

# BIOMETRIC ASSESSMENT AND INTRAOCULAR LENS POWER CALCULATION IN ADULTS

Asif Iqbal<sup>1</sup>, Muhammad Idrees<sup>2</sup>, Bilal Bashir<sup>1</sup>, Mubashir Rehman<sup>1</sup>, Omer Khan Orakzai<sup>1</sup>

Department of Ophthalmology, Hayatabad Medical Complex, Peshawar - Pakistan

Department of Ophthalmology, Lady Reading Hospital Peshawar, Peshawar - Pakistan

## ABSTRACT

**Objectives:** To determine the keratometric readings, axial length of the eyeball and intraocular lens (IOL) power for adults and whether or not it is advisable to implant intraocular lenses without proper pre-operative assessment.

**Material and Methods:** It was a prospective Observational study conducted from March 2010 to January 2013. Setting; Community based Trust eye hospital in Tarakai village of District Swabi. All adult patients, undergoing cataract surgery with IOL implantation were included in the study after informed consent and fulfilling the inclusion and exclusion criteria. Keratometric readings (K1 & K2), axial length and IOL power were calculated and data analyzed by using SPSS software database.

**Results:** Out of 1100 patients with cataract 554 (50.4%) were males and 546(49.6%) were females. Right eye was involved in 597(54.3%) patients whereas; left eye was involved in 503 (45.7%) patients. Mean K1 reading was 44.81 D with minimum reading of 39.50 D, maximum of 52 D and range was 12.50 D. Mean K2 reading was 44.92 D with minimum reading of 37.50 D, maximum of 50.50 D and range was 13.00 D. 23.3% (n=257) patients had K1 reading between 44-44.99 D whereas, 20.9% (n=230) patients had K2 reading between 45- 45.99D. Mean axial length reading was 23.11 mm with minimum reading of 18.06mm, maximum of 31.81mm and range was 13.75mm. 36.6%(n=403) patients had axial length between 23-23.99 mm. Mean IOL power in diopters was 20.11 D with minimum power of -2.00 D, maximum of 36.50 D and range was 38.50 D. 21%(n=230) patients had IOL power between 20- 20.50 D.

**Conclusion:** There is a wide range of keratometric readings, axial length and IOL power. Therefore, the biometric readings vary greatly from patient to patient. Proper pre-operative biometric assessment is desirable for good post operative vision.

**Key Words:** Biometry, Keratometric readings, Axial Length, Intraocular lens.

## INTRODUCTION

Cataract is the commonest age related disease in most countries Worldwide and is the leading cause of preventable blindness<sup>1</sup>. According to WHO estimates, 285 million people are visually impaired worldwide, of these 39 million people are blind and 246 million people have low vision<sup>2</sup>. Globally cataract is the leading cause of blindness and about 90% of blind people live in low income countries<sup>2</sup>. Pakistan is the sixth most populous country in the world with total population of over 170 million<sup>3</sup>. The number of blind people is 2 million, of these 1.3 million are estimated blind due to cataract<sup>4</sup>. It is expected that by year 2020, the elderly population of 60 years and above is expected to double from today's number thus increasing the number of blind people due to cataract even more<sup>5</sup>. According to Pakistan National blindness and visual impairment survey 2007, cataract accounts for 51.5% blindness while previous survey in 1989- 90 reported 66.7% cataract related blindness in

Pakistan. This decrease in blindness due to cataract was brought by increasing the surgical facility centers as well as arranging the outreach surgical camps in the far flung areas of the country<sup>3</sup>. Cataract extraction accounts for more than half of all ophthalmic operations and is the most common elective operation in many countries of the world<sup>7</sup>.

Intraocular lens (IOL) implantation is the revolutionary breakthrough in Ophthalmology. Awareness regarding IOL implantation is very high and almost every patient demand for IOL during his/ her cataract surgery. In most of the camps as well as in some tehsil and district hospitals, IOLs are implanted without proper pre-operative biometric assessment. IOL powers in the range of 20-22 diopters (D) are randomly implanted to the patients. To achieve a desired amount of post operative refraction, IOL power is routinely calculated pre-operatively. IOL power calculation is done using different formulas like SRK, SRK II, SRK/T and Holladay formulae installed in variety of biometers. Mostly SRK II formula is used for IOL power calculation. Keratometric readings (K readings) both for vertical and horizontal corneal curvatures in dioptres, axial length (AL) of eye ball in millimetres and A-constant provided by IOL manufacturers are required for SRK II formula. The two ocular parameters that need to be measured are

### Address for Correspondence:

Dr. Asif Iqbal

Department of Ophthalmology, Hayatabad Medical Complex, Peshawar - Pakistan

Cell: 0333- 911- 6370.

Email: dcasif@yahoo.com

K readings and axial length. K readings are measured on either manual or automated keratometers in both horizontal and vertical meridians whereas axial length is measured using A- scan of ophthalmic ultrasound, which is available in all currently marketed biometers. Accurate ocular axial length measurement is extremely important for accurate IOL power calculation because it is the major identifiable source of error in IOL power calculation. To avoid error, it is commonly recommended that multiple A- scan readings should be taken sequentially. The objectives of the study were to determine keratometric (K) readings, axial length (AL) of eye ball and intraocular lens (IOL) power in adults.

## MATERIAL AND METHODS

It was a prospective, observational, cross sectional study conducted at community based trust eye hospital in Tarakai village of district Swabi. Duration of the study was three years from February 2010 to January 2013. All patients between 20-80 years, both male and female. Co-operative patients having cataract were included. Patients less than 20 years of age and very old patients who cannot co-operate. Patients having fixation problems like nystagmus, mentally unstable etc. Patients having ocular surface irregularities like corneal opacity, corneal dystrophy, corneal edema, keratitis, advanced pterygium etc. Patients having anatomically abnormal globe like pthisis, microphthalmia, buphthalmos. Patients having silicon oil in vitreous cavity were excluded from the study.

Adult patients assessed properly and enrolled for cataract extraction were assessed for inclusion and exclusion criteria. Informed consent was taken from every patient. K readings were measured with manual keratometer using Schin Nippon keratometer (—). The axial length measured and IOL power calculated by using A- scan (Quantel Medical). The IOL power calculated by SRKII formula using dense phakic mode built in the A- scan software. Serial axial length measurements were taken and average calculated by built-in software to avoid error. A- constant of 118.3 was used for all patients. Age, gender and laterality was also recorded in the proforma. Data was entered into SPSS version 20, analyzed and presented as frequencies and percentages.

## RESULTS

Total of 1100 patients were included in the study. Males were 50.4% (n=554) and females were 49.6% (n=546). 30.4% (n= 334) patients were in the age range 61-70 years and 26.9% (n=296) patients were between 51-60 years. Overall, right eye was involved in 54.3% (n= 597) patients and left eye was involved in 45.7% (n= 503). Vertical and horizontal Keratometric readings are shown in Table 1. Axial length (AL) measured in millimetres is shown Table 2. Intraocular lens (IOL) power was calculated in diopters by using SRK-II formula and is shown in Table 3.

## DISCUSSION

Cataract is the leading cause of avoidable blindness and commonest age related diseases in most countries worldwide. Approximately 45 million people are blind globally; almost 80% of these live in developing countries and more than half are blind as a result of cataract. These areas are underprivileged and eye care facilities are even scarce in such areas of the world<sup>7</sup>. In this study, males were 50.4% and females were 49.6%. This was in agreement with Naz MA<sup>8</sup> who reported 66.4% males and 43.6% females. Similar results were also reported by Chanchlani M et al<sup>9</sup>. Studies of Rashid H<sup>10</sup> and Saleem M et al<sup>9</sup> reported female predominance.

Most of the patients were from 61-70 years (30.4%). This was in agreement with Rashid H<sup>10</sup> and

**Table 1: Keratometric readings Distribution**

Power in Diopters (D)	Vertical Keratometry (K 1)	Horizontal Keratometry (K 2)
39.99 & Below	1 (0.1 %)	6 (0.5%)
40- 40.99	8 (0.8%)	8 (0.7%)
41- 41.99	28 (2.5%)	31 (2.8%)
42- 42.99	118 (10.7%)	93 (8.4%)
43- 43.99	171 (15.5%)	171 (15.5%)
44- 44.99	257 (23.3%)	228 (20.7%)
45- 45.99	211 (19.1%)	230 (20.9%)
46- 46.99	166 (15.1%)	175 (15.9%)
47- 47.99	88 (8%)	105 (9.5%)
48- 48.99	30 (2.8%)	34 (3.1%)
49- 49.99	15 (1.3%)	13 (1.2%)
50 & Above	7 (0.6%)	6 (0.5%)
Total	1100 (100.0%)	1100 (100.0%)

**Table 2: Axial length Distribution**

Axial Length (mm)	No. of cases and percentage
18-18.99	02(0.2%)
19- 19.99	02(0.2%)
20- 20.99	33(3%)
21- 21.99	119(10.8%)
22- 22.99	362(33%)
23- 23.99	403(36.6%)
24- 24.99	129(11.7%)
25- 25.99	29(2.6%)
26- 26.99	07(0.6%)
27- 27.99	03(0.3%)
28- 28.99	03(0.3%)
29 & above	08(0.7%)
Total	1100(100.0 %)

**Table 3: IOL Power Distribution**

Axial Length (mm)	No. of cases and percentage
14.50 & Below	38(3.5%)
15- 17.50	88 (8%)
18- 18.50	113 (10.3%)
19- 19.50	179 (16.3%)
20- 20.50	230 (21%)
21- 21.50	184 (16.7%)
22- 22.50	125 (11.4%)
23- 23.50	67 (5.8%)
24- 24.50	43 (3.9%)
25- 25.50	16 (1.4%)
26- 27.0	13 (1.1%)
27.50- 29.50	01 (0.1%)
30 & Above	03 (0.2%)
Total	1100 (100.0 %)

Chanchlani M et al<sup>9</sup> who reported 62.2% and 43.6% cases in same age group. Contrarily, studies of Saleem M et al<sup>3</sup> and Naz MA<sup>8</sup> reported 32.3% and 22.7% respectively. Poverty, illiteracy, traditional medicines use and lack of eye care facilities all contribute to high prevalence of cataract in these patients. In this study, 23.3% cases had dioptric power of corneal vertical meridian (K1) between 44- 44.99 D. This was contrary to Rashid H<sup>10</sup> and Saleem M et al<sup>3</sup> who reported 40.8% and 44.9% cases having K1 reading from 42- 44 D.

This study showed 20.9% patients were having corneal horizontal meridian (K2) power between 45-45.99 D. This was contrary to Rashid H<sup>10</sup> and Saleem M et al<sup>3</sup> who reported K2 readings from 42- 44 D in 41.2% and 49% cases respectively. Mean K1 reading was 44.81D and K2 reading was 44.92D. This was contrary to Rashid H<sup>10</sup> who reported K1 as 42.65 D and K2 as 42.48 D.

In this study, mean axial length (AL) was 23.11 mm, minimum reading of 18.06 mm and maximum of 31.81 mm and range was 13.75 mm. 69.6% had AL from 22- 24 mm. Rashid H<sup>10</sup> reported AL range from 18 - > 28 mm with 39% cases in the range of 22- 23 mm. Saleem M et al<sup>3</sup> reported AL range from 19.5- 28mm while 58% were 22- 23.5mm. Naz MA<sup>8</sup> reported AL range from 20-28 mm, with 54% between 22- 23 mm. Other studies done by Krimmer JE<sup>11</sup>, Raz PS<sup>12</sup> and Lesiews KA et al<sup>13</sup> reported that majority of AL were between 22- 23 mm.

In this study, 70% cases had estimated IOL power between 20- 20.50 D with minimum and maximum IOL power of -2.00 D and 36.50 D respectively, mean IOL power was 20.00 D. Rashid H<sup>10</sup> reported mean IOL power of 23.17 D and range from 6.50- 36.00 D. Naz MA<sup>8</sup> reported IOL power range from 4- 35 D, Elder<sup>14</sup> reported it from 12- 27 D and Saleem MA et al<sup>3</sup> reported IOL power range from 10- 33 D and 52.5% cases had

IOL power between 20- 22 D. This wide range of IOL power shows the importance of proper pre-operative assessment.

## CONCLUSION

Biometric readings vary greatly from patient to patient so proper pre-operative biometric assessment is desirable for good post operative vision.

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