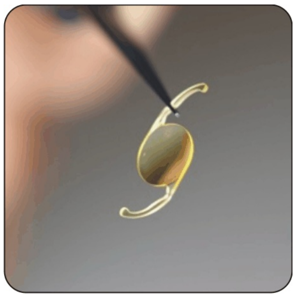
ORIGINAL PROF-1330

CATARACT SURGERY;
AXIAL LENGTH VARIATION



DR. EJAZ AHMAD JAVED (FCPS)
Senior Registrar Ophthalmology
Allied Hospital PMC, Faisalabad

PROF. DR. MUHAMMAD SULTAN (FCPS)
Professor & Head Department of Ophthalmology
Allied Hospital / PMC, Faisalabad

ABSTRACT... eajaved@hotmail.com. **Objectives:** To describe the variation of axial length in patients undergoing cataract surgery. **Study design:** A retrospective case series. **Place and duration of study:** At Opthalmological Department, Allied Hospital, PMC, Faisalabad from May 2006 to June 2007. **Patients and methods:** The axial length of 566 patients who were admitted for cataract surgery were measured with A. scan (Axis II, Quantel). The eleven patients with age below 15 years and above 90 years and with history of trauma, corneal scarring were excluded. So there were 555 patients for this study. A careful history of diabetes mellitus, hypertension, trauma, previous history of surgery, glaucoma and uveitis was taken, and slit lamp examination, tonometry, pupillary reactions, perception and projection of light was done. The data collected was entered in specially designed Performa. An average of ten readings of axial lengths with A-Scan for each patient was taken. **Results:** Out of 555 patients, there were 350 male (63.06%) and 205 female (36.94%) patients. There were 250(45.05%) patients having age between 46 to 60 years. There were 27(4.86%) patients having age between 15 to 30 years and the same number 27(4.86%) of patients was seem having age between 76 to 90 years. The most of the patients 273(49.18%) had axial length between 23mm to 25 mm. There were only 3 patients with axial length between 29.01 to 31 mm. There were a significant number of patients, 230(41.45%) having axial length between 21.01 to 23mm. **Conclusion:** The biometry depends upon axial length, kratometry and anterior chamber depth. Most of the formulae supposed for IOL calculations depend upon only two factors, the axial length and the keratometry. In our community, short and long eyes are very rare and so SRK-T formula for IOL calculations provides satisfactory postoperative results. The axial length carries more importance as its variation causes a gross change in IOL power and postoperative refractive errors.

Key words: Axial length, intraocular lens power, biometry, keratometry.

INTRODUCTION
The post-operative visual recovery depends largely upon biometry. It may be very surprising and disappointing when patients will often give an unsatisfactory answer other than emmetropia. So all the cataract surgeons want to achieve highly accurate postoperative results. The patient selection, accurate keratometry, the methods of biometry, the IOL power formula selection and the

surgical techniques all play important roles[1]. The refractive surprises have occurred ever since Sir Harold Ridley implanted the first IOL in 1949[2]. With technological advances, the overall accuracy of refractive outcome has generally doubled after every 5 to 10 years. Without the introduction of IOL master (Carl Zeiss Meditec Inc Dublin, CA) in north America in 2000[3]), the good refractive outcome was difficult with previous kerato-refractive surgery, keratoconus, pathological myopia with posterior staphyloma, nanophthalmic eyes or eyes with silicon oil.

There are currently four methods available for axial length measurement;

1. Applanation A. scan
2. Immersion A. Scan
3. Immersion A/B Scan
4. Optical coherence biometry using the IOL master[4].

The applanation biometry yields a falsy short axial length due to variable amount of corneal compression. The immersion biometry is much more consistent because there is no corneal compression and the measurement displayed is closer to the true axial length. The most sophisticated form of ultrasound based biometry is a combined immersion vector A/B scan. This equipment is some what expensive and a higher level of operative skill is required. The IOL master has a much higher resolution than ultrasonic axial measurement, so it is based on a very short 780nm light wave rather a longer 10 MHz sound wave.

By optical coherence biometry, the IOL master measures the distance from the corneal vertex to the retinal pigment epithelium and then subtracts the foveal thickness. So the IOL master is the equivalent of an upright, non contact immersion a.scan but with a five fold increase in resolution. The IOL master is excellent for accurate biometry in nanophthalmia, pathological hyperopia, pathological myopia, pseudophakia, poly pseudophakia and phakic IOLs[5].

If the one eye measures 28mm and other eye is 26mm, some thing is obviously wrong. A 27mm axial length displays error[6], if the difference between eyes is greater than 0.33mm, a second person should independently verify the results. If the axial length is less than 22mm or greater than 26mm, a second person reviews or repeats the measurements. There are many theoretical IOL power calculation formulas (Hoffer Q, Holladay1 and SRK.T) for effective thin lens position. some formulae assumes that the anterior and posterior segments of the eye are mostly proportional or that there is always the same relationship between central corneal power and the effective lens position, which is not always true especially in axial hyperopia[7].

By late 1980s the Holladay I formula was adviceable for normal and long axial lengths. This was followed in 1990 by SRK.T formula which works for normal to moderately long axial lengths. Several years latter Hoffer Q formula was added which works well for eyes with short and normal axial lengths. The BinKhorst II, SRK.I and SRK.II are now mostly of historical interest only. In 1991 Wolfgang Haigis (Germany) published the Haigis formula with three constants. So it is expected and extended greatly to cover both high axial hyperopia and high axial myopia.

The Holladay 2 formula since 1998 is considered by many the most accurate of the theoretic formulas but its main limitations are that it requires the manual input of eleven variables and is relatively expensive to purchase. But a simple rule to follow is to use the Holladay I formula for normal to long eyes and Hoffer Q formula for normal to short eyes. Besides all of above a failure to pay close attention to the capsulorrhexis can input on the refractive outcome more than ultrasound based biometry or keratometry. There is a growing trend towards IOL implantation in infants whose eyes are still undergoing rapid growth and refractive changes[8]. The studies have shown that IOL implantation does not cause any changes in the axial length of the growing eyes[9]. The accurate measurement of axial length in hyperopic eyes is especially important since any error is greatly magnified in proportion to the length of the eye. Ultrasound axiometers are calibrated with average velocities for normal length eyes. These velocities are incorrect for short eyes causing significant measurement errors[10].

MATERIAL AND METHODS

Initially we entered 566 patients of cataract in Proforma. Out of these, 11 patients were excluded as having age below 15 years or above 90 years or with history of previous surgery, trauma, and corneal scarring. Besides this, a careful history of diabetes, hypertension, and history of wearing glasses, was taken and examination as distant direct ophthalmoscopy, pupillary reactions, light reflex tests, cover tests, slit lamp examination, keratometry, A-Scan, indirect ophthalmoscopy (after the pupillary dilatation when required), and B-Scan (in cases of doubt, full posterior segments in mature cataract) was done. The A-Scan (Quantel, Axis II) was used in supine position, with same gain under topical anesthesia by one operator on each eye for 10 times and average of 10 readings were entered in the Proforma. Five groups of patients were made on the basis of age e.g.

1. 15 to 30 years
2. 31 to 45 years
3. 46 to 60 years
4. 61 to 75 years
5. 75 to 90 years

And so the number and the percentage was calculated in each group. Six groups of patients were made on the basis of axial lengths e.g.

1. axial length 19mm to 21mm
2. axial length 21.01mm to 23mm
3. axial length 23.01mm to 25mm
4. axial length 25.01mm to 27mm
5. axial length 27.01mm to 29mm
6. axial length 29.01mm to 31mm

The number of patients and percentage pertaining to each group was entered in the Proforma. All the readings were taken in supine position with eye ball in the center and with alkcaine (Propracaine hydrochloride) as topical anesthetic drops were used in each case.

RESULTS

Out of the 555 patients, 350(63.06 %) were male and 205(36.94%) were female (Table-I). The lowest age was 15 years and highest was 90 years. The highest number of patients between age 46 to 60 years was, 250(45.05%). The minimum number of patients between age 15 to 30 years was, 27(4.86%) and also between age 76 to 90 years was, 27(4.86%) Table-II.

There were 273 patients (49.18%) having axial length between 23.01 to 25mm. There were only 3(0.54%) patients having axial length between 29.01 to 31mm and 5(0.91%) patients having axial length between 27.01 to 29mm. There were 230(41.45%) patients who had axial length between 21.01 to 23mm. The 18 patients (3.24%) had axial length between 19 to 21mm and 26 patients (4.68%) had axial length between 25.01 to 27mm. So the maximum number of patients had axial length between 23.01 to 25mm (Table-III & IV).

Table-I Sex distribution

Sex	No pf pts	%age
Male	350	63.06%
Female	205	36.94%
Total	555	100%

Table-II. Age distribution

Age range	No of pts	%age
15 to 30 years	27	4.86%
31 to 45 years	95	17.12%
46 to 60 years	250	45.05%
61 to 75 years	150	28.11%
76 to 90 years	27	4.86%
Total	555	100%

So the most common occurrence of axial length range was 21.01mm to 25mm, 503(90.63%) in Table-II.

Table-III. Axial length variations 1		
Range of Axial Length	No of pts	%age
19 to 21 mm	18	3.24%
21.01 to 23 mm	230	41.45%
23.01 to 25 mm	273	49.18%
25.01 to 27 mm	26	4.68%
27.01 to 29 mm	5	0.91%
29.01 to 31 mm	3	0.54%
Total	555	100%

Table-IV. Axial length variations 2		
Axial Length	No of pts	%age
≤20 mm	3	0.36%
22 to 25 mm	467	84.15%
≥ 27 mm	10	1.80%

DISCUSSION

The axial length is an important component of biometry for all most all of the formulae. The variation of axial length contributes more to postoperative refractive outcome than does the keratometry. The ultrasound axiometers are calibrated with average velocities for normal length eyes. These velocities are incorrect for short eyes, causing significant measurement errors[11].

The indentation applanation biometry causes significant problems, even the slightest indentation can cause significant measurement errors which are magnified when the eye is short[12]. The immersion biometry can provide superior results in these cases. The skilled ultrasonic technicians may watch for consistency of the echo height, axial length, lens thickness and anterior chamber depth readings. The short eyes may have normal anterior[13] Segment dimensions (corneal diameter, keratometry) and anterior segment length[13].

Dr. Holladay said that there are different types of eyes with respect to axial length and anterior segment size. About 80% of short eyes were with normal anterior segment length and 20% had short anterior segment sizes. The IOL calculations play an important role in short and long eyes[14]. But the question was how to define short or long eyes? Wolfgang Haigis defined short eyes having axial length 20mm or less and found them 0.3% of the total. He defined long eyes having axial length, 27mm or more and these were found to be 4.1% in his study. He further defined normal eyes having axial length between 22 to 27mm and this number was 78%[15]. In our study there were 3 patients (0.36%) having axial length ≤20mm. This percentage was comparable to the study of Haigis. We found 467 patients (84.15%) having axial length between 22mm to 25mm and Haigis studies showed 78%. Again the value of our study is comparable to his study. We found 10 patients (1.8%) having axial length ≥27mm while Haigis found 4.1%. So in our community there are small number of the patients having axial length ≥27mm and these are 3 times less than Haigis study. In 1981 KJH Hoffer published his well known paper on the short eye problems[16].

So the different eyes have different axial lengths and we should use different formulae for IOL calculations. The Royal College of Ophthalmologists in the United Kingdom had set up some guide lines based on the work of K.J. Hoffer that which formulae work best for short eyes, normal or long eyes. According to these recommendations the Hoffer Q formula should be used in cases of short eyes, SRK.T in long eyes and average of Hoffer Q, SRK.T and Holladay formulae for medium eyes[17].

CONCLUSION

Excellent and high quality results or outcome is dependant upon exact axial length measurements, anterior chamber depths measurements, keratometry, accurate lens calculations, and no doubt good surgery. Extreme biometry care is needed for extreme eyes. In our study there were minimal numbers of patients having extreme eyes. So the problem of short eye and wrong IOL calculations did not pose much problem. Since there were minimal number of long eyes and the maximum number of patient's eyes lie in the normal range. We should follow the guide lines laid by the Royal College of Ophthalmologists in the United Kingdom in case of extreme short or long eyes.

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