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# A STUDY OF CATARACT IN RELATION TO ANATOMICAL DIMENSIONS AND REFRACTIVITY OF THE EYE

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## ABSTRACT

**Aims and objectives:-** The aim of this study was to establish the relationship between type of cataract and anatomical dimensions i.e., axial length and refractivity of the eye, also to find out relationship between cataract and its type with that of axial length, and relationship between different type of refractive errors and cataract were included in the study. Eye examinations included detailed torch light examination of the patient's eyes, cycloplegic refraction and retinoscopy, slit lamp biomicroscopy, A-scan ultrasonography and keratometry. Cataract is graded on the basis of Lens Opacification Classification System II. **Stastical analysis:-** Statisical analysis was carried out using student 't' test and data was analysed using SPSS version 17 software programme. **Observations:-** 150 subjects were studied with 84 females and 66 males. Mean age of the patients was 67.8 + 9.5 years. 66 eyes out of 154 had posterior subcapsular cataract, making it most common cataract combination in the study. Out of 154 eyes, 4 eyes were hypermetropic, 139 were emmetropic and 11 eyes were myopic. Out of 11 myopic eyes, 4 had nuclear with posterior sub capsular cataract, 4 had nuclear cataract alone and rest 3 had cortical with nuclear with posterior sub capsular cataract. The grade of nuclear cataract in this study increased with increasing age. **Conclusions:-** The most common type of cataract in elderly age group is nuclear sclerosis. The mean refractive error in terms of spherical equivalent in nuclear cataract was -2.35 D, and -1.76 D in non nuclear cataract. In the myopic group, the most common type of cataract is nuclear type. Nuclear cataract leads to a myopic shift in refraction. A positive correlation was found between spherical equivalent and axial length, axial length and nuclear opalescence and, age and nuclear opalescence. A negative correlation was found between spherical equivalent and nuclear opalescence, and age and spherical equivalent.

**KEYWORDS:** cataract, axial length, refractive error, spherical equivalent, nuclear opalescence.

**INTRODUCTION**

Cataract is one of the most common eye diseases of elderly people and is a major cause of visual impairment and blindness worldwide. Pathophysiology behind cataracts is multifactorial involving complex interactions between various processes, As the lens ages, its weight and thickness increases while its accommodative power decreases. As the new cortical layers are added in a concentric pattern, the central nucleus is compressed and hardened in a process called nuclear sclerosis.[1,2,3]

According to American Academy of Ophthalmology, cataract is the degradation of the optical quality of the crystalline lens. According to the World Health Organisation, about 50% of the global blindness is attributable to cataract.

Ametropia is a condition when parallel rays of light coming from infinity are not focused at the sensitive layer of the retina. There are 3 types of ametropia - myopia, hypermetropia and astigmtism.

The overall refractive power of the eye is determined by the cornea, lens and axial length. Hypermetropia and myopia may be defined by refractive and or axial length measurements.

**Etiological types of ametropia.**

1) AXIAL
2) CURVATURAL
3) INDEX

Risk factors for development of cataract are many. Some of the are - myopia, smoking, hypertension, diuretics, diabetes, obesity, heredity, alcohol use, glaucoma, severe diarrhoea, renal failure, trauma, retinitis pigmentosa, dietary factors, use of steroids, exposure to ultraviolet radiation and ageing. High myopia is one such factor which may lead to cataract. Various mechanisms of cataractogenesis in myopic eyes have been proposed but none has been proved. They are.

1) Increased zonular stress in myopic eyes[3,6,7] than hypermetropic eyes due to reduced accommodative need of myopic eyes.

2) It has been found that more lipid peroxidation by the retina in myopes may lead to early cataract formation as compared to senile cataracts.[8]
3) Increased oxidative stress on the lens[9] and the vitreous[8] of the myopic eye as compared to age-related cataracts.
4) Syneretic vitreous in the myopic eye may facilitate diffusion of oxidizing molecules from the retina to the lens [8] leading to cataract.
5) Vitreo-retinal degenerative diseases like gyrate atrophy, retinitis pigmentosa, stickler syndrome and Leber's congenital amaurosis have a higher incidence of cataract[10-13], and congenital myopia is also associated with vitreo-retinal degeneration.
6) It has also been hypothesized that decreased diffusion of metabolites or nutrients to the back of the lens as an effect of longer vitreous cavity may inhibit the oxidative defence mechanism and thereby promote cataract.[4,5,8,9,14] The rapid development of nuclear cataract in the patients undergoing hyperbaric oxygen therapy strongly supports his oxidative theory of nuclear cataract formation. Decreased amounts of protein sulfydrils (P-SH) and increased amounts of protein carbonyls in proteins in the lens occurs earlier in myopes and diabetics.[14,15-19]
7) The aggregation of lens proteins into randomly distributed high molecular weight clusters are thought to produce sufficient fluctuation in protein density to account to account for the opacification of the lens.[20-24]

We designed an observational institute based longitudinal study to investigate the prevalence of different types of cataract in relation to axial length as well as refraction. This study documents both axial length as well as refraction. This study documents both axial length and refractive error as the criteria to define hypermetropia, emmetropia and myopia. In addition, an association between refraction, axial length and cataract has been reported in this study with statistical analysis being carried out.

**Aims and objectives**

1) The main aim of this study was to establish the relationship between type of cataract and anatomical dimensions i.e., axial length and refractivity of the eye

a) To find out the relationship between cataract and its type with that of axial length of the eyeball.
b) To find out the relationship between different type of refractive errors and cataract.

## MATERIALS AND METHODS

The study was a prospective, and observational institute based longitudinal study in human eyes. Patients were taken on a random basis from Jawaharlal Nehru Medical College Hospital and Gandhi Eye Hospital OPD at Aligarh from September 2008 to November 2009. Eye examinations included detailed torch light examination of the patient's eyes, cycloplegic refraction and retinoscopy, slit-lamp biomicroscopy, A-scan ultrasonography and keratometry.

Eye with primary cataract (U/L or B/L) in the age group >40 years were included in the study.

Eyes with following characteristics were excluded from study.

- Patients <40 years of age
- Patients with secondary cataract
- Patients using systemic/topical steroids for various reasons for>3 months
- Patients with history of intraocular surgery
- Patients with history of significant intraocular trauma.
- Patients with increased intraocular pressure
- Patients with uveitis
- Patients with pseudoexfoliation
- Patients with diabetes mellitus
- Patients who had undergone Laser-in-situ keratomileusis
- Patients who had undergone photorefractive keratometry
- Patients who had undergone prophylactic laser photocoagulation
- Patients who had undergone cryotreatment

**Instruments used**

- Torch light examination
- Slit lamp biomicroscopic examination
- Cycloplegic refraction and retinoscopy
- Fundus examination
- Keratometry
- A-Scan ultrasonography

Eyes with cataract were studied in detail. Firstly, a thorough torch light examination was done. An axial length measurement was obtained before dilatation of the pupil. A trained observer recorded the observations and measurements for each eye. Ocular dimensions including axial length were measured with an A-scan ultrasound device (Sonomed, 3000 Marcus Ave lake Success New York 11042). The study defined hypermetropia as axial length < 21 mm, emmetropia as axial length 21-25 mm and myopia as axial length > 25 mm on the basis of axial length of the eye.

It was followed by cycloplegic refraction and retinoscopy. For this, after dilatation of the pupil with 1% tropicamide (Sunways Pvt. Ltd, Mumbai, India) and 2.5% phenylephrine hydrochloride (Sunways Pvt. Ltd.) eye drops, a single observer examined the patient for refraction. A single observer was used to avoid bias and to maintain reliability and consistency. Spherical equivalent was calculated by adding the spherical component of refraction to half of the cylindrical component. A proper slit lamp examination was done to classify the type of cataract (Takagi Model 1208, Tokyo, Japan). The slit lamp was set at its narrowest setting, the slit beam height greater than papillary diameter. The biomicroscopist uses the low magnification view of the slit lamp with the slit beam oriented approximately 45 degrees to the patient's visual axis. The transformer settings are same as that of standard photograph-flash brightness 3, illumination intensity 3 with diffuse illuminator turned off. The slit beam was focussed at the centre of the nucleus. For classifying cataractous changes in-vivo, the standard photograph is prepared as 21.25 by 27.5 cm transparency and is placed on a light box at the level of and behind the right shoulder of the patient seated at the slit lamp. Thereafter, keratometry was done for which Super AAK 6 model of Appasamy keratometer was used.

The type and severity of cataract were graded and recorded by the LENS OPACIFICATION CLASSIFICATION SYSTEM-II, which involves the use of 4 nuclear standards for grading nuclear opalescence (NO), 5 cortical standards and 4 subcapsulsar standards. Nuclear colour is graded by comparing the colour of the posterior cortical-posterior sub-capsular reflex to the nuclear I (N I) standard, which is the same standard as in LOCS I. The standards demarcate boundaries between grades. The methodology adopted for evaluating the type and density of the cataract was standardized in terms of illumination and magnification.

**Statistical analysis**

In this study, statistical analysis was carried out using the student 't' test. To analyze correlations between age of patients, axial length of the eyeball and spherical equivalent we used Fisher and Yates probability tables. Data was analysed using spss version 17 software programme. On statistical analysis of the patient variables, a positive correlation was found between spherical equivalent and axial length, axial length and nuclear opalescence and, age and nuclear opalescence. A negative correlation was found between spherical equivalent and nuclear opalescence and, age and spherical equivalent. In this study, it was seen that both nuclear colour (grade 2) and opalescence (grade 3-4) have a significant ($p<0.05$) relationship with the axial length of the eye. Also, posterior sub-capsular cataract (grade 3-4) has a significant ($p<0.05$) relationship with the axial length of the eye. It was seen that a nuclear cataract shows a myopic shift in refraction.

**Observations**

The study was carried out in Institute of Ophthalmology, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh from September 2008 to November 2009. Out of one fifty patients, females outnumbered males with females 84 in number and males 66 in number and female to male ratio (1.3:1). The age range of the patients was between 40 years to 92 years. Mean age of patients was 67.8+- 9.5 (Mean + - standard deviation) years. Majority of patients were in the age group of 70-79 years (40.6%). Most common cataract combination was nuclear with posterior sub-capsular, 66 eyes having this combination out of 154 eyes. Least common type of cataract was Posterior sub-capsular, only 1 cae and with no cortical type of cataract occurring alone in any eye.

**The following observations were made by the study**

- Out of 150 patients, females outnumbered males with females 84 in number and males 66 in number and female to male ratio of 1.3:1.
- The age range of the patients was between 40 years to 92 years. Mean age of patients was 67.8 +- 9.5 (mean with standard deviation) years.
- Majority of patients were in the age group of 70-79 years (40.6 %)
- Most common cataract combination was Nuclear with Posterior sub-capsular, 66 eyes having this combination out of 154 eyes.
- Least common type of cataract was Posterior sub-capsular, only 1 case and with no cortical type of cataract occurring alone in any eye.
- In this study, hypermetropia was defined as axial length <21 mm, emmetropia was defined as axial length 21-25 mm and myopia was defines as axial length >25 mm.

- Emmetropia was most common group out of hypermetropia, emmetropia and myopia. Out of 154 eyes, 3 eyes were hypermetropic, 139 eye were emmetropic and 11 eyes were myopic.
- In myopic eyes, the most common cataract combinations were Nuclear with Posterior sub-capsular, (4 out of 11 myopic eyes) and Nuclear catatract alone, (4 out of 11 myopic eyes). Rest 3 myopic eyes had Cortical with Nuclear with Posterior sub-capsular cataract.
- In this study, majority of patients had refractive error between 0 to -5 D showing myopic shift of refraction with increasing age (139 patients). Only 10 patients had refractive error 0 to +5 D. Only 1 patient had refractive error > -5 D.
- The grade of nuclear cataract in this study increased with increasing age. Majority of patients with grade 4 nuclear cataract belong to 70-79 years age group.
- In the myopia group (11 cases), 6 patients had grade 3 or higher nuclear cataract.
- The study analyzed patient variables by student‘t’ test. The unpaired ‘t’ test utilized Fisher and Yates probability tables to find correlation between age of patients, axial length of the eyeball and spherical equivalent.

## CONCLUSIONS

Age related cataract is the leading cause of blindness in the developing world today. Several studies have been launched to measure cataract severity. By quantitating cataract, we can correlate risk factors such as myopia with the type of opacity. In this study, cataract is graded on the basis of Lens Opacification Classification System II, the favourable outcomes of this study are.

- The most common type of cataract in elderly age group is nuclear sclerosis (150 eyes out of 154 eyes)

| | |
|---|---|
| Nuclear alone- | 43 eyes |
| Nuclear with cortical- | 4 eyes |
| Nuclear with posterior sub capsular- | 66 eyes |
| Nuclear with cortical with posterior sub-capsular- | 37 eyes |

- The mean refractive error in our study in terms of spherical equivalent in dioptres-

| | |
|---|---|
| Nuclear cataract: | -2.35 D |
| No nuclear cataract: | -1.76 D |

- In the myopic group, the most common type of cataract is nuclear type. This nuclear sclerosis may be caused by decreased nutrition to the nucleus of the lens with longer axial length. Another probability is increased zonular stress in myopic lenses due to decreased accommodation used as compared to hypermetrope.
- Nuclear cataract leads to a myopic shift in refraction. Our study proves this as the most common type of refractive error is 0 to -5 D. In otherwise healthy eyes, there is a gradual hypermetropic shift.
- The prevalence of nuclear cataract increases with age.

In our study, by LENS OPACIFICATION CLASSIFICATION SYSTEM-II,

60-69 years age group- Nuclear grade III – 3 cases

Nuclear grade IV – 10 cases

70-79 years age group- Nuclear grade III – 2 cases

Nuclear grade IV – 16 cases

The grade of nuclear cataract gets higher with increasing age.

- In our study, the relationship between a higher grade of nuclear cataract and number of patients is significant.

**Nuclear colour –** $t = 2.87$, $p < 0.05$ and highly significant

**Nuclear opalescence** – $t = 4.9$, $p < 0.001$.

- In our study, increasing axial length is associated with a higher grade of nuclear colour ($t=2.3$, $p<0.05$) and nuclear opalescence (t=2-2, $p<0.05$). Increased axial length is associated with Posterior sub-capsular cataract ($t=2.7$, $P<0.05$). This relationship is significant.
- A higher grade of nuclear cataract is associated with a more negative spherical equivalent.

**Nuclear colour and Nuclear opalescence** – $t = 2$, $p<0.05$. Our study statistically proves that a higher grade of nuclear cataract leads to a myopic shift in refraction. This relationship is significant.

**A positive correlation was found between**

Spherical equivalent and Axial length- $r = +0.35$, $t = 4.5$, $p<0.001$ (highly significant).

Spherical equivalent and Cortical cataract – $r = +0.04$, $t = 0.48$

Axial length and Nuclear opalescence – r = =0.12, t = 1.5

Age and Nuclear opalescence – r = +0.29, t = 3.7

Age and Nuclear colour – r = +0.16, t = 1.98

It means that a direct correlation exists between these 2 variables. If one variable increases, the other variable also increases.

**A negative correlation was found between**

Spherical equivalent and Nuclear opalescence – r = -0.18, t = 2.2

Spherical equivalent and Nuclear colour – r = -0.09, t = 1.1

Age and Spherical equivalent – r = -0.07, t = 0.86

It means that an inverse correlation exists between these 2 variables. If one variable increases, the other variable decreases.

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