CATARACT;

Evaluation of density and its relation with axial length.

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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.

Key words: Cataract density, visual acuity, Axial length.

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INTRODUCTION

Cataract is the leading cause of blindness in the world today[1]and is likely to present an increasing burden to health care systems as the world's population ages[2]. According to the latest assessment, cataract is responsible for 51% of world blindness, which represents about 20 million people[3]. 5.5 million people have a cataract interfering with their vision in the US[4]. 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[5]. In a report, the ten-year cumulative incidence was 43.6% for any cataract[6].

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[7]. 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[8]. The first comprehensive cataract classification system was introduced in 1978 and adopted by the American Cooperative Cataract Research Group(CCRG) in 1980[9,10]. 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[11]. 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[8]. 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[12]. 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[13].

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 ofLeske MC and his coworkers[14] 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[15].

High myopia is thought to be a risk factor for development of cataract[16]. However, several studies have contradictory conclusions whether lesser degree of myopia also predisposes to cataractogenesis[17]. 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[18].

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[19]. 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[20]. 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[21]. 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[20]. Eyes with unilateral cataract had shorter ALs than eyes with bilateral cataract during the earlier years, but had longer ALs during later childhood[22]. Due to increase in AL , axial myopia can be caused[23]. Highly myopic eye can be defined as one with AL $\geq$ 26.50 mm[24].

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[25]. 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[26]. In eyes with high myopia after cataract surgery , mild to moderate myopia was the most common refractive status.Because the refractive

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 nessessary[24]. Highly myopic eyes implanted with a low power IOLs including negative powered IOLs tend to result postoperatively in hyperopic refractive errors[27,28,29]. 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[30,31].

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[32]. 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[15].An Austrian man has developed a star-shaped (stellate) cataract after a blow to the eye that had occurred nearly nine months earlier[33] (Fig: 1.)

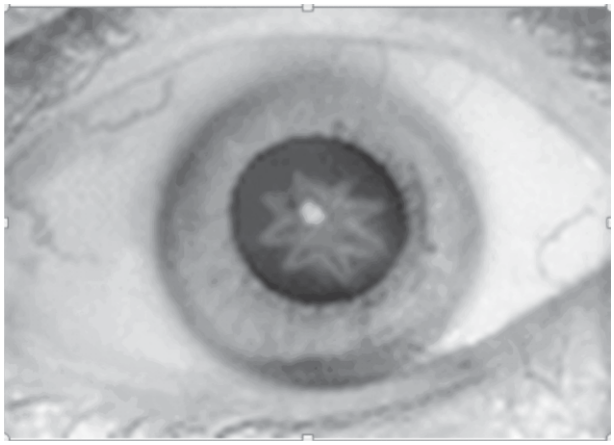

Fig-1. Stellate Cataract

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 Goldmannapplanation 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 pizoelectric 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.

Descriptive statistics		
	Mean	**Std. Deviation**
Age	55.3500	8.76215

Table-I. Description about age.

Descriptive statistics		
	Mean	**Std. Deviation**
R visual acuity	.1924	.09408
L visual acuity	.2334	.08185

Table-II. Description about Visual acuity.

Descriptive statistics		
	Mean	**Std. Deviation**
R axial length	24.8434	1.72910
L axial length	21.6263	1.63792

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

Correlations left

		Axial length	**Visual acuity**
Axial length	Pearson Correlation	1	-.124**
	Sig. (2-tailed)		.218
	N	100	100
Visual acuity	Pearson Correlation	-.124	1
	Sig. (2-tailed)	.218	
	N	100	100

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

*** Correlation is significant at the 0.01 level (2-tailed)*

Correlations right

		Axial length	Visual acuity
Axial length	Pearson Correlation	1	-.040**
	Sig. (2-tailed)		.694
	N	100	100
Visual acuity	Pearson Correlation	-.040	1
	Sig. (2-tailed)	.694	
	N	100	100

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

*** Correlation is significant at the 0.01 level (2-tailed)*

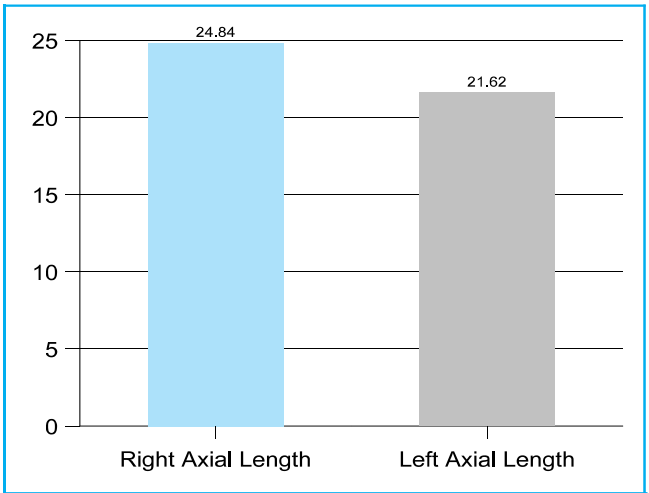

Fig-2. Comparison of Right and Left Axial Lengths

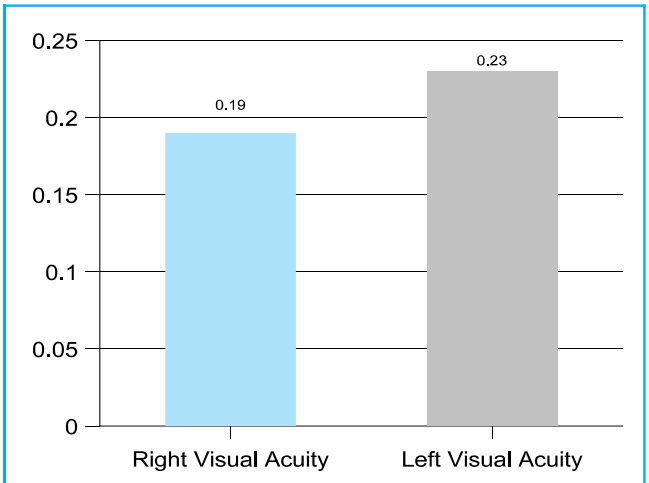

Fig-3. Comparison of Right and Left Visual Acuity

DISCUSSION

Myopia including pathological myopia is a worldwide health concern, especially in East Asia[34,35]. Because the incidence of cataract is significantly higher in eyes with moderate to high myopia[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[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[37].

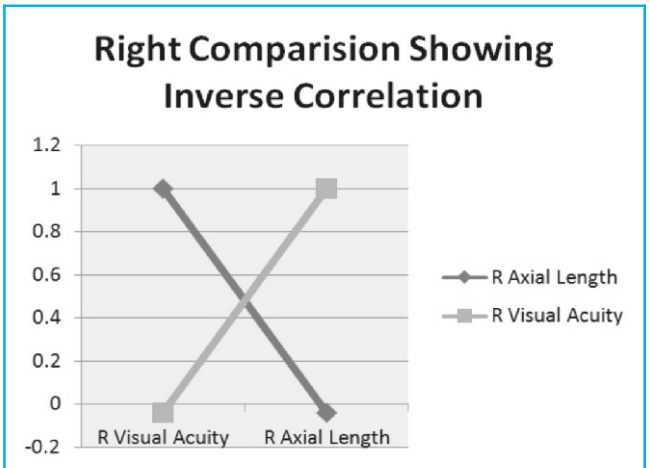

Fig-4. Right comparison of visual acuity and axial lengths

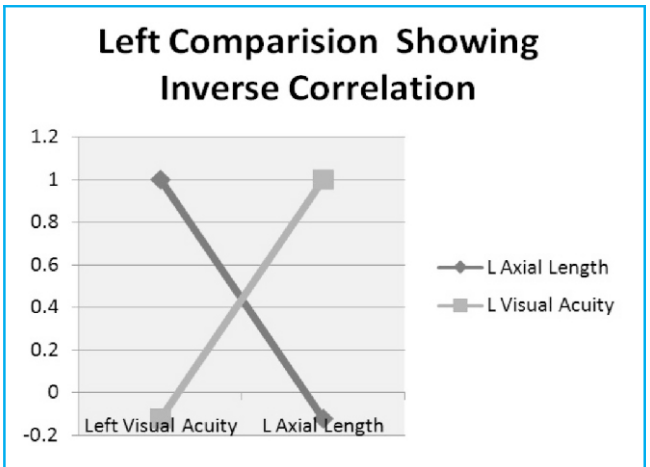

Fig-5. Left comparison of visual acuity and axial lengths

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[38,39]. 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[38]. 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[40].

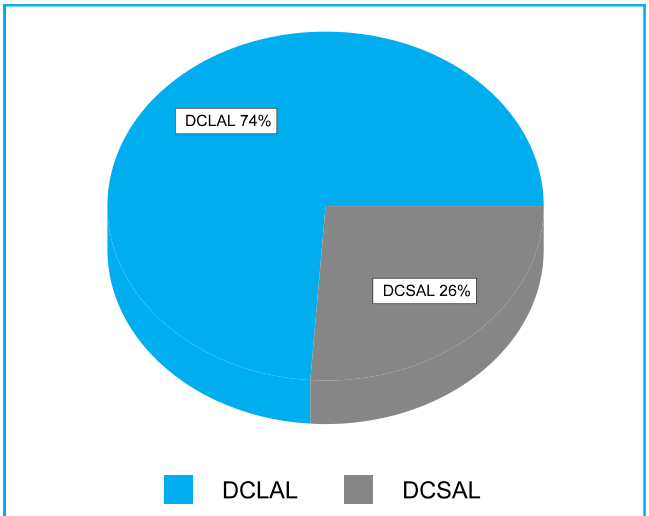

Fig-6. Graphical presentation of density of cataract with axial length percentage results

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 Ziqianget al[14]. 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

1. Nathan Congdon, Sheila K. West, Ralf R. Buhrmann, Anthony Kouzis, Beatriz Mu oz,Harran Mkocha : **Prevalence of the Different Types of Age-Related Cataract in an African Population Invest.** Ophthalmol. Vis. Sci.Oct , 2001; 42 (11), 2478-2482.

2. Shrestha LB: **Population aging in developing countries.** Health Affairs.2000;19: 204–212.

3. **Prevention of blindness and visual Impairment,** WHO Report (2013): www.who.int/blindness/causes/priority/en/index1.html

4. Prevalence and Incidence of Cataracts. **Research to Prevent Blindness,** NISE, NSF: May 7, Rightdiagnosis 2013.

5. Z Jadoon, S P Shah,R Bourne, B Dineen, M A Khan et al. **Cataract prevalence, cataract surgical coverage and barriers to uptake of cataract surgical services in Pakistan: the Pakistan National Blindness and Visual Impairment Survey,** Br J Ophthalmol; 2007; 91(10)1269-1273 doi:10.1136/bjo.2006.106914.

6. Euna Koo, Jessica R. Chang, Elvira Agrón, Traci E. Clemons, et al: **Ten-Year Incidence Rates of Age-Related Cataract in the Age-Related Eye Disease Study (AREDS):** AREDS Report No. 33 April; 2013; 20(2), 71-81 (doi:10.3109/09286586.2012.759598).

7. David A. Paine, J. Bradley Randleman: **Cataract Overview,** March 18, emedicine health 2008.

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.

9. Chylack LT Jr. **Classification of human cataracts.** Arch Ophthalmol;1978; 96:888

10. Chylack LT Jr, Lee MR, Tung WH, Cheng HM. **Classification of human senile cataractous change by the American Cooperative Cataract Research Group (CCRG) method.** I: Instrumentation and technique. Invest Ophthalmol Vis Sci; 1983; 24:424.

11. Baweja V, Brar GS (2011): **In Vitro Cataract Classification Systems:** A Reviewwebpublication ©www.eophtha.com.

12. Stifter E, Sacu S, Benesch T, Weghaupt H. **Impairment of visual acuity and reading performance and the relationship with cataract type and density.** Invest Ophthalmol Vis Sci. Jun 2005; 46(6):2071-5.

13. Yamaquchi T, Negishi K, Tsubota K: **Functional visual acuity measurement in cataract and intraocular lens implantation.** Curr Opin Ophthalmol. Jan 2011;22(1):31-6. doi: 10.1097/ICU.0b013e 3283414f36.

14. Ziqiang Wu, Jennifer I Lim: **Axial length : A risk factor for cataractogenesis.** Annals academy of medicine,2006;35 (6).

15. Vicente Victor D Ocampo Jr. **Senile Cataract** , May 6, Medscape reference 2013.

16. Duke-Elder S. **System of Ophthalmology.** London: Kimpton, 1970; 11:225.

17. Lim R, Mitchell P, Cumming RG. **Refractive associations with cataract: the Blue Mountains Eye study.** Invest Ophthalmol Vis Sci 1999; 40: 3021-6.

18. N A Brown , A R Hill. **Cataract: the relation between myopia and cataract morphology.** Br J Ophthalmol 1987; 71:405-414 doi:10.1136/bjo.71.6.405

19. **Intraocular lens power calculation:** Wikipedia, the free encyclopedia, 2013; March 12.

20. Neal H. Atebara: **Basic and Clinical Science Course,** Section 3: Clinical Optics. (2011-2012 ed.). American Academy of Ophthalmology. pp. 211–223. ISBN 978-1615251100.

21. Roger F. Steinert, David F. Chang (2010). Cataract surgery (3rd ed. ed.). Saunders. ISBN 9781416032250.

22. M. Edward Wilson, Rupal H. Trivedi. **Axial length measurement techniques in pediatric eyes with cataract,** Saudi Journal of Ophthalmology, 2012; 26(1), 13-17, January.

23. Cline, D; Hofstetter HW; Griffin JR. **Dictionary of Visual Science (4th ed.).** Boston: Butterworth-Heinemann 1997. ISBN 0-7506-9895-0.

24. Tae Yokoi, Muka Moriyama, Kengo Hayashi et al: **Evaluation of refractive error after cataract surgery in highly myopic eyes,** IntOphthalmol, 2013; Jan 12.

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

26. Hamid Fesharaki, Alireza Peyman, Mehdi Rowshandel et al. **A comparative study of complications of cataract surgery with phacoemulsification in eyes with high and normal axial length,** Adv Biomed Res 2012; Oct 31, 1:67, DOI: 10.4103/2277-9175.10297.

27. Zaldivar R, Shultz MC, Davidorf JM, Holladay JT. **Intraocular lens power calculations in patients with extreme myopia.** J Cataract Refract Surg 2000; 26:668–674.

28. Tsang CS, Chong GS, Yiu EP, Ho CK. **Intraocular lens power calculation formulas in Chinese eyes with high axial myopia.** J Cataract Refract Surg 2003; 29:1358–1364.

29. Zuberbuhler B, Seyedian M, Tuft S. **Phacoemulsification in eyes with extreme axial myopia.** J Cataract Refract Surg 2009; 35:335–340.

30. Haigis W. **Intraocular lens calculation in extreme myopia.** J Cataract Refract Surg 2009; 35:906–911.

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

calculation and optimized constants for highly myopic eyes. J Cataract Refract Surg 2009; 35:1575–1581.

32. Gary Heiting. **For the latest myopia control news,** Feb, AllAboutVision.com 2013.

33. Claus Zehetner, Nikolaos Bechrakis (2013): **Stellate Cataract,** N Engl J Med 2013; 368:e18 April 4 ,DOI: 10.1056/NEJMicm1204510.

34. Rosman M, Wong TY, Tay WT, Tong L, Saw SM. **Prevalence and risk factors for refractive errors in the Singapore Malay eye survey.** Ophthalmology 2008; 115:1713–19.

35. Hyman L. **Myopic and hyperopic refractive error in adults: an overview.** Ophthalmic Epidemiol 2007; 14:192–197.

36. Leske MC, Wu SY, Nemesure B, Hennis A. **Barbados eye studies group risk factors for incident nuclear opacities.** Ophthalmology 2002; 109:1303–1308.

37. Shammas HJ, Milkie CF. **Mature cataracts in eyes with unilateral axial myopia.** J Cataract RefractSurg 1989;15:308-11.

38. Micelli-Ferrari T, Vendemiale G, Grattagliano I, Boscia F, Arnese L, Altomare E. et al. **Role of lipid peroxidation in the pathogenesis of myopic & senile cataract.** Br J Ophthalmol 1996;80:840-3.

39. Simonelli F, Nesti A, Pensa M, Romano L, Savastano S, Rinaldi E, et al. **Lipid peroxide and human cataractogenesis in diabetes and severe myopia.** Exp Eye Res 1989;49:181-7.

40. Dovrat A, Ding LL, Horwitz J. **Enzyme activities and crystalline profiles of clear and cataractous lenses of the RCS rat.** Exp Eye Res 1993;57:217-24.

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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.