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Original Research Article

A Comparative Study of Anterior Segment Complications in Manual Small Incision Cataract Surgery in Eyes with High and Normal Axial Length

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Abstract

Purpose of the study: To study the comparison of intra operative and post-operative anterior segment complications in manual small incision cataract surgery in eyes with high and normal axial length.

Materials and methods: 100 eyes were included in our study (50 eyes of normal axial length and 50 eyes of high axial length). We have calculated the sample size by using the formula of simple random sampling method. Eligible cases will be around 100 as per inclusion, exclusion criteria and error of loss of follow up. Intra operative and post-operative complications were depicted with different charts and diagram.

Result and Observation: Intra operative complications were present in 10 (20%) patients in normal axial length group (NALG), whereas it was 21 (42%) patients in high axial length group (HALG). So in our study HALG patients had significantly higher (p=0.029) intra operative complications as compared to their counterparts. It was observed that patients with high axial length had significantly (p=0.045) higher rates of postoperative day 1 complications as compared to their normal axial length counterparts. There was no statistically significant (p=0.061) two-week post-operative complication as well as 6 weeks postoperative complications rates (p=0.275) in NALG and HALG. It was observed that the commonest 6-week postoperative complications in the patients with high axial length were corneal edema, posterior synechia, and pseudophakic bullous keratopathy. That for the patients in normal axial length was de-centered IOL.

Conclusion: SICS remains a viable and effective option for cataract surgery across different axial lengths, a tailored approach is imperative for high axial length eyes. By incorporating advanced preoperative planning, refined surgical techniques, and robust postoperative care, the risk of anterior segment complications can be minimized, ensuring optimal visual outcomes for all patients.

Keywords: High Axial Length, Normal Axial Length, Intra Operative Complications, Post-Operative Complications, Small Incision Cataract Surgery.

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Introduction

Cataract is the leading cause of blindness and low vision.[1-4] As the world population ages, cataract-induced visual dysfunction and blindness will be on the rise.[5] The expectations of cataract patients have risen with introduction of innovative tools and technical improvement in surgical methods. Most surgeries end with excellent results, and patients as well as the surgeon are intolerant of occasional complications.

Precaution taken during surgery to prevent for the potential complications may improve the outcome. Cataract surgery and implantation of an intraocular lens (IOL) is an especially efficient refractive procedure in high myopia. With adequate expertise and proper implantation of IOL with correct power, patients will enjoy an improved vision. This is not achievable in the majority of patients by most of the other refractive modalities, such as glasses, contact lenses, and corneal refractive procedures as the patient having cataract. Some intra operative complications may raze this benefit.

Surgery is the only satisfactory method of treatment currently available for lens opacity. Ophthalmic surgeons have witnessed a significant improvement in surgical technique for cataract extraction in recent years. The demand of the cataract patients for quick visual improvement has never been as high as it is today. The surgery of

cataract was practiced by Egyptians and by Susruta in India about 800 BC. Susruta's procedure was known as Couching or reclinition.[6] Von Grafee in 1865 introduced ECCE by superior incision.[7] In 1895 Colonel Henry Smith advocated performing the intra capsular cataract extraction without internal anterior chamber manipulation.[8]

In 1949 Harold Ridley9 introduced ECCE with PCIOL implantation. [9] ECCE with acrylic ACIOL implantation was advocated be Strampelli in 1953. [10] In 1967 Charles Kelman introduced phacoemulsification. [11] Early in 1982, Kraff and Sanders advocated small incision surgery which producing less induced astigmatism and less late-healing astigmatic shift.[12] Here is a study to evaluate the safety and efficacy of manual small incision cataract surgery in high axial length eyes in comparison with the eyes with normal axial length and aim to reduce intra operative and post-operative complications. Surgical management of cataract in patients with high myopia is associated with special difficulties provision for prevention of potential complication may improve the outcome. [13] Cataract surgery and implantation of an intraocular lens (IOL) is an especially efficient refractive procedure in high myopia.

Material and Methods

Study Design: Institution based prospective observational study of cross sectional design.

Study was conducted at Regional Institute of Ophthalmology, Medical College Kolkata for a period of 18 months.

Sample Size: calculated by using simple random sample formula.

$$n=(p1-p2)^2\,(Z1-\alpha/2+Z1-\beta)^2[p1(1-p1)+p2(1-p2)]$$

From previous studies assuming complication rates in NALG group is 18% and in HALG group it is 40% with using power of the study 75%.

- p1=0.18, p2=0.40.
- Two-sided α = 0.05 → Z1−α/2=1.96Z_{1-\alpha/2} = 1.96Z1−α/2=1.96
- Power = 0.75 → Z0.75≈0.674Z_{0.75} \approx 0.674Z0.75≈0.674
- Difference = |p1−p2|=0.22|p_1 - p_2| = 0.22|p1−p2|=0.22

N= 58.8 (nearly 59) in each group

By assuming loss of follow up of 10% it will be about N = 50 in each group.

Total sample size about 100 (50 eyes of normal axial length and 50 eyes of high axial length).

Statistical Analysis: All statistical analysis was done using IBMSPSS.

Ethical Clearance: was taken from the Ethical committee of our Medical College and hospital on 10/11/2022, letter number: MC/KOL/IEC/NON-SPON/1612/11/2022.

Inclusion criteria:

1. Eligible patients were aged 18 years or older with cataract.
2. In the normal group with axial lengths ranging between 21 and 24.5 mm, and in other group will be considered myopic with axial length equal or greater than 26 mm.
3. Eyes with normal transparent cornea.
4. Eyes with well dilated pupil in both group.

Exclusion criteria:

Cases which were excluded from the study were as follows:

1. Age of the patients less than18years.
2. Prior ocular trauma.
3. Eyes with posterior segment pathology
4. Subluxated or dislocated cataract with weak capsular support.
5. Other ocular pathology like: Microcornea, Scleral thinning, Peripheral corneal thinning, Low endothelial cell count, Ciliary staphyloma Scleral ectasia, Conjunctival scarring.
6. Any active corneal or conjunctival infection.

IOL Power Calculation: A-scan biometry was performed to measure the axial length (L) of each eye. IOL power (P) was calculated by SRK formula, which is as follows:

P = A – 2.5 L – 0.9 K.

Where, P= IOL power to be implanted.

A= Specific constant for each lens type as per recommendation of

Manufactures, which is between 114 and 119.

L= Axial length of each eyeball in mm.

K= Average keratometric readings (KV + KH)/2.

Surgical Steps:

1. A fornix based conjunctival flap was prepared and hemostasis was done by cautery.
2. Incision: Frown incision of 5-7 mm in length and 2-2.5 mm away and parallel to the limbus was given.
3. Sclero-corneal tunnel was made with 2.8 crescent knife.
4. Side Port was made with the 15^0 lance tip knife at 10 O' clock position in the clear cornea
5. Staining of anterior capsule with trypan blue dye and continuous curvilinear capsulorrhexis was made
6. Completing the sclero-corneal tunnel with help for a 2.8 mm keratome and anterior chamber was entered.

7. Hydrodissection was done and hydrodelineation in some cases
8. Nucleus management: The nucleus was prolapsed into the anterior chamber and delivery of the nucleus was done with the help of a vectis
9. Cortical cleanup was done by using Simcoe's irrigation aspiration cannula of 23 G.
10. IOL implantation: Rigid PMMA iol was implanted in capsular bag with help of a McPherson's forceps
11. Once the IOL is in place and well centered the remaining viscoelastic was removed and replaced with ringer lactate or BSS.
12. Wound closure: Side port was closed by stromal hydration. At the end of the procedure sub-conjunctival injection with 20 mg gentamycin and 2 mg of dexamethasone was given. Patching of the eye was done with sterilized eye pads.

Postoperative Dressing and Evaluation: First postoperative dressing was done in the next morning and individual complain if any was noted. Visual acuity was recorded for distance with and without pinhole. Then every patient was examined carefully under slit lamp.

Intraocular pressure was recorded by non-contact tonometer. Fundus was examined in all cases with direct, indirect ophthalmoscope and with +90 D lens. Gonioscopy was performed in selected cases.

Medications at the Time of Discharge:

1. Systemic antibiotics (tablet Ciprofloxacin 500 mg 12 hourly) continued for 5 days.
2. Topical antibiotic-steroid combination eye drop was instilled 2 hourly then tapered over 6 weeks.
3. Timolol maleate 0.5% eye drop- 2 times daily in some cases.

Advice at Discharge:

1. To wear dark goggles at day time for at least 4 weeks.
2. To avoid stress and strain like sneezing, coughing, weight lifting and constipation for 6 weeks.
3. To avoid contact of water with the operated eye and to take bath below neck region and onwards.

Patients were instructed to attend ophthalmology outpatient department at 2nd week and 6th week postoperative for review and checkup.

Results and Observation

50 patients of normal axial length (21.5-24 mm) and 50 patients of high axial length were participated in our study. According to distribution of age of participants: in normal axial length group (NALG) 50-59 years of age were 10 (20%), 60- 69 years were 28 (56%), 70-79 years 11(22%), 80 and above 1(2%). In high axial length group (HALG) it was 13(26%) patients of age 50-59 years, 19(38%) of age 60-69 yers, 15(30%) of age 70-79 years, 3(6%) of age 80 and above. It was observed that there was no statistically significant (p=0.92) difference between the normal and high axial length patients with respect to their age. According to distribution of study participants to their sex (n=100) it was observed that a statistically significantly (p=0.001) higher proportion of men had high axial length than women. There was no statistically significant difference (p=0.572) between the normal and high axial length patients with respect to their religion. According to the duration of dimness of vision (in months) (n=100) it was observed that there was no statistically significant difference (p=0.131) between the normal and high axial length group.It was observed that no statistically significant difference (p=0.441) between the normal and high axial length patients with respect to their type (Nuclear sclerosis 1-4 and mature) of cataract. Intra operative complications (Table 1) were present in 10 (20%) patients in NALG, where as it was 21 (42%) patients in HALG. So in our study HALG patients had border line statistically significant (p=0.029 with 95% confidence interval) intra operative complications as compared to their counterparts. According to type of intra operative complications in NALG patients incomplete rhexix 1(2%), recurrent iris prolapse 2(4%), Iris trauma 1(2%), Posterior capsular rupture (PCR) 6(12%), shallow anterior chamber 2(4%), Descemet's membrane tears 1(2%), vitreous prolapse 5(10%). In HALG patients intra operative complications were-Capsular bag dialysis 1(2%), Iridodialysis 1(2%), incomplete rhexis 1(2%), iris sphinctre trauma 1(2%), posterior capsular trauma 15(30%), incomplete cortical clean-up 9(18%), nucleus drop 1(2%), vitreous prolapse 12(24%), retained cortical matter 1(2%).

Table 1: Distribution of study participants according to type of intra operative complications (n=100)

Complications	Normal axial length (%)	High axial length (%)
Bag dialysis	0 (0)	1 (2)
Iridodialysis	0 (0)	1 (2)
Incomplete rhexis	1 (2)	1 (2)
Iris prolapse	2 (4)	1 (2)
Iris trauma	1 (2)	1 (2)
Posterior capsular rupture	6 (12)	15 (30)
Rhexis extension	1 (2)	0 (0)
Shallow AC	2 (4)	0 (0)
Descemet's membrane tear	1 (2)	0 (0)
Hyphema	0 (0)	1 (2)
Incomplete cortical cleanup	0 (0)	2 (4)
Vitreous prolapse	5 (10)	12 (24)
Nucleus drop	0 (0)	1 (2)
Retained cortical matter	0 (0)	1 (2)

It was observed that patients with high axial length had significantly (p=0.045) higher rates of postoperative day 1 complications (Table 2) as compared to their normal axial length counterparts. It was also observed that the commonest post-operative day 1 complication in either of the two group of patients was corneal edema. This was followed by DM folds in high axial length group and central striae in normal axial length group.

Table 2: Distribution of study participants according to type of postoperative complications at day 1

Complications	Normal axial length (%)	High axial length (%)
Absent	38 (76)	28 (56)
Corneal edema	5 (10)	9 (18)
A/C reaction grade 1	0 (0)	1 (2)
A/C reaction grade 2	0 (0)	1 (2)
Aphakia	0 (0)	4 (8)
Central striae	3 (6)	1 (2)
De-centered IOL	1 (2)	1 (2)
DM folds	1 (2)	7 (14)
Hyphema	1 (2)	0 (0)
Residual cortical matter	1 (2)	0 (0)
Vitreous strands in AC	2 (4)	1 (2)
Iritis	0 (0)	2 (4)
Irregular pupil	0 (0)	1 (2)
Posterior synechiae	0 (0)	1 (2)

It was observed that no statistically significant (p=0.061) difference between the normal and high axial length patients with respect to their two-week postoperative complication rates in this study (Table3).

Table 3: Distribution of study participants according to type of postoperative complications at 2 weeks (n=100)

Complications	Normal axial length (%)	High axial length (%)
Absent	42 (84)	34 (68)
Aphakia	0 (0)	1 (2)
Central striae	1 (2)	1 (2)
Corneal edema	1 (2)	6 (12)
De-centered IOL	2 (4)	1 (2)
DM folds	1 (2)	6 (12)
Irregular pupil	0 (0)	1 (2)
Pigment dispersion	1 (2)	0 (0)
Posterior synechiae	1 (2)	2 (4)
Pupillary distortion	1 (2)	0 (0)
Residual cortical matter	1 (2)	0 (0)
Total	50 (100)	50 (100)

It was observed that the commonest complications in the high axial length patients at two weeks of observation were corneal edema and DM folds. That for normal axial length patients was de-centered IOL. It was observed

that no statistically significant (p=0.275) difference between the normal and high axial length patients with respect to their 6-week postoperative complication rates (table 4).

Table 4: Distribution of study participants according to type of post-operative complications at 6 weeks (n=100)

Complications	Normal axial length (%)	High axial length (%)
Absent	44 (88)	40 (80)
Aphakia	0 (0)	1 (2)
Central straie	1 (2)	0 (0)
Corneal decompensation	0 (0)	1 (2)
Corneal edema	0 (0)	2 (4)
De-centered IOL	2 (4)	0 (0)
DM folds	0 (0)	1 (2)
Irregular pupil	0 (0)	1 (2)
PCO	2 (4)	0 (0)
PBK	0 (0)	4 (8)
Posterior synechiae	1 (2)	2 (4)

It was observed that the commonest 6-week (Table 4) postoperative complications in the patients with high axial length were corneal edema, posterior synechiae, and pseudophakic bullous keratopathy. That for the patients in normal axial length was de-centered IOL.

Discussion

In our study it was observed that on comparison of high axial length between men and women, a statistically significant higher proportion of men (86%) had higher axial length than women (14%). This is in corroboration with a study conducted in an elderly Chinese population Chen et al stated that age and gender were the most consistent predictors of ocular biometrics.[14] Nangia V. et al conducted a study in a rural area of central India with healthy subjects aged 30 years and older and found that body height and eye size were related. [15]

In this study it was observed that among the 50 patients of normal axial length, 28 patients (56%) had belonged to the age group of 60-69 years and among the 50 patients with high axial length, 19 patients (38%) belonged to the same age group of 60-69 years. Hence it was observed that there was no statistically significant difference between the normal and high axial length patients with respect to their age.

In this study it was observed that 42% patients of normal axial length developed nuclear sclerosis grade 2 and 32% patients with high axial length developed nuclear sclerosis grade 2. Followed by 28% patients of normal axial length developing nuclear sclerosis grade 3 and 30%patients of high axial length developing nuclear sclerosis grade 3. On comparison, it was observed that there was no statistically significant difference between normal and high axial length groups with respect to the type of cataract. In a study conducted on the complications of Myopia: A Review and Meta-Analysis by Annechien E. G. Haarman et al seven out of the 11 studies reported an association between myopia and nuclear cataract.[16] Similar finding was observed in a study by Nicholas AP Brown et al on Cataract: the relation between myopia and cataract morphology. Among those eyes presenting with cataract cortical opacities were the most common, occurring in 63% of eyes, with nuclear cataract in 41% and subcapsular cataract in 24%.[17] It was observed that no statistically significant difference between the normal and high axial length patients with respect to the eye operated.

According to this study 15(30%) patients with normal axial length had a preoperative visual acuity of 6/36 and 17 patients (34%) with high axial length had a preoperative visual acuity of 6/36. However it was observed that there was no statistically significant difference between the normal and high axial length patients with respect to their preoperative visual acuity.

In this study it was observed that in 15(30%) patients with high axial length had posterior capsular rupture whereas 6(12%) patients with normal axial length had posterior capsular rupture. 12(24%) patients with high axial length compared to 5(10%) patient with normal axial length with intra-operative vitreous prolapse. Other complications that were more in high axial length group include incomplete cortical cleanup, capsular bag dialysis, nucleus drop, iris prolapse, incomplete capsulorhexis and capsulorhexis extension. However other complications noted among normal axial length included shallow anterior chamber, iris prolapse, trauma to iris and tearing of Descemet's membrane.These findings can be compared with study done by Hamid Fesharaki et al in which it was observed that eighteen cases in the normal axial group (2.5%) had posterior capsular rupture compared with 9 cases (5.7%) in the high axial length group and sixteen cases (2.3%) in the normal group had vitreous loss versus 7 cases

(4.5%) in the high axial length group.[18] A similar finding was observed in a study conducted by Yao et al it was found that posterior capsular rupture (3.91%), capsular contraction syndrome (2.1%), intraocular lens dislocation (0.58%), and transient intraocular pressure elevation (28.15%) occurred more frequently in the highly myopic population.[19] In this study it was observed that the patients with high axial length had significantly higher rates of postoperative day 1 complications as compared to their normal axial length counterparts.

There were 9(18%) patients with high axial length who developed corneal edema postoperative day 1 while only 5(10%) patients with normal axial length developed corneal edema postoperative day 1. These findings can be corroborated with a study conducted by S. J. Tuftl et al on peripheral corneal oedema following cataract extraction where postoperative inflammation occurred in at least 5(24%) eyes. [20]

In this study it was observed that 16 (32%) patients with high axial length had complications on 2nd week post-operative follow up which included 6(12%) patients with corneal edema, 6 patients (12%) with DM folds, 2 patients (4%) with posterior synechiae, others included aphakia, central striae, irregular pupil and de-centered IOL compared to 8 patients (16%) with normal axial length who had complications on 2nd week follow up which included 2(4%) patients with de-centered IOL, others included central striae, corneal edema, DM folds, pigment dispersion, pupillary distortion, posterior synechiae and residual cortical matter. On comparison there was no statistically significant difference between the normal and high axial length patients with respect to their two-week postoperative complication rates. On 6 weeks follow up, it was observed that 10 patients (20%) among the patients with high axial length had complications that included 2 patients with corneal edema (4%) and 2 patients (4%) with posterior synechiae.

Others included aphakia, corneal decompensation, irregular pupil, DM folds. On comparison, only 6 patients (12%) among those with normal axial length had complications on post op 6 weeks follow up that included 2 patients (4%) with de-centered IOL and 2 patients (4%) with mild PCO. Other complications included central striae and posterior synechiae.

Conclusion

Small incision cataract surgery is the procedure of choice in developing country facing huge volumes of cataract patients of any axial length because of the following advantage:

- It yields the excellent visual rehabilitation of pseudophakic vision.
- It provides rapid visual rehabilitation of suture less surgery and absence of suture-induced complications including astigmatism, irritation, infection, and necessity of removal.
- Simple instrumentation is its key advantage.
- No special training of surgical personal is required.

In conclusion, while SICS remains a viable and effective option for cataract surgery across different axial lengths, a tailored approach is imperative for high axial length eyes. By incorporating advanced preoperative planning, refined surgical techniques, and robust postoperative care, the risk of anterior segment complications can be minimized, ensuring optimal visual outcomes for all patients.

This conclusion provides a comprehensive summary of our findings, emphasizes the clinical relevance, and suggests practical steps and future research directions to enhance the safety and efficacy of cataract surgery in varying axial lengths.

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