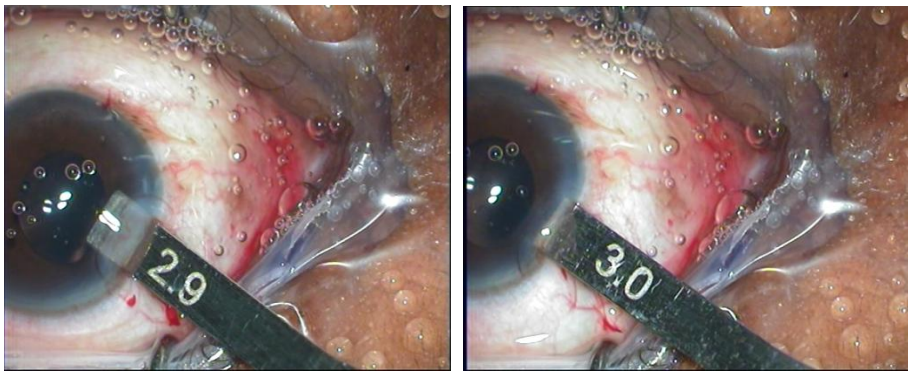


Fig1: Appasamy incision gauge measurement before and after phacoemulsification



inner lip of the incision: 2.9 mm outer lip of the incision: 3.0 mm

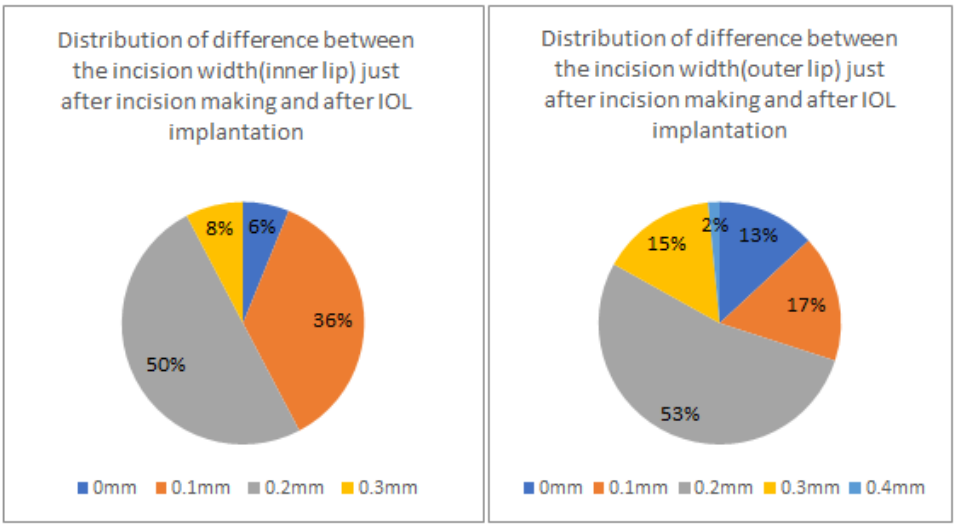
Fig 2: Appasamy incision gauge measurement After IOL implantation

RESULT

In this prospective observational study, we have taken 130 patients. Out of 130 patients, most patients were male (58%) and the remaining were female (42%). Among 130 eyes 71 were left eye and 59 was right eyes, the larger number of the patient had NS Grade III with PSCC (n=46: 35%), NS Grade II (n=35:27%) and NS Grade III (n= 28: 21.5%).

When we compared the change of the incision width of the inner and outer lips after creating the incision and after IOL implantation, there was a change of 0.2mm in the inner lip of the incision in about 50% of the patients. 8% of the patients had a change of 0.3 mm, 36% had a change of 0.1 mm and 6% had no change in the incision site at all. Similarly, when

we compared the outer lip 2% had a change of 0.1mm, 15% had a change of 0.3mm, 53% had a change of 0.2mm, 17% had a change of 0.1mm, 13% had no change.

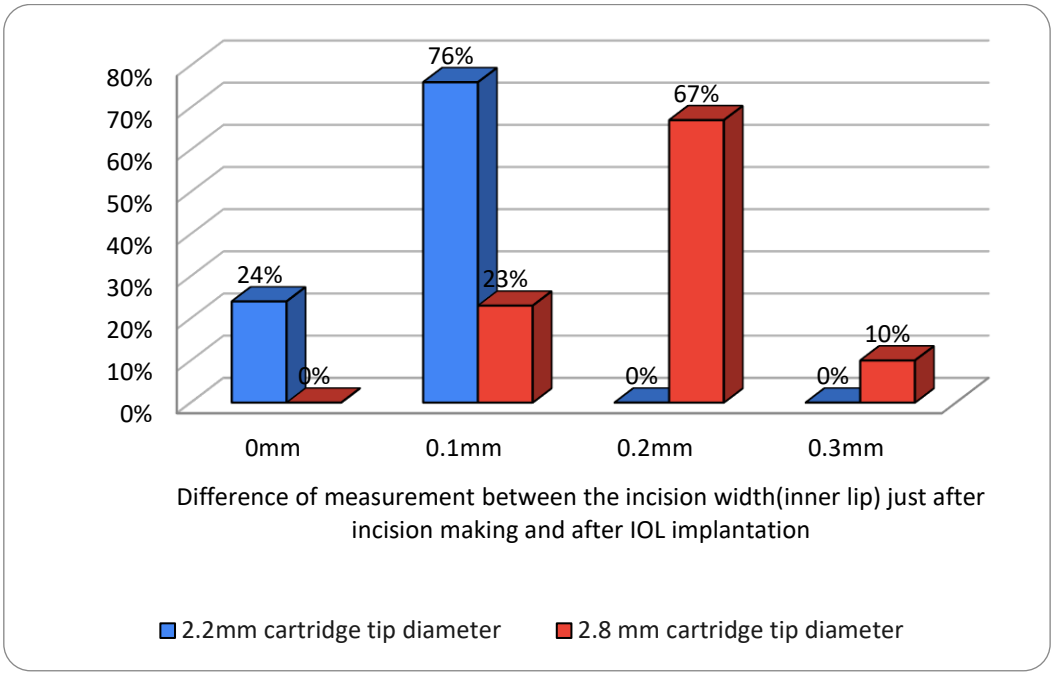


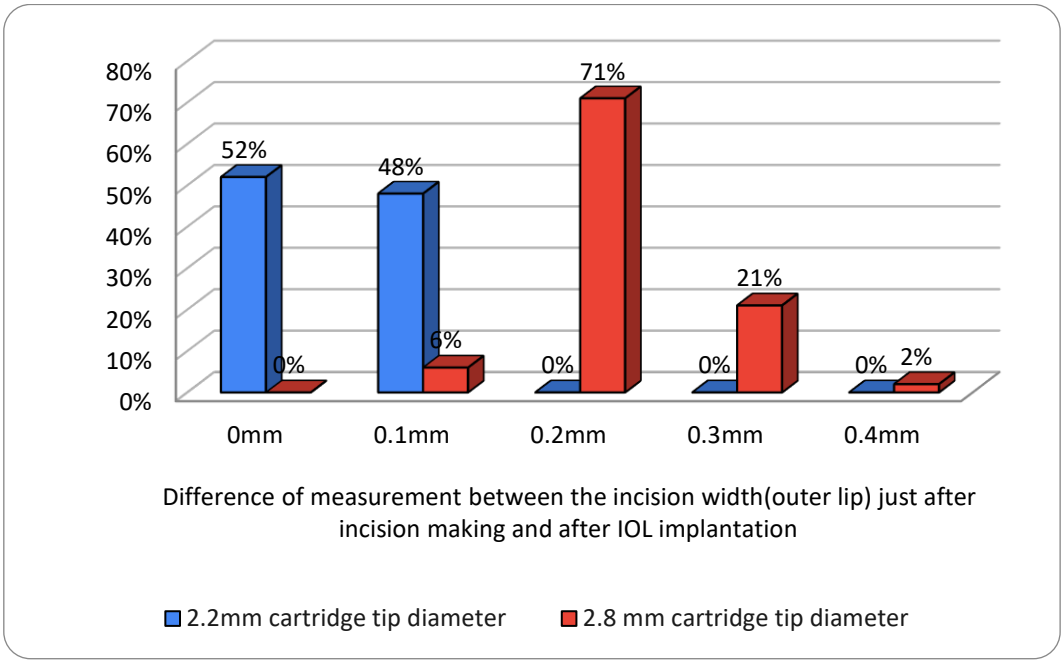
Two types of the cartridge were used for IOL implantation, in 33 patients 2.2 mm cartridge tip diameter was used and in 97 patients 2.8mm cartridge tip diameter was used.

So, when we saw the difference in width after creating the incision and after IOL implantation for both 2.2- and 2.8-mm cartridges for IOL injection, when the 2.2 mm cartridge was used, 24% of eyes had no change at all in the incision width and 76% of the eyes had a change of width of 0.1 mm. None of the eyes had a 0.2mm or 0.3mm stretch of the inner lip. Similarly with respect to the outer lip when we used a 2.2 mm cartridge 52% had no change and 48% had a 0.1 mm change of width.

When a 2.8 mm cartridge tip was used, the inner lip change in width of 0.1mm was seen in 23% of the eyes, 67% had a change of 0.2 mm, 10% had a change of 0.3 mm. Similarly, for outer lip, 70% had a change of width of 0.2 mm, 21% changed to 0.3 mm, 6% changed to 0.1 mm, and 2% changed to 0.4 mm.

Comparison between the change in width of the inner and outer lips of the incision, while using the 2.8 mm and the 2.2 mm cartridges, shows a P-value of 0.001 which is statistically significant.





In this study, we also correlated the change of incision width of the inner lip and the SIA using the Pearson correlation coefficient and found its value to be 0.19, which shows that there is a weak correlation between them, the comparison between the two has a P-value of 0.05 which is statistically significant. This shows that a stretch of the inner corneal lip correlates with the SIA.

DISCUSSION

In phacoemulsification the 2.8 mm incision is constructed in such a way that there is no distortion or extension of an incision during surgery. The outer diameter of a standard phacoemulsification tip varies from 0.9 to 1 mm and along with the silicon irrigation sleeve it is designed to fit snugly into the incision without producing an undue stretch or distortion.
In this study, we noticed that during the foldable IOL implantation, the barrel of the injector cartridge has an outer diameter varying from 1.9 to 2.65 mm which usually results in distortion of the clear corneal incision. The clear corneal incision is a slit whereas the nozzle of the injector is cylindrical in dimension, so when we compare the circumference of the cylinder to the diameter of the slit for a perfect fit the diameter of the nozzle should be 1/3rd the size of clear corneal incision slit (circumference: $2\pi r$), which means for cartridge diameter of 2.65mm will have a circumference of 8.32 mm. Circumference being almost 3 times the diameter of the nozzle of the injector, it stretches and distorts the surgical incision site.

In this study, two types of cartridges were used for IOL implantation. The 2.2mm cartridge tip is meant to be used with 2.2mm clear corneal incisions and has an outer diameter of 1.9mm with a circumferential area of 5.7mm as opposed to the 2.8mm cartridge tips which have an outer diameter of 2.65mm and a circumferential area of 8.32mm. The 2.2mm tips therefore will create lesser incision stretch.

So, we saw the difference in width after creating the incision and after IOL implantation for both 2.2- and 2.8-mm cartridges for IOL injection.

Surgically induced astigmatism is post-operative astigmatism induced primarily by the incision creation, which generally results in a flattening of the corneal meridian at the axis of placement of the clear corneal incision. However, several other factors can influence it, including the size and width of the incision, the age of the patient, the corneal collagen content, the type of cataract and the duration of the surgery and the effective Phaco time (EPT).

The study done by Robert f. Steinert et al investigated the dimensional stability of incisions during phacoemulsification and foldable silicone intraocular lens (IOL) implantation, from this study he concludes that in phacoemulsification incision enlarges at each step of the procedure, Irreversible incision stretching or incision tearing occurs, rather than reversible elastic incision deformation.

Another study was done by Thomas Kohnen et al he compared the Incision Sizes before and after Implantation of 6-mm Optic Foldable Intraocular Lenses Using Monarch and Unfolder Injector Systems, he concludes that Post implantation incisions sizes were determined with 6-mm total optic foldable IOLs using Monarch and Unfolder injector systems, Because the effective optical zone size is different for some of these IOLs, the incision size alone may not be the only relevant factor.

One more study done by T. Kohnen et al compared the incision sizes and wound shape for both forceps and injector implantation of high-refractive-index silicone IOLs. From this study, he came to the conclusion that the final incision size after IOL implantation is small in the injector system when compared to forceps implantation of IOLs.

While the studies conducted by T. Kohnen et al compared incision stretch induced by two types of IOL insertion methods, namely the forceps method to fold and insert the IOL and the injector systems for IOL insertion, our study compared two different cartridge types namely the 2.2mm and 2.8mm cartridges. We believe that therefore our study is a unique one of its kind. We also further believe that our study is more clinically relevant in the modern scenario, where the folder type of IOL insertion has become obsolete.

To conclude IOL injector cartridge can cause distortion and stretch of the clear corneal incision which may lead to difficulty in the sealing of the clear corneal incisions and sometimes produce unpredictable surgically induced astigmatism (SIA). The 2.2mm cartridge tip when used causes less or no change in the width of the clear corneal incision when compared with the 2.8mm cartridge tip so, we can conclude that when phacoemulsification is performed through a 2.8mm incision, using 2.2mm cartridge tip for injecting IOL will lead to less distortion of the corneal wound architecture.

CONCLUSION

The IOL injector can cause distortion and stretch of the clear corneal incision which may lead to difficulty in sealing of clear corneal incision and sometimes unpredictable surgically induced astigmatism.

2.2mm cartridge tip when used causes less or no change in the width of the clear corneal incision when compared with the 2.8mm cartridge tip so, we can say that for phacoemulsification when done in a 2.8mm incision using 2.2mm cartridge tip for injecting IOL will have less distortion of the cornea.

Limitations

SIA is multifactorial it can get influenced by incision site, type of incision, the shape of incision, surgeon operation, etc, in this study the SIA seen with the change of width of the incision can have other confounding factors leading to it.

When a comparison of 2.2mm and 2.8mm cartridge tip was done the number of patients for 2.2mm cartridge tip was less compared to 2.8mm tip.

The sample size was less for the prevalence of cataracts in the community.

Strengths

All the surgeries were performed by 2 chief surgeons in the same microscope so data collected from it have high accuracy and less confounding bias.

This type of study; compares two types of injectors with different tip diameters, observing both the inner lip and outer lip of the clear corneal incision was never done before so, this is a unique study.

In spite of the covid pandemic desired sample size was reached.

Recommendations

This study identifies the IOL injector can cause distortion and stretch of the clear corneal incision which may lead to difficulty in sealing of clear corneal incision and sometimes unpredictable surgically induced astigmatism.

so, we recommend the use of a 2.2mm cartridge tip for a 2.8mm clear corneal incision created for phacoemulsification as it will have no distortion of the clear corneal incision,

Or extend the clear corneal incision to 0.3mm before IOL implantation as it will be guarded increase in width so, it won't cause any distortion of the clear corneal wound.

These methods can be used till a better injector system is developed which will cause less distortion and change in width of the incision.

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