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Ocular Axial Length and Keratometry Readings of Normal Eyes in Southern Nigeria

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SUMMARY

Aim: To provide average axial length and keratometry readings in healthy eyes of people in Rivers and surrounding states in southern Nigeria. This may guide the purchase of intraocular lens in the study area.

Materials and methods: Four hundred consecutive patients with 800 non-cataractous eyes attending the eye clinic of the University of Port Harcourt Teaching Hospital eye clinic over a period of 2 years (January 2006 to December 2007), had amplitude scan ultrasonography. The instrument used was the Auto Axial length Biometer, model AL-010 by Tomey.

Keratometry readings were carried out within the same period using the Acutus auto-refractor model 5015-3212 by Carl Zeiss Meditec AG. All results were fed into and analysed using the Tomey biometer.

Results: The average A-Scan was 23.86 mm (SD±1.2) for male subjects and 23.27mm (SD±1.18) for females. The overall range for axial length among the cohort was 21.14mm to 28.91mm. Average axial length for both sexes is 23.57mm (SD±1.19).

The mean for male subjects was 42.95D (SD±1.30) while for females it was 41.90D (SD±1.55). The keratometry readings ranged between 41D and 45D. The overall mean keratometry reading was 42.43D.

Conclusion: The average calculated IOL power was 22.61D for female and 20.11D for male subjects, using the SRKII formula. The overall average of 21.34D makes it easier for supplies to be purchased in bulk for use in remote places.

Keywords: A-scan, keratometry, IOL power, non-cataractous eyes, Nigeria

INTRODUCTION

The A-scan ultrasound biometry, commonly referred to as an A-scan, is a routine diagnostic test used in ophthalmology to provide data on the axial length of the eye, from which the power of the intraocular lens (IOL) to be implanted during modern cataract surgery may be calculated.[1] Cataract still remains the most common cause of avoidable blindness in Nigeria and in the developing world.[1,2,3,4,5] Treating the blindness resulting from it is a formidable challenge worldwide due to significant barriers, one of which is poor surgical outcomes.[3]

When a cataract is removed, it is replaced with an artificial lens implant. By measuring both the length of the eye (A-Scan) and the power of the cornea (keratometry), a simple formula can be used to calculate the power of the intraocular lens needed.[1]

Indeed it is highly recommended that biometry be carried out prior to cataract surgery to improve outcome.[2,6] In the developing world, however, the machines needed to make these calculations may not always be readily available or might be faulty, particularly in rural areas where the majority of people affected by cataracts reside.[7] The lack of facilities to do this effectively has resulted in refractive surprises in the past. Otherwise good surgeries have been marred by the implantation of incorrect IOL power. Implanting the correct IOL power at once is obviously much better than the relatively difficult job of explanting and reinserting another lens. In the absence of the required machines, or when such machines are faulty, which is a common occurrence in some settings in Nigeria, there is the need to have an average measurement which is applicable to the majority of the people in our locality and which would be fairly close to the required intraocular lens power. Furthermore, knowing the average would serve as a guide in ordering appropriate IOL powers to be used by cataract service providers.

To the best of the authors' knowledge, no figures have been published in the area of study or indeed in the country. There is, therefore, a need for a study such as this.

To carry out this study, the A-scan and keratometry readings of a cohort of people attending the University of Port Harcourt Teaching Hospital eye clinic were we examined and measured. The cohort was made up mainly of Nigerians from the South-south region. The readings were analysed so that the figures can be used to represent the average A-scan and keratometer readings when calculating the intraocular lens power.

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METHODOLOGY

Four hundred consecutive patients with 800 non-cataractous eyes attending the eye clinic of the University of Port Harcourt Teaching Hospital over a period of 2 years (January 2006 to December 2007) had amplitude ultrasonography scan. The instrument used was the Auto Axial Length Biometer, model AL-010 by Tomey.

After ethical approval was obtained from the hospital authorities and verbal consent from the patients, all eyes were anaesthetized with 2% xylocaine drops so that an applanation probe attached to the machine could be placed in contact with the corneae while the subject is seated and looking straight ahead. Corneal compression was strictly avoided. For each subject, the two eyes were measured three times each and an average of the 3 readings was taken. Measurements were repeated if there was a difference of greater than 0.3 mm between the axial length measurements for the two eyes or if consecutive readings differed by more than 0.2 mm.

Keratometry readings for the same subjects were obtained using the Acutus auto-refractor model 5015-3212. by Carl Zeiss Meditec AG. This was done with the patient seated comfortably in front of the machine with the chin resting on the appropriate place while readings were done automatically. These instruments are calibrated every six months. All measurements were made and cross checked by 2 experienced senior residents (2 of the authors) who had been trained on routine biometry for at least 3 years prior to the study.

All results were fed into and analysed by the Tomey biometer. Other simple calculations were done with a manual calculator.

RESULTS

Of the 800 eyes of 400 healthy patients examined, 176 were male and 224 were female, giving a male to female ratio of approximately 2:3. The average age was 45.59 years for the male and 34.63 years for the female patients.

The patient pool was mainly from Rivers State, with 224 subjects (56%). Others were from Imo (n=56, 14%), Bayelsa (n=28, 7%), Anambra (n=16, 4%), Delta (n= 20, 5%), Kogi (n=4, 1%), Akwa-Ibom (n=24, 6%), Edo (n=4, 1%), and Abia (n=20, 5%) states.

The mean axial length reading for the right eye in male subjects was 23.86mm and 23.40mm in female subjects, while for the left eye, it was 23.85mm in male subjects and 23.14mm in the female subjects. The average for the males was 23.86mm (SD±1.2) and for the females, 23.27mm (SD±1.18).Thus, males seem to have slightly longer eyes than females.

The overall range for axial length among the cohort was 21.14mm to 28.91mm. The general average axial length was 23.57mm (SD±1.19).

The mean keratometry readings 1 and 2 (K1 and K2) for the right eye in the male subjects were 43.40 diopters (D) and 43.7D and for the left eye, 42.50D and 43.1D. For the female subjects, the mean readings for the right and left eyes were K1– 42.30D and 42.5D and K2– 41.50 D and 41.8D respectively. The mean for the male patients was 42.95D (SD±1.30) while for females it was 41.90D (SD±1.55). The keratometry readings for all ranged between 41 D and 45 D. The overall mean keratometry reading was 42.43D.

The average intraocular lens power can then be calculated using different formulas depending on the actual characteristics of the eye. In our center, the SRK II formula is used as most eyes are within the normal range of axial length. Using this formula, the IOL power for this cohort was calculated to be RE 19.76D, LE 20.46D for males (average 20.11D), and for females RE 21.94D and LE 23.27D (average 22.61D). The overall IOL power for both male and female was 21.34D.

DISCUSSION

Postoperative refraction results depend on the precision of multiple factors and measurements and combined with heightened patient expectations for precise results it is important to offer the best and pay attention to accuracy. A-scan and keratometry readings are therefore important in the assessment of the calculation of the intraocular lens (IOL) implant power used in modern cataract surgery which virtually all ophthalmologists are performing all over the world. .The use of the IOL in cataract surgery has revolutionized the visual outcome for patients who have had to undergo this procedure. However it gives excellent results only if the parameters used to calculate the particular power of the IOL are in place. This has made this surgery so unpredictable on occasion as the instruments used to calculate the power to be inserted are very expensive to purchase and maintain. Having one and not the other is also useless but if there are facilities to have only one of this equipment, having access to the general average of the other in the area where one works is an advantage. This even though not ideal may be useful where biometric machines are either not available or faulty. Surgeries are increasingly being done in the rural areas and in camp settings and a working figure for the axial length and/or keratometry values in the locality where the procedure is taking place are useful. The average A-scan reading of 23.57mm obtained in this study is similar to that obtained in a study in Singapore and an American study where they had 23.38D and 23.69mm respectively as their average axial length.[9, 10] Our figure is however higher than that observed in another study in Singapore which reported axial length of 23.23mm.[11] This is probably due to the fact that oriental people are generally smaller and there is a correlation between stature and ocular dimensions as taller people have longer axial length than shorter persons.[12] These figures however fall between 22.5D and 24.5D which is deemed as the normal range for axial

length in humans.[9] The difference in ocular dimensions observed between males and females was also significant and was also observed also in the Singaporean study.[10] There difference is clearly observed physically as there has always been a distinction among male and female parts of the body. For instance males are generally taller. Their bones are also generally longer and bigger.

Keratometry readings are also extremely important as they have a 1:1 correlation with postoperative refractive errors at the spectacle plane even if all other aspects of the IOL power calculation and surgery is perfect. The average K readings we had of 42 43 D is similar to a study by Moura et al where a value of 42.97D was obtained by the manual method of Bausch and Lomb.[13] Though this value is closest to the average values we had for male subjects of 42.95D. A study of Eritrean eyes had a slightly higher average of 43.37D in their series for healthy eyes.[14] The mean reading in the study by the Lim group was 43.94±.27D.[9]

Other important parameters apart from proper patient selection include appropriate intraocular lens power formula selection with optimized lens constants.[8] The mean IOL power calculated by the Lim group using the SRK II formula as in our study is 21.77D which is close to what we got in this study.[9] There is however a paucity of studies that can be compared locally. The average IOL power calculated of 21.34D for our center is representative and can be used for the population of patients who present with avoidable blindness of cataractous origin in our region in the absence of A-Scan readings.

CONCLUSION

The average calculated IOL power is 22.61D for females and 20.11D for males. The overall average of 21.34D makes it easier for supplies to be purchased in bulk for use in remote places and where there is hardly any access to biometric equipment. This would at least take care of the visual rehabilitation of about 80% of those who may need cataract surgery in our locality. A range of between 20D and 22D would likely take care of about 95% of those who need cataract surgery. This can be a useful information for organizers of IOL purchase in the study region. Furthermore, this will assist the surgeon in deciding the 'standard' IOL power to use in case of absent biometric readings.

However it is highly recommended that cataract service providers and other stake holders should ensure provision of biometric machines and adequate maintenance for all cataract service outlets.

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