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Original Research Article

Evaluation of axial length and association with morphology of cataract

Vatsala Vats*, Manisha Gupta, Shantanu Aggarwal

Department of Ophthalmology, SGRRIMHS, Patel Nagar, Dehradun, Uttarakhand, India

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***Correspondence:**
Dr. Vatsala Vats,
E-mail: vatsym@gmail.com

ABSTRACT

Background: Cataractogenesis is associated with alteration in the nature of lens epithelium. How a change in morphology of cataract relates to axial length and IOL power is an interesting area to explore. The aim of the study was to evaluate the association between axial length and age-related cataracts, and intra ocular lens (IOL) power in eyes undergoing cataract surgery.
Methods: A cross sectional study was conducted from 2019 to 2020 on 550 eyes with age related cataract for morphology of cataract and axial length of eye. Data was analyzed using statistical software One-way ANOVA and Post HOC test.
Results: Out of a total 550 eyes, 122 (22.2%) were Nuclear, 79 (14.4%) were PSC, and 349 (63.5%) were of Mixed morphology. Mean age of patients with PSC was 56.41±14.55 years, 58.52±14.16 years with Nuclear, and 62.88±9.86 years in Mixed morphology. This difference was found to be statistically significant with p value of 0.001. In this study, the mean axial length in eyes with only Nuclear, only PSC, and Mixed morphology, was measured to be 23.19±1.29, 23.26±0.91, 23.24±1.47 respectively. This was found to be statistically insignificant with p=0.92. The mean power intraocular lens 20.96±3.03 D in Nuclear Cataract, 21.25±2.39 D in PSC, and 21.25±2.60 D in Mixed cataract, and was statistically insignificant with p value of 1.
Conclusions: This study suggests no impact of morphology of cataract on axial length or IOL power.

Keywords: Cataract, Axial length, Intraocular lens

INTRODUCTION

Age-related cataract is a leading cause of visual impairment in both the developing and developed world.[1] Cataractogenesis is associated with alteration in the nature of lens epithelium. It has been hypothesized that decreased diffusion of nutrients to lens due to changes in axial length may promote cataract.[2-4] The changes in vitreous circumstances due to longer axial length might contribute to the formation of senile nuclear cataract.[5] Eyes with axial myopia are more likely to develop cataracts at an earlier age than those with shorter axial lengths.[6-8] Cataract management involves calculation of intraocular lens (IOL) power preoperatively by means of different methods. Out of the various factors in the formulas for IOL, keratometry and axial length are specific to the respective eye, but the A constant belongs to the characteristic IOL to be implanted. Various studies conducted on axial length, attribute its variations to geography, and genetics. This information probably explains that axial length is also one of the parameters that affects the refractive status preoperatively.

However, the IOL power along with other variables like incision, has an impact on refraction post operatively. Through this study, we intend to explore the relationship, if any, in axial length, morphology of cataract, and IOL power among residents of northern India in patients undergoing cataract surgery.

Aim

The purpose of this present analysis was to evaluate the association between axial length and age-related cataracts and intra ocular lens (IOL) power in eyes undergoing cataract surgery in a tertiary care hospital of northern India.

METHODS

It is a cross sectional, hospital based, observational study conducted in a tertiary care teaching and research institute (Shri Guru Ram Rai Institute of Medical and Health Sciences) placed in a valley of Uttarakhand state of India, from September 2019 to August 2020.

Approval from the institutional research ethical committee was duly sought. Only 550 eyes with age related cataract were evaluated for senile cataract, ocular biometry like axial length and IOL power. Eyes with ocular or systemic associations likely to result in cataract like ocular trauma, intraocular surgery, retinal detachment, uveitis, diabetes, steroids and complicated cataracts were excluded. All eyes underwent complete ophthalmologic examination including visual acuity, refraction, slit-lamp examination, tonometry, keratometry, and ocular ultrasound B- scan if required. The Posterior Subcapsular Cataract (PSC), Nuclear, and Cortical cataract was graded on density as per LOCS III classification.[9] As most of the cataracts had features of more than one morphology, we suggested a new category of Mixed cataract that included the eyes not having only PSC, Nuclear, Cortical, but features of features of more than one morphology. Keratometric data was recorded using NIDEK ARK-1/432132 /2015. Axial length was measured using immersion technique by NIDEK ECHOSCAN US 4000/41187/2015. IOL power was calculated in dioptres (D) using The Sanders-Retzlaff-Kraff (SRK/T) formula with 'A' constant of 118.5 with values closest to 0 or emmetropia.

Statistical methods

Data was analyzed using statistical software one-way ANOVA and Post Hoc test. P value less than 0.05 has been stated to suggest the significance.

RESULTS

Out of a total 550 eyes, 122 (22.2%) were Nuclear, 79 (14.4%) were PSC, and 349 (63.5%) were of mixed morphology. Both the genders presented maximally with mixed variety. Vision at the time of presentation, showed that just 51 (9.28%) eyes had no visual impairment, with 499 (90.72%) had vision less than 6/18.This difference was found to be statistically significant with p=0.03.

Table 1: Distribution of patients with different morphology of cataract according to sex.

Sex	Morphology			Total
	Nuclear	PSC	Mixed	
Female	66 (22.1)	38 (12.7)	195 (65.2)	299
Male	56 (22.3)	41 (16.3)	154 (61.4)	251
Total	122 (22.2)	79 (14.4)	349 (63.5)	550

Table 2: Distribution of patients with different morphology of cataract according to level of visual impairment.

Visual impairment	Morphology			Total
	Nuclear	PSC	Mixed	
No visual impairment	5 (9.8)	12 (23.5)	34 (66.7)	51
Visual impairment	35 (14.1)	27 (10.8)	187 (75.1)	249
Blind	82 (32.8)	40 (16)	128 (51.2)	250
Total	122 (22.2)	79 (14.4)	349 (63.5)	550

Table 3: Comparison of mean parameters among patients with different morphology of cataract.

Parameter	Morphology						P value*
	Nuclear		PSC		Mixed		
	Mean	SD	Mean	SD	Mean	SD	
Age	58.52	14.16	56.41	14.55	62.88	9.86	0.001
K1	4417	1.67	44.01	1.65	44.23	1.69	0.57
K2	45.13	1.68	44.71	1.62	45.01	1.71	0.22
AXL	23.19	1.29	23.26	0.91	23.24	1.47	0.92
IOL	20.96	3.03	21.25	2.39	21.25	2.60	0.58

*One way ANOVA

Table 4: Post HOC test for different pairs of morphology of cataract.

Parameter	Nuclear and PSC		Nuclear and Mixed		PSC and Mixed	
	Mean difference	P value	Mean difference	P value	Mean difference	P value
Age	2.12	0.63	-4.36	0.001	-6.48	0.001
K1	0.16	1.00	-0.06	1.00	-0.22	0.89
K2	0.42	0.25	0.13	1.00	-0.29	0.49
AXL	-0.07	1.00	-0.05	1.00	0.02	1.00
IOL	-0.29	1.00	-0.29	0.92	-0.001	1.00

The table shows the mean difference in age of presentation between nuclear and mixed variety was- 4.36, and that between PSC and mixed type of cataract was -6.48, which was statistically significant with a p value of 0.001.

DISCUSSION

Out of a total 550 eyes, 122 (22.2%) were Nuclear, 79 (14.4%) were PSC, and 349 (63.5%) were of Mixed morphology having features of nuclear, PSC, and sometimes cortical cataract also. We did not come across pure cortical cataract that could be taken up for surgical intervention. Both the genders presented maximally with Mixed variety of cataract for surgical management in nearly the same proportion, with 195 (65.2%) females, and 154 (61.4%) males out of 550 patients. Even among the individual morphology of PSC, Nuclear, and Mixed category, there was nearly equal distribution between males and females with no significant trend. As per status of vision at the time of presentation, it was found that just 51 (9.28%) eyes had no visual impairment, with 499 (90.72%) had vision less than 6/18.This difference was found to be statistically significant with p=0.03. This reflects the decisive nature of patients and the visual status they considered as a functional hazard. One such study from Kashmir has reported the common refractive status of eyes with cataract but not the vision at presentation.[10] Another study done on ocular biometrics by Wickremsighe et al, showed that all gender differences related to axial length, anterior chamber depth, and lens thickness ceased to be significant after adjustments for height were made. They noted no significant difference in mean absolute asymmetry of axial length between men and women.[11] A study from Nepal has reported a pre operative visual status below 20/400 in 71.1% of eyes that opted for surgical management.[12] We observed that the mean age of presentation of patients was 59.27 years, which is close to the age of population (60.5 years) studied in Kashmir.[10] We studied those eyes which underwent cataract surgery, so laterality as a factor was not chosen for consideration. In a study by Wickremsinghe, no major difference was found between the right versus the left axial length, diminishing the laterality bias.[11] Mean age of patients with PSC was 56.41±14.55 years, 58.52±14.16 years with nuclear sclerosis, and 62.88±9.86 years in patients with mixed type of morphology in our study. This difference was found to be statistically significant with p value of 0.001. PSC type causes difficulty in vision during day, hence people become symptomatic early, while in nuclear and mixed type of morphology, the patient keeps adjusting to the changes in refractive index, and continues to opt for glasses as therapeutic measures. We performed a Post HOC test and observed that the mean difference in age of presentation between nuclear and mixed variety was -4.36, and that between PSC and mixed type of cataract was -6.48, which was statistically significant with a p value of 0.001. In a similar study from Nepal the average age was found to be 61.93±16.48 years, however their range of age was from 2 to 111 years.[12] Another study from Pakistan showed a mean age of 55.08±14.52 years with a range from 4 to 95 years.13 In this study, the mean axial length in eyes with only Nuclear, only PSC, and Mixed morphology, was measured to be 23.19±1.29, 23.26±0.91, 23.24±1.47 respectively. This was found to be statistically insignificant with p=0.92. In a study from Kashmir, the mean axial length of the study population was 22.66 mm. Also they found that the axial length in the age group of 40 to 60 years (22.74 mm) to be insignificantly higher than those between 60 to 80 years (22.52 mm).10 The mean axial length reported from a study in Nepal was 23.08±0.1.26 mm, while from Pakistan was found to be 22.96±1.04 mm.[12,13] A study from Central India on rural population was found to be shorter (22.6±0.91 mm). This study attributed the variation in axial length to height, weight, systemic parameters and education.14 Influence of ethnicity on axial length can be emphasized from data gathered from different studies.[15] Although the IOL implanted was chosen unanimously by the patient and his condition, but when we considered the values of IOL with an 'A' Constant of 118.5 at emmetropia, the results showed the mean power of 20.96±3.03 D in Nuclear Cataract, 21.25±2.39 D in PSC, and 21.25±2.60 D in Mixed type of cataract, and was thus statistically insignificant with p=1. One study from Nepal calculated a mean IOL power 21.37±3.07 D.[12] A similar study on axial length variability in cataract surgery done in Pakistan showed a mean IOL power of 21.10±2.5 D.[13] The mean intraocular lens power calculated in a study from Norway was 21.72 D in comparison to Taiwanese population that required an IOL power of 20.0.[17,18] This change of IOL power is suggestive of variation in ocular parameters due to race and ethnicity.[14] A longer axial length predisposes to cataract has been studied, but some studies have reported progression in cataract due to increase in age.[19-21] However, alteration of ocular biometrics significantly by morphology of cataract needs more confirmation. Our

study concurs with the Malay Singapore Eye study that states that axial length per se is not associated with any cataract subtypes.1 The Pagar Study stated that there was no correlation of axial length with cataract or its subtype.[20]

The Salisbury eye evaluation project, and the Blue mountain eye study have emphasized the association of myopia and cataract, however the sample of population studied does not match with our study, as we have taken only those cases of cataract which have agreed upon surgical management.[2,16] Our observations suggest no specific change in axial length with morphology of cataract, and no impact of morphology of cataract on IOL power. The present study could be an encouraging statement for those centres which are situated in the interiors of the Himalayas and are yet to be upgraded in techniques and infrastructure for cataract management. Also this study could prove to be a reference point for developing countries where procurement of IOL could be a hindering factor in eradicating needless blindness.

Limitations

One possible limitation of our study could be the sample size, which was affected due to the pandemic scenario. With a senile cataract surgery being an elective procedure, such a decline in numbers has continued till date in the wake of new protocols and guidelines. However, such setbacks should not undermine the plausibility of the research.

CONCLUSION

Through this study, we make an effort to eradicate blindness due to cataract. With an evolving science in techniques of cataract management, some common factors like morphology, axial length, and IOL power when explored in different ways might give simple yet authentic solutions in cataract management.

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