

# A Study on Repeatability and Agreement of Keratometry & Refractive Prediction between Verion and IOL Master

Kaksha Desai<sup>1</sup>, Riddhi Shah<sup>2</sup>

<sup>1</sup>M. Optom, Assistant Professor, Hari jyot College of Optometry  
kaksha.naik[at]gmail.com

<sup>2</sup>4<sup>th</sup> Year, B. optom  
riddhis302[at]gmail.com

**Abstract:** ***Purpose:** The aimed to analyse the predictability of the instrument for calculation of IOL power and K reading on VERION planner and to check the verion predicted refractive power or final follow - up refractive power. **Methodology:** From March 2020 to July 2021, a retrospective investigation was done at the Rotary Eye Institute in Navsari. The study included 120 eyes, both preoperatively and postoperatively, from people who had cataract surgery (phacoemulsification). The patients were assessed on both machines by the same examiner during each individual pre - assessment, and then followed up on the VERION image - guided system as well as the IOL master roughly 2 months after surgery by the same examiner. The calculation for the predictive spherical outcomes for both the IOL Master and VERION systems. Then both IOL Master IOL power and verion IOL power and the VERION Predicted refractive power and after final follow up refractive power were compared using SPSS software. **Result:** Pre - operative IOL K1 (43.42 ± 1.94) was almost same significantly (p<0.01) VERION K1 value (43.42 ± 1.94). Pre - operative IOL K2 (43.31 ± 2.07) was significantly same as the VERION K2 (43.40 ± 2.07). Pre - operative VERION predicted refractive status (SPH & CYL) in 2.2mm incision (- 0.15 ± 0.12) (- 0.70 ± 0.54) was decreases (- 0.04 ± 0.20) (- 0.49 ± 0.60) significantly after Final follow - up. Pre - operative VERION predicted refractive status (SPH & CYL) in 2.8mm incision (- 0.18 ± 0.11) (- 0.93 ± 0.56) was decreases (- 0.07 ± 0.21) (- 0.88 ± 0.96) significantly after Final follow - up. Pre - operative VERION predicted refractive status (SPH & CYL) in 3.0mm incision (- 0.17 ± 0.10) (- 0.76 ± 0.54) was decreases (-0.13 ± 0.33) (- 0.88 ± 0.96) significantly after Final follow - up. The correlation between two (IOL master 500 & VERION) for determining pre - operative keratometry reading demonstrated a high relationship between the pre - operative K1 of IOL master & VERION (p<0.01, r=0.975) and pre - operative K2 of IOL master & VERION (p<0.01, r=0.981). The correlation between (IOL master, VERION and IOL implanted power) demonstrated a medium relationship between the IOL master power and VERION power (p<0.01, r=0.679) & a high relationship between the IOL master and IOL implanted power (p<0.01, r=0.954) & a high relationship between the VERION and IOL implanted power (p<0.01, r=0.748). **Conclusion:** After the two months final follow - up the Sph&Cyl power are decreased then the VERION predicted refractive power but the cylinder power was almost same as the VERION predicted power. The analysis suggests that there was a statistically correlation between IOL master and VERION.*

**Keywords:** VERION planner, IOL master 500, cataract, IOL power, K reading, post - operative spherical outcome.

## 1. Introduction

One of the most prevalent reasons for impaired vision in the elderly is a cataract. It can either be inherited or acquired. Cataract leads to hardening of the lens fibers which leads to opacification of the lens so there is decreased in visual acuity. A cataract is the leading cause of vision loss in the world. The World Health Organization (WHO) has estimated that 18 million people are bilaterally blind due to cataracts and that the condition causes 48% of cases of blindness worldwide. A cataract is also a leading cause of visual impairment, with 33% of the world's population experiencing decreased vision because of this disorder; only refractive error has a greater impact in this regard. It is important to note that most cases of blindness due to cataracts (up to 90%) are found in developing nations [1]. Pre - operative planning for cataract surgery involves reliable and accurate measurements of the globe, including corneal curvature (keratometry) and axial length to choose the appropriate power of an intraocular lens (IOL) to implant. The IOL Master is well established for use within cataract surgery due to the high repeatability in keratometric measurements [2]. The advent of a new system, VERION has provided a need to assess the accuracy and reliability of

this new device. One study analyses the repeatability of keratometry and white - to - white distance measurements using the VERION system and these results were compared with the results from the IOL Master [3]. The VERION system demonstrated high repeatability and the measurements agreed with the IOL Master, however, the results also highlighted that further studies into the postoperative outcomes of patients measured with the VERION image - guided system are needed. [4]The IOL Master 500 is a noncontact biometry tool that takes eye measurements that are used to calculate the type and power of intraocular lenses (IOLs) before surgery. The Verion Image Guided System (Verion) is a new preoperative measurement device that captures and utilizes a high - resolution reference image of a patient's eye to calculate steep and flat axes' radii and corneal curvature, limbal position and diameter, pupil location and diameter, and corneal reflex position. It also has preoperative surgical planning features that use the reference image and preoperative measurements to help plan cataract surgeries, using existing formulas to determine the number and location of incisions, as well as the proper intraocular lens [4]. In a study the aim of the study was to compare the verion predicted power and final follow up refractive error

and a comparison of which instrument is more accurate, for IOL power calculation in my study included IQ, Aurovue EV, three pieces, IQ Toric, single piece, Auroflex, and Panoptic Toric (data from 120 eyes were included in the last year to till 2021 final follow up)

## 2. Material

Duration and Place: A Retrospective, randomized, Observational based study was carried out at rotary eye institute, Navsari in the duration from March 2020 to March 2021. In this study, 120 eyes were included which were diagnosed with cataracts after complete ophthalmologic examination and which agreed to have cataract surgery. **The inclusion criteria for this study are:** Pre - operative IOL master and VERION planner scans., Patients who are opting for cataract surgery. Verion predicted Refractive Power and Final Follow up Refractive Power. **The exclusion criteria for this study are:** Any ocular pathology except cataract, LASIK and BMV not include

## 3. Methodology

The study was designed to compare IOL K reading and VERION K reading calculated IOL power by using IOL master 500 and VERION. The protocol was reviewed and approved by the institutional review of Hari Jyot College of Optometry and complied with the declaration of Helsinki. First of all, detailed history was taken then followed by a torch light examination. Then IOP measurement was done and subjective, and then dilation followed by objective refraction. At last slit lamp examination was done and grading of cataract was done and also fundus examination was done by the ophthalmologists. Then according to the grades of the cataract the patients were diagnosed with cataracts and were advised for cataract surgery by the ophthalmologist. A counselor counseled them about all the features of different types of intraocular lenses and then IOL and the date for surgery was finalized by the patients. Written informed consent was then taken from the patients regarding their cataract surgery. All necessary investigations i. e. blood pressure, sac syringing, complete blood count, blood sugar were carried out. After getting the informed consent of the patient, the pre - operative ocular examination was performed. Patients were explained regarding how the Intraocular lens power will be calculated on IOL Master and also using VERION with SRK?T formula, Haigis formula, and Holladay formula by optometrists. K reading was

measured using IOL Master and VERION. IOL master was done in all individuals with **Zeiss IOL Master - 500**. In IOL master measurement, patient data was entered first which include patient name, ID, birth date, and gender. The patient was sited properly with chin on a chin rest and head with headrest. From start measurement, keratometry measurement was taken first. Measurements were conducted by the different optometrists. Auto measurement was taken directly by instrument. Axial length was measured with five consecutive measurements with an average of it than ACD was measured. HVID was also measured. Measurements were only taken if the SNR ratio was more than 5. IOL power was calculated by the SRK - T or Barrett formula. VERION was done in all individuals with **Alcon VERION**. VERION is used to measure biometric measurements. During the measurement, subjects were seated with the chin on the chinrest and the forehead against the measurement module. With the help of a joystick, the examiner targeted the marker on the center of the cornea, enabling the patients to see a red circle of light, at which they were instructed to look. After the adjustment of the direction, according to the arrows displayed on the screen, the circle appeared to be green and the examiner pushed the button of the joystick to take a snapshot. During the adjustment, four green signals appeared on the monitor called 'Centration', 'Corneal Power', 'Focus', and 'Fixation' verifying the accuracy of the setting. Pre - operative medicines were then explained to the patients for proper and safe surgery. Patients were informed regarding their post - operative medicines after their surgery and were called for follow - up after 1 week of surgery and after 1 month and last after 2 months for checking the refractive error. Data were then collected properly and Statistical analysis was done using IBM SPSS 26 software.

## 4. Observation and Results

A total of 120 eyes were taken. The IOL Implanted name is distributed into five groups according to Indian or Foreign: (1) Indian monofocal (2) foreign monofocal (3) foreign monofocaltoric (4) foreign multifocal (5) foreign multifocal toric. All the IOL Implanted also distributed into three groups according to incision (1) 2.2mm (2) 2.8mm (3) 3mm. Data were analysed using IBM SPSS statistics 26 software. All the data were evaluated using a pair sample T - test to compare the mean difference where,  $P < 0.05$ , the Pearson correlation coefficient was used to check the IOL power calculation of the difference between two instruments where  $P < 0.05$  method with 95% confidence intervals (CI).

**Table 1:** Correlation between Pre OP IOL Master K1 and Verion K1

Pre K1	Count eyes	Mean $\pm$ SD	Diff. pre k1 (IOL M - VERION)	correlation	R <sup>2</sup> value	P value
Pre IOL k1	120	43.42 $\pm$ 1.94	- 0.15 $\pm$ 0.44	0.975	0.951	0.000
Pre VERION k1	120	43.57 $\pm$ 2.00		0.975	0.951	0.000

The mean value and standard deviation (Mean  $\pm$  SD) of pre - op IOL master k1 and VERION k1 were shown in the table with mean diff [pre k1 (IOL M - VERION) ], correlation of coefficient value (r), and R<sup>2</sup> value. There was a significant

difference in the pre - op IOL master k1 (M=43.42, SD=1.94) and pre - op VERION k1 (M=43.57, SD=2.00); T (119) = - 2.410, p=0.00

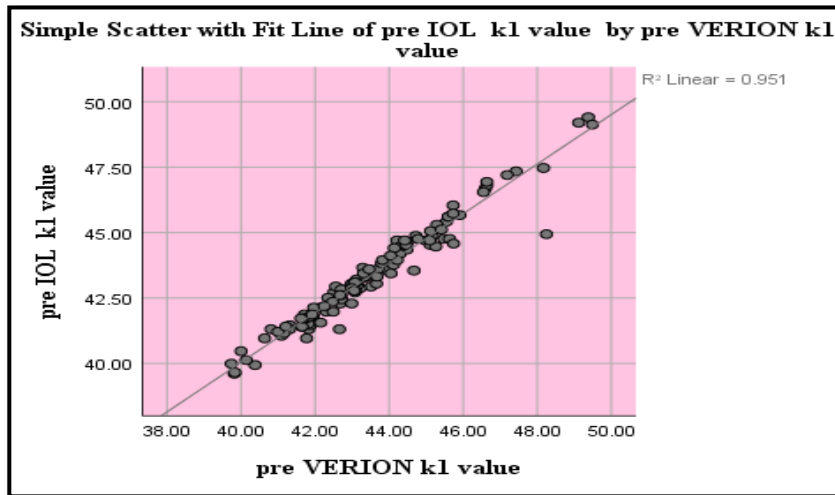


Figure 1: This shows the correlation between pre - op IOL master k1 and VERION k1.

The graph shows the correlation between the pre IOL k1 value and pre VERION K1 value. (r=0.975, R<sup>2</sup>=0.951, P=0.00).

Table 2: Correlation between Pre OP IOL Master K2 and Verion K2

Pre K2	Count eyes	Mean ± SD	Diff. pre k1 (IOL M - VERION)	correlation	R <sup>2</sup> value	P value
Pre IOL k2	120	44.31 ±2.06	- 0.09 ± 0.40	0.981	0.963	0.000
Pre VERION k2	120	44.40± 2.08		0.981	0.963	0.000

The mean value and standard deviation (Mean± SD) of pre - op IOL master k2 and VERION k2 were shown in the table with mean diff [pre k1 (IOL M - VERION) ], correlation of coefficient value (r), and R<sup>2</sup>value. There was a significant

difference in the pre - op IOL master k2 (M=44.31, SD=2.06) and pre - op VERION k2 (M=44.40, SD=2.08); T (119) = - 3.625, p=0.00

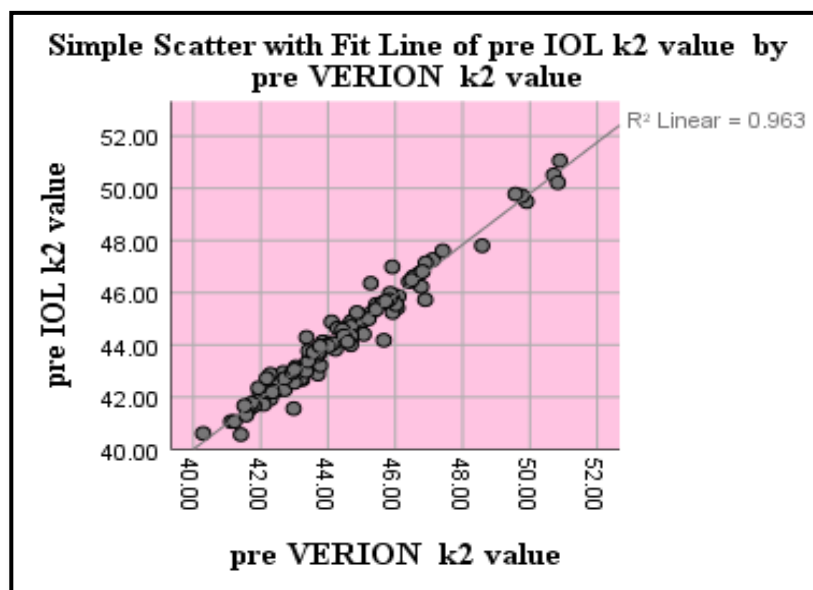


Figure 2: This shows the correlation between pre - op IOL master k2 and VERION k2

The graph shows the correlation between the pre IOL k2 value and pre VERION K2 value. (r=0.981, R<sup>2</sup>=0.963, P=0.00).

### 5. Discussion

The verion system is a much newer device and has been shown to demonstrate a high repeatability of keratometric measurements compared with those from the IOL master 500 [3]. In planning for cataract surgery the senior author

tended to look at both predications from the VERION and IOL master 500, given both are as accurate as each other. It was therefore found that sometimes having two machines allowed for further refinement of the spherical outcome over and above one machine's predications. The VERION system still requires axial length values to be inputted from another device, the IOL master 500 being used in this study. Thus, for the same A constant, any differences in postoperative predicted outcomes must be explained by differences in the actual measurement of the keratometry [4]. VERION image

guided system is a new device that uses central 2.8mm of cornea and refractive index of 1.3375. one remarkable disadvantage of the VERION system is that posterior corneal measurement is not possible, this may have a significant role in a relatively high percentage of the patients, especially those waiting for toric IOL implantation. Another disadvantage of the system is that another tool measuring the axial length is required for the completion of the calculations for cataract surgery (i. e. IOL dioptre planning). Table 1 to 12 summarises the IOL master and VERION pre - operative keratometry and IOL implanted data and also post - operative refractive power. The research demonstrates that there was a statistically significant difference ( $p=0.017$ , Table - 2) pre - operative keratometric K1 reading between IOL master ( $43.42 \pm 1.94$ ) and VERION ( $43.42 \pm 1.94$ ) which shows a difference of  $- 0.15 \pm 0.44$ . Pre - operative keratometric K2 reading between IOL master ( $43.31 \pm 2.07$ ) and VERION ( $43.40 \pm 2.07$ ) which shows a small difference of  $- 0.08 \pm 0.40$  in pair t - test. There was a significant difference ( $p=0.00$ , Table3) in SPH between pre - VERION predicted and two months after surgery final follow up in 2.2mm incision, which was  $- 0.15 \pm 0.12$  &  $- 0.04 \pm 0.20$ . The mean difference between these two was  $- 0.11 \pm 0.24$ . In CYL, the values were  $- 0.70$   $0.54$  and  $- 0.49$   $0.43$ . The mean difference between these two was  $- 0.20 \pm 0.43$ . In the 2.8mm incision, there was a significant difference ( $p=0.096$ , &  $p=0.771$  Table4) in SPH, which was  $- 0.18 \pm 0.11$  &  $- 0.07 \pm 0.21$  pre VERION anticipated and two months after surgery final follow up. The mean difference between these two was  $- 0.10 \pm 0.25$ . In CYL, the values were  $- 0.93 \pm 0.56$  and  $- 0.88 \pm 0.96$ . The mean difference between these two was  $- 0.04 \pm 0.66$ . The final follow - up following surgery revealed that SPH and CYL power had decreased. There was a significant difference in SPH between pre - VERION anticipated and two months after surgery final follow up in 3.0mm incision ( $p=0.608$  &  $p=0.124$  Table5), which was  $- 0.17 \pm 0.10$  &  $- 0.13 \pm 0.33$ . The mean difference between these two was  $- 0.04 \pm 0.33$ . In CYL, the values were  $- 0.91 \pm 0.57$  and  $- 0.76 \pm 0.54$ . The mean difference between these two was  $- 0.15 \pm 0.38$ . The results show that after surgery final follow up the SPH & CYL power were decrease. The implanted IOL were distribute in three groups in incision wise 2.2mm, 2.8mm, and 3.0mm (Table6) and also in other five groups Indian monofocal, Foreign monofocal, Foreign monofocaltoric, Foreign multifocal and foreign multifocal toric (Table7). The Pearson correlation test and a scatter graph were used to investigate the relationship between preoperative IOL master K1 and VERION K1 had a statistically significant correlation ( $p<0.01$ ,  $r=0.97$  Table 8). The coefficient of determination ( $R^2$ ) was 95.1% indicating a strong relationship between preoperative IOL master K1 and VERION K1. Preoperative IOL master K2 and VERION K2 had statistically significant correlation ( $p<0.01$ ,  $r=0.98$  Table 9). The coefficient of determination ( $R^2$ ) was 96.3% indicating a strong relationship between each other. IOL master power and VERION power had a statistically significant correlation ( $p<0.01$ ,  $r=0.67$  Table 10) the coefficient of determination ( $R^2$ ) was 46.2% indicating moderate relationship between each other. IOL implanted power and IOL master power had a statistically significant correlation ( $p<0.01$ ,  $r=0.95$  Table 11) the coefficient of determination ( $R^2$ ) was 91% indicating strong relationship

between each other. IOL implanted power and VERION power has a statistically significant correlation ( $p<0.01$ ,  $r=0.74$  Table 12) the coefficient of determination ( $R^2$ ) was 55.9% indicating moderate relationship between each other. So that the IOL master and VERION powers are different from each other. Statistics show that IOL master and VERION have a strong relationship for the keratometry reading and when it comes to calculating IOL power and forecasting refractive error. However, the IOL implant in the patient's eye and the IOL power are determined by the doctors.

## 6. Conclusion

Our goal was to see the VERION predicted refractive power changed after two months final follow - up and to compare the accuracy of two instruments for estimating IOL power calculation, and to compare the keratometry reading between two instruments. After the two months final follow - up the Sph&Cyl power are decreased then the VERION predicted refractive power but the cylinder power was almost same as the VERION predicted power. The analysis suggests that there was a statistically correlation between IOL master and VERION.

## References

- [1] "Sharon L. Jick, Thomas L. Beardsley, Lisa Park, Timothy V. Roberts, Carlos Buznego. "
- [2] S. Srivannaboon, C. Chirapapaian, P. Chonpimai, and S. Koodkaew, "Comparison of ocular biometry and intraocular lens power using a new biometer and a standard biometer," *J. Cataract Refract. Surg.*, vol.40, no.5, pp.709–715, 2014, doi: 10.1016/j.jcrs.2013.09.020.
- [3] G. Nemeth, E. Szalai, and Z. Hassan, "Repeatability Data and Agreement of Keratometry With the VERION System Compared to the IOLMaster," no. May, 2015, doi: 10.3928/1081597X - 20150424 - 01.
- [4] A. Sachdev and S. Madge, "VERION vs IOLMaster: Which is More Accurate in Predicting Post - op Spherical Equivalent Outcomes for Phacoemulsification with IOL Implant Surgery?," *J. Biotechnol. Biomed.*, vol.02, no.04, pp.169–173, 2019, doi: 10.26502/jbb.2642 - 91280020.
- [5] T. Olsen and M. Thorwest, "Calibration of axial length measurements with the Zeiss IOLMaster," *J. Cataract Refract. Surg.*, vol.31, no.7, pp.1345–1350, 2005, doi: 10.1016/j.jcrs.2004.12.066.
- [6] T. Teshigawara, "Comparison of tendency and accuracy in predicted post - operative refraction and recommended IOL power between IOL Master and VERION before and after optimizing IOL - constant in the VERION CURRENT STATUS : POSTED," pp.1–19, doi: 10.21203/rs.2.21267/v1.
- [7] O. Article, A. Habib, M. S. Khan, M. Ishaq, and M. A. Yaqub, "Agreement between Keratometric readings by VERION image guided System, Galilei G4 and Pentacam," vol.34, no.3, pp.740–743, 2018.
- [8] A. Habib, M. S. Khan, and M. Ishaq, "Effect of Using Verion Image Guided System on Surgically Induced Astigmatism (Sia) in Patients Undergoing Cataract Surgery," *Pakistan Armed Forces Med. J.*, vol.68, no.

June, pp.1533–1537, 2018, [Online]. Available: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=135363783&site=eds-live>.

- [9] A. K KHURANA. .
- [10] A. C. Lee, M. A. Qazi, and J. S. Pepose, “Biometry and intraocular lens power calculation,” 2008.
- [11] P. O. W. Er, *Kenneth J. Hoffer, Jaime Aramberri, Wolfgang Haigis. .*
- [12] Carl Zeiss Meditec Inc, “zeiss User Manual, IOLMaster with advanced technology, software version 5.4,” 2000.
- [13] E. K. Panagiotopoulou *et al.*, “Image - guided lens extraction surgery: A systematic review, ” *Int. J. Ophthalmol.*, vol.12, no.1, pp.135–151, 2019, doi: 10.18240/ijo.2019.01.21.
- [14] C. Ruiz - Belda, F. Rodrigo, and D. P. Piñero, “Validation of keratometric measurements obtained with an intraoperative image - guided system: intra - session repeatability and interchangeability with an optical biometer, ” *Clin. Exp. Optom.*, vol.101, no.2, pp.200–205, 2018, doi: 10.1111/cxo.12623.