CATARACT: Evaluation of density and its relation with axial length.

ABSTRACT... Introduction: Among all ophthalmic diseases, cataract is the most commonest disorder not only in Pakistan but also worldwide. There are a number of causes for cataract development. Purpose: The present study was carried out to evaluate the density of cataract and its relation with axial length of the eye. Study design: In this observational study, the patients with cataract in both eyes were selected by simple random technique. Period: From June to December 2012. Place: This study was conducted in Diagnostic and Research Centre, Department of Ophthalmology, Allied Hospital, Punjab Medical College, Faisalabad. Subjects and settings: In present study 200 eyes of 100 patients were included having cataract in both eyes. Only those patients were selected who had no pathology other than cataract affecting visual acuity. The density of the cataract was assessed by measuring visual acuity. The axial lengths of both eyes were measured at the time of examination to see the relation between the axial length and density of cataract. Results: The comparison of the two eyes regarding the evaluation of the density of cataract and its relation with axial length was performed. Out of 100 patients 74 (74%) had a denser cataract or lesser visual acuity in the eye with a longer axial length (DCLAL) and 26 (26%) had a denser cataract or a lesser visual acuity in the eye with shorter axial length (DCSAL). On right side the axial length was 24.84 ± 1.73 and on left side, it was 21.62 ± 1.63. Our results showed that on right side, the visual acuity was 0.19 ± 0.09 and on left side, it was 0.23 ± 0.08. The axial length and visual acuity were statistically analyzed. The correlation was significant at the 0.01 level (2-tailed). The correlation coefficient was -0.04 on right side and on left, it was -0.12 showing inverse correlation between the two variables. Conclusions: There is a strong correlation between density of cataract and the axial length of the eyeball.

INTRODUCTION
Cataract is the leading cause of blindness in the world today and is likely to present an increasing burden to health care systems as the world’s population ages. According to the latest assessment, cataract is responsible for 51% of world blindness, which represents about 20 million people. 5.5 million people have a cataract interfering with their vision in the US. Approximately 570,000 adults are estimated to be blind (<3/60) as a result of cataract in Pakistan, and 3,560,000 eyes have a visual acuity of <6/60 because of cataract. In a report, the ten-year cumulative incidence was 43.6% for any cataract.

The term cataract is derived from the Greek word cataractos, which describes rapidly running water. When water is turbulent, it is transformed from a clear medium to white and cloudy. Keen Greek observers noticed similar-appearing changes in the eye and attributed visual loss from "cataracts" as an accumulation of this turbulent fluid, having no knowledge of the anatomy of the eye or the status or importance of the lens. There is no universally accepted method of quantifying the density of cataract for comparison in different patients, although some scales have been used in randomized clinical trials. The first comprehensive cataract classification system was introduced in 1978 and adopted by the American Cooperative Cataract Research Group (CCRG) in 1980. The most widely used classification system in the United States is the Lens Opacities Classification Systems I to III, which has been used in several national and international collaborative projects. The Age-Related Eye Disease Study System for Classifying Cataracts From Photographs could be useful in studies where there is a need to standardize data collection over time and across different data collection sites. However, by
measuring visual acuity, we can determine the density of cataract in these patients. Stifter conducted a study to evaluate the association between the density of nuclear, cortical, and posterior subcapsular lens opacities and visual impairment in patients with cataract and concluded that there was a strong association between visual impairment in patients with cataract and the severity of posterior subcapsular cataract (PSC) and nuclear opacity. Recently, functional visual acuity (FVA) measurement has been reported to be an important method of determining ‘masked impairment of visual function’ and assessing visual acuity in detail. FVA measurement is an effective and noninvasive test that reflects the complaints of blurring/glare and postoperative satisfaction in patients with mild cataract.

Cataract can be caused by aging process only or it may be due to lower educational status, smoking, ultra violet light exposure, trauma, dehydration, diabetes mellitus, uveitis and glaucoma. The results of Leske MC and his coworkers supported a role for the nutritional, medical, personal, and other factors in cataractogenesis. Senile cataract is an age-related, vision-impairing disease characterized by gradual, progressive thickening of the lens of the eye. It is one of the world’s leading causes of blindness. Clinical staging of senile cataract is based largely on the visual acuity of the patient.

High myopia is thought to be a risk factor for development of cataract. However, several studies have contradictory conclusions whether lesser degree of myopia also predisposes to cataractogenesis. It is also not clear which type of myopia (corneal, lenticular or axial) predisposes to cataract formation. The myopic change precedes the development of cataract, and patients over the age of 55 showing a myopic change in refraction have a very high probability of developing nuclear sclerotic cataract.

The axial length (AL) is the distance between the anterior surface of the cornea and the fovea and usually measured by A-scan ultrasonography or optical coherence biometry. The AL is the most important factor in IOL calculation: A 1-mm error in AL measurement results in a refractive error of approximately 2.35 D in an average eye. Ultrasonographically, the eye is divided into four components: Cornea, Anterior chamber, Lens thickness and Vitreous cavity. The velocity of sound in these compartments are 1620, 1532, 1641, 1532 m/s respectively. The measured transit time is converted to a distance using the formula d = t/v, where d is the distance, t is the time and v is the velocity. Eyes with unilateral cataract had shorter ALs than eyes with bilateral cataract during the earlier years, but had longer ALs during later childhood. Due to increase in AL, axial myopia can be caused. Highly myopic eye can be defined as one with AL ≥ 26.50 mm.

In this study we evaluated the relationship between the density of cataract and the axial lengths in two eyes of the same patient.

Postoperative complications
Cataract surgery complications are few, and cataract surgery is among the most common and most successful surgical procedures performed today. According to the American Society of Cataract and Refractive Surgery (ASCRS), 3 million Americans undergo cataract surgery each year, with an overall success rate of 98 percent or higher. A comparative study of complications of cataract surgery with phacoemulsification in eyes with high and normal axial length showed that age and high axial length were statistically significant risk factors for incidence of intraoperative complications of cataract surgery with phacoemulsification technique. Anticipation of these complications and also preparation and prophylactic measures may decrease incidence of these complications. In eyes with high myopia after cataract surgery, mild to moderate myopia was the most common refractive status.
status of the eye after cataract surgery is important in obtaining good quality of vision, a careful selection of the power of the implanted intraocular (IOL) is necessary. Highly myopic eyes implanted with a low power IOLs including negative powered IOLs tend to result postoperatively in hyperopic refractive errors. The degree of hyperopia can be minimized by using the 2-set optimized A constants to calculate the power separately for positive and negative power IOLs.

LATEST NEWS
Currently there are no contact lenses that have been FDA approved specifically for controlling progressive myopia. But research is ongoing, and that might change in the near future. The FDA approved Abbott's TecnisToric 1-piece intraocular lens (IOL) to treat preexisting astigmatism in patients with cataract. Toric intraocular lenses are used to manage corneal astigmatism in patients who have undergone cataract surgery and who have had their natural lenses removed. An Austrian man has developed a star-shaped (stellate) cataract after a blow to the eye that had occurred nearly nine months earlier (Fig. 1.)

METHODOLOGY
Aims And Objectives
According to the research plan the aims of this study was to evaluate the density of cataract and its relation with axial length of the eye.

Study Design
It was an observational study in which the patients with cataract in both eyes were selected by simple random technique.

Settings
The study was carried out at Diagnostic and Research Centre, Department of Ophthalmology, Allied Hospital, Punjab Medical College, Faisalabad.

Study Duration
The study duration was six months.

Sample Size
A total number of 100 subjects (200 eyes) were taken.

Age
39-71 Years.

Sex
Both male and female subjects

INCLUSION CRITERIA
• Having senile cataract in both eyes.
• None of the subjects were suffering from any systemic medical disorder. This was assessed by the history and general physical examination.
• Subjects not taking steroids.

EXCLUSION CRITERIA
• Patients with a history of any other ophthalmic disorder like uveitis or retinal detachment.
• Patients with any other type of cataract.
• Complicated cataract.

Materials and Methods
Total 100 patients were included in this study who came for treatment of cataract in Ophthalmology Department, Allied Hospital, Faisalabad. Out of these
100 patients 56 were females and 44 were males with age ranging from 39 to 71 years (Table-I). Detailed ocular examination of both eyes was performed including the best corrected visual acuity (BCVA) by using Snellen’s acuity chart (Table-II), anterior segment examination with slit lamp, dilated fundus examination with the help of direct ophthalmoscope, Indirect ophthalmoscope, slit lamp biomicroscopy. Intraocular pressure was measured with Goldmann applanation tonometer. All those patients were excluded from the study who had any other ocular disease affecting the visual acuity or causing the complicated cataract. The best corrected visual acuity (BCVA) was chosen as a criterion to quantify the density of cataract. The difference of at least of one line on Snellen’s chart between the BCVAs of the two eyes was considered significant. The A-scan was performed on all 200 eyes of 100 patients to measure the axial length with the help of Quantal medical II biometer (France). This equipment uses ultrasonic waves which are produced by a probe having piezoelectric crystals vibrating at the frequency of 11MHz. After instillation of local anesthetic eye drops (Proparacaine 2%) the probe was placed on the apex of the cornea. It measured the axial length ten times and gave us a mean reading. The axial length (Table-III) and density of cataract was compared in each eye of every patient. All the data was collected and analyzed statistically.

**RESULTS**

The comparison of the two eyes regarding the evaluation of the density of cataract and its relation with axial length was performed. Out of 100 patients 74 (74%) had a denser cataract or lesser visual acuity in the eye with a longer axial length and 26 (26%) (Fig.5) had a denser cataract or a lesser visual acuity in the eye with shorter axial length. On right side the axial length was 24.84±1.73 and on left side, it was 21.62±1.63. Our results showed that on right side, the visual acuity was 0.19±0.09 and on left side, it was 0.23±0.08. The axial length and visual acuity were statistically analyzed. The correlation was significant at the 0.01 level (2-tailed). The correlation coefficient was -0.04 on right side and on left, it was -0.12 showing inverse correlation between the two variables.

<table>
<thead>
<tr>
<th>Descriptive statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>55.3500</td>
<td>8.76215</td>
</tr>
</tbody>
</table>

**Table-I. Description about age.**

<table>
<thead>
<tr>
<th>Descriptive statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R visual acuity</td>
<td>.1924</td>
<td>.09408</td>
</tr>
<tr>
<td>L visual acuity</td>
<td>.2334</td>
<td>.08185</td>
</tr>
</tbody>
</table>

**Table-II. Description about Visual acuity.**

<table>
<thead>
<tr>
<th>Descriptive statistics</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>R axial length</td>
<td>24.8434</td>
<td>1.72910</td>
</tr>
<tr>
<td>L axial length</td>
<td>21.6263</td>
<td>1.63792</td>
</tr>
</tbody>
</table>

**Table-III. Description About axial length (mm).**

<table>
<thead>
<tr>
<th>Correlations left</th>
<th>Axial length</th>
<th>Visual acuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial length</td>
<td>Pearson Correlation Sig. (2-tailed)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>-124**  .218  100</td>
</tr>
<tr>
<td>Visual acuity</td>
<td>Pearson Correlation Sig. (2-tailed)</td>
<td>-124  .218 100</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table-IV. Descriptive analysis of (left) axial length and visual acuity.**

**Correlation is significant at the 0.01 level (2-tailed)**
DISCUSSION
Myopia including pathological myopia is a worldwide health concern, especially in East Asia\textsuperscript{34,35}. Because the incidence of cataract is significantly higher in eyes with moderate to high myopia\textsuperscript{36}, eyes with high myopia tends to undergo cataract surgery more frequently than low myopic eyes. In one study even in the hypermetropic patient the longer eye developed cataract earlier than shorter eye\textsuperscript{14}. This shows that it is not myopia but the axial length correlated to the cataract formation which supports our current study. In another study it was reported that in patients with higher axial length asymmetry, the longer eyes had more mature cataract\textsuperscript{37}.

Table-V. Descriptive analysis of (right) axial length and visual acuity.

<table>
<thead>
<tr>
<th></th>
<th>Axial length</th>
<th>Visual acuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial length</td>
<td>Pearson Correlation</td>
<td>-0.040**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.694</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Visual acuity</td>
<td>Pearson Correlation</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.040</td>
</tr>
<tr>
<td>N</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed)
Cataract formation can be caused by lipid peroxidation in the retina. The increased concentration of products of lipid peroxidation like Malondialdehyde and decreased concentration of reducing agents like glutathione has been found in the retina, vitreous and lens in myopic patients with cataracts. Increased axial length results into the thinning of the choroid and retina resulting into hypoxia to the rod outer segment. This causes increased lipid peroxidation of rod outer segment resulting into increased concentration of product of lipid peroxidation in retina and vitreous. This may result into cataract formation. It has been suggested by many studies that there is possible role of vitreoretinal degeneration in cataract formation. In patients with vitreoretinal degenerative conditions like retinitis pigmentosa, Stickler’s syndrome, Leber’s congenital amaurosis and gyrate atrophy, there is higher incidence of cataract formation.

From the above studies the increased axial length seems to be correlated with higher incidence of cataract formation which is quite comparable with our findings. The results of our study are slightly different from those of Ziqiang et al. In our study the incidence of denser cataract in eyes with longer axial length was 74% while in Ziqiang study it was 91%. The reason of this difference is that they have included only those patients who had the difference of 0.3mm or more of axial length between two eyes. In our study we included the patients with a difference of axial length even as low as 0.02mm.

**CONCLUSIONS**

The current study has shown that there is a strong correlation between the axial length of the eyeball and density of cataract. The eyes with longer axial length have denser cataract.

**REFERENCES**


8. The age related Eye disease study research group. The age related eye disease study (AREDS) System for classifying cataracts from photographs: AREDS report no.4 Am J Ophthalmol; 2001;131:167-75.


25. Chris A. Knobbe (2013), Cataract Surgery Complications, April, All About Vision.com


31. Petermeier K, Gekeler F, Messias A, Spitzer MS, Haigis W, Szurman P. Intraocular lens power


### PREVIOUS RELATED STUDIES


**Sarfraz Husain Syed, Muhammad Arif, Muhammad Sultan**, *CATARACT; CORTICOSTEROID INDUCED INTRAOCULAR PRESSURE ELEVATION AFTER EXTRACTION* (Original) Prof Med Jour 17(3) 416-419 Jul, Aug, Sep 2010.