Original Research Article

Comparison of keratometric value in calculation of IOL (intraocular lens) power between manual keratometry and automated keratometry

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Abstract

Background: Cataract is the opacity of the normal human crystalline lens of the eye. There are 1.3 Billion people are visually impaired. Among this, 188.5 million people are affected by mild visual impairement, 217 million people are moderate to severe million impairment and 36 million people are blind. The most common cause of blindness is a cataract. 50-80% of blindness in India is due to cataract. **Aim of Study:** To compare the Keratometric Value in Calculation of IOL (Intra Ocular Lens) Power with Manual Keratometry and Automated Keratometry. **Methodology:** A prospective study for evaluation of diagnostic technology was carried out from 100 eyes of 88 patients selected by non-probability purposive sampling technique who were admitted in Ophthalmic Ward for cataract surgery with IOL at Vinayaka Missions Kirupananda Variyar Medical College Hospital, Salem, Tamil Nadu, which is 560 bedded hospital having all inpatients and outpatient services. Among this 50 eyes were selected for manual keratometry from 49 patients and 50 eyes were selected for automated keratometry from 39 patients. Before surgery, the keratometry reading was taken for the patients to calculate the IOL power to be implanted by Manual Keratometry and Automated Keratometry. Forty-five days after the cataract surgery, refraction was done for maximum visual acuity correction in that operated eye and the power of the glasses was prescribed. Further, the difference in keratometry value between the manual keratometry and automated keratometry were analyzed. **Results:** Test of significance of Automated Keratometry and Manual Keratometry shows that the mean value of Automated Keratometry was 44.64 with the standard deviation of + 1.58, whereas the mean value of Manual Keratometry was 39.16 with the standard deviation of + 1.34, which reveals that the Automated Keratometry was more effective than the Manual Keratometry in calculation of IOL (Intra Ocular Lens) power for cataract surgery. **Conclusion:** The automated machine was found to be the most accurate, reliable, simple and easier to use. It also required less skill and less time to operate, that is significantly quicker than manual keratometry. Values are not influenced by the skill of operating person and therefore interobserver variations are eliminated. Patient cooperation is better due to the shorter duration and therefore auto keratometer is preferable. The only disadvantage is the cost of the machine.

Key Word: Intra Ocular Lens- Spherical- Cylindrical- Keratometry Horizontal Reading- Keratometry Vertical Reading

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INTRODUCTION

Cataract is the opacity of the normal human crystalline lens of the eye. There are 1.3 Billion people are visually impaired. Among this, 188.5 million people are affected by mild visual impairement, 217 million people are moderate to severe million impairment and 36 million people are blind. The most common cause of blindness is a cataract. 50-80% of blindness in India is due to cataract[1]. In olden days, cataract patients came for cataract surgery at a later stage after maturation only.

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Initially, cataract surgery was performed without IOL implantation and the patients were left aphakic. When these aphakic patients were treated with aphakic glasses, they encountered various problems[2]. Gradually, the method of cataract surgery was improved by implantation of IOL with sutures (Intra Capsular Cataract Extraction). But, there was a lag in vision due to astigmatism. So, patients required glasses to get accurate vision after surgery. But nowadays, cataract surgeries are performed by Phacoemulsification with Primary Foldable IOL Implantation and the patients are discharged on the day of Surgery (Day Care Surgery)[3]. After cataract surgery, patients are expecting accurate vision without glass correction. So, the Ophthalmic Surgeons should take more care in the IOL power calculation to give accurate vision after the cataract surgery. The keratometry readings are playing an important role in IOL power calculation[4]. Two methods of keratometry available are i) Manual keratometry ii) Automated keratometry. Currently, almost 100% of all the cataract surgeries are performed with IOLs. After cataract surgery to give the better vision the mistakes in the IOL calculation should be avoided[5]. This study was undertaken to find out the efficient method in calculating the IOL power for the patients who will undergo cataract surgery with IOL and to compare the keratometric value in the calculation of IOL power between manual keratometry and automated keratometry for the patients who will undergo cataract surgery[6].

MATERIAL AND METHODS

A prospective study with evaluative design and approach was carried out with 100 eyes of 88 patients who were admitted in Ophthalmic Ward for cataract surgery with IOL at Vinayaka Missions Kirupananda Variyar Medical College Hospital, Salem, TamilNadu, between January to June 2018. All patients provided informed and written consent. The selection criteria to study patients was the presence of cataract eye. All the patients were subjected to a detailed IOL power calculation and the following clinical signs were specifically looked for visual disturbances, duration of symptoms, duration of wearing glasses, any prolonged use of medications any history of systematic diseases and about any other systemic medications. A complete ocular examination was done for each patient which included uncorrected visual acuity, visual acuity with pinhole, best corrected visual acuity, intraocular pressure measurement, duct syringing, slit lamp examination, fundus examination. Blood sugar level, blood pressure, HbsAg and HIV 1and2 were also checked for all selected patients. Preoperative antibiotic eye drops applied hourly before the day of surgery.

Manual Keratometry: By the manual Keratometry the corneal curvature of the patients, both horizontal and vertical reading was taken to calculate the IOL power with Manual Keratometer. Fifty eyes of 49 patients were selected for Manual Keratometry with the help of Manual Keratometer and the horizontal measurement (K1) and the vertical measurement (K2) were taken.

Biometry: After the keratometry, Proparacaine 0.5% (local anesthetic) eye drops were applied in the selected eye and A scan was done for measuring the axial length and IOL power was calculated.

Surgery: Phacoemulsification with foldable IOL surgery was done for all patients by the same surgeon.

After Surgery: Patients were asked to come for a review for every week for 45 days.

Postoperative refraction: Forty-five days after the cataract surgery, refraction was done to give the maximum visual acuity with the help of appropriate glasses in that operated eyes.

Automated Keratometry: By the Automated keratometry the corneal curvature was measured for the other group of 50 eyes of 39 patients with the help of automated keratometer and the horizontal measurement (K1) and the vertical measurement (K2) was taken.

Biometry: After the keratometry, Proparacaine 0.5% (local anesthetic) eye drops were applied in the selected eye and A scan was done for measuring the axial length and IOL power was calculated.

Surgery: Phacoemulsification with foldable IOL surgery was done for all patients by the same surgeon.

After Surgery: Patients were asked to come for a review for every week for 45 days.

Postoperative refraction: Forty-five days after the cataract surgery, refraction was done to give the maximum visual acuity with the help of appropriate glasses in that operated eyes. Further, the difference in keratometry value between the manual keratometry and automated keratometry were analyzed.

Statistical Analysis: Data were analyzed using SPSS software version 22 and MedCalc software version 15. Data were interpreted using descriptive and inferential statistics. The Chi-square test was used to test the statistical significance of the relationship between two variables.

RESULTS

Percentagewise distribution of the mean value of the patients with Manual and Automated Keratometry according to their Spherical Requirement shows that the mean value of patients for Spherical Requirement was higher (64.3%) for Manual Keratometry when we compared to Automated Keratometry (43.9%).Test of significance of Automated Keratometry and Manual

Keratometry shows that the mean value of Automated Keratometry was 44.64 with the standard deviation of ±1.58, whereas the mean value of Manual Keratometry was 39.16 with the standard deviation of ±1.34, which reveals that the Automated Keratometry was more effective than the Manual Keratometry in calculating the Intra Ocular Lens power for cataract surgery.

Table 1: Percentagewise Distribution of Patients according to their Spherical Correction in Manual and Automated Keratometry after Cataract Surgery with IOL

SPH Limits	Manual Frequency		Automated Frequency	
	No. of patients	Percentage	No. of patients	Percentage
± 0.00 to ± 0.25	8	16	35	70
± 0.50 to ± 0.75	28	56	14	28
± 1.00 to ± 1.25	9	18	1	02
± 1.50 to ± 1.75	5	10	-	-
Total	**50**	**100**	**50**	**100**

Percentagewise distribution of patients according to the requirement of spherical correction in manual and automated keratometry after cataract surgery with IOL shows that the highest percentage of spherical correction which is ± 0.00 to ± 0.25 was for patients who had undergone surgery after automated keratometry testing was 70%, whereas in manual keratometry it was only 16%. Further, the lowest percentage of patients in manual keratometry were with the spherical correction of ± 1.50 to ± 1.75 was 10 %, whereas, it was 0% in automated keratometry. Hence, it can be interpreted that the number of patients with spherical correction in automated keratometry was less when compared to manual keratometry (Table:1).

Table 2: Percentagewise Distribution of Mean Value of the Operated Eyes of Patients with Manual and Automated Keratometry according to their Spherical Power Requirement after Surgery

Manual Keratometer SPH	Automated Keratometer SPH
64.3	43.9

Percentagewise distribution of mean value of the patients with Manual and Automated Keratometry according to their Spherical power Requirement after surgery shows that the mean value of patients for Spherical Requirement was higher (64.3%) for Manual Keratometry when we compared to Automated Keratometry (43.9%) Test of significance of Automated Keratometry and Manual Keratometry shows that the mean value of Automated Keratometry was 44.64 with the standard deviation of ±1.58, whereas the mean value of Manual Keratometry was 39.16 with the standard deviation of ±1.34, which reveals that the Automated Keratometry was more effective than the Manual Keratometry in calculating the Intra Ocular Lens power for cataract surgery (Table:2).

Table 3: Test of Significance in Automated and Manual Keratometry

	Mean	Standard Deviation	No of Samples
Automated Keratometery	44.64	1.58	50
Manual Keratometery	39.16	1.34	50

Null Hypothesis: The automated keratometry is more effective than Manual keratometry in calculating the Intra Ocular Lens Power. Calculated Values is Less than P -Value, hence we accept the Null Hypothesis. We concluded that Automated keratometry is more effective than Manual keratometry in calculating the Intra Ocular Lens Power. Test of significance of Automated Keratometry and Manual Keratometry shows that the mean value of Automated Keratometry was 44.64 with the standard deviation of ±1.58, whereas the mean value of Manual Keratometry was 39.16 with the standard deviation of ±1.34, which reveals that the Automated Keratometry was more effective than the Manual Keratometry in calculating the Intra Ocular Lens power for cataract surgery.

DISCUSSION

Cataracts are generally not treated until they begin to affect the vision noticeably. Some minor symptoms of cataracts, including dulling of vision or small changes in visual acuity, may be improved by non-surgical approaches such as improved lighting or changes in eyewear prescriptions. When the cataract nears the matured stage it needs a surgical procedure.[7,8,9] Percentagewise distribution of patients for Manual Keratometry and Automated Keratometry according to their age group shows that the highest percentage of the patients for Manual and Automated Keratometry were between the age group of 60 – 70 years (53% and 36%, respectively) it is also supported by a study done by

Balantrapu. T (2017) who found that majority of the people beyond the age group of 55 were affected by cataract[10]. The lowest percentage was between 30–40 years for both types (Table No.1) (0%and3%, respectively). Percentagewise distribution of patients for Manual Keratometry and Automated Keratometry according to their gender shows that the highest percentage of patients for Manual and Automated Keratometry were females (53% and 64%, respectively). Percentagewise distribution of the mean value of the patients with Manual and Automated Keratometry according to their spherical requirement shows that the mean value of patients for spherical requirement was higher (64.3%) for Manual Keratometry when we compared to Automated Keratometry (63.9%) which is supported by Pant HB. *Et al*., (2017) who revealed that women are more likely to have blindness than men[11]. Percentagewise distribution of patients according to their Spherical Correction in Manual and Automated Keratometry after surgery shows that the highest percentage of Spherical Correction which is ±0.00 to ±0.25 was for the patients who had undergone surgery after Automated Keratometry testing (25%), whereas in Manual Keratometry it was only 6%[10]. Further, the lowest percentage (1%) of patients in Automated Keratometry were with the Spherical Correction of ±1.00 to ±1.25, whereas it was 19% in Manual Keratometry. In IOL calculation the method of automated keratometry was supported by Friedman NJ and Kaiser PK (2018) and American Academy of Ophthalmology (2018)[12,13]. However, there were no patients with ±1.50 to ±1.75 Spherical Correction in Automated Keratometry and there was 7% of patients in Manual Keratometry. Test of significance of Automated Keratometry and Manual Keratometry shows that the mean value of Automated Keratometry was 44.64 with the standard deviation of ±1.58, whereas the mean value of Manual Keratometry was 39.16 with the standard deviation of ±1.34, which reveals that the Automated Keratometry was more effective than the Manual Keratometry in calculating the Intra Ocular Lens power for cataract surgery which was similar to the study of Ramakrishnan R and Naik Abhijit (2014)[14]. The coefficient of variation was 3.24% at the steep and 3.22% at the flat meridian and16 % for axis measurements for manual keratometry. For automated keratometry, this coefficient was 3.32% at the steep and 3.21% at the flat meridian and 18.8% for the axis. It was concluded that clinically when using automated keratometry values for intraocular lens power calculation, the difference determined between the two keratometric measurements obtained with the two instruments should be remembered and the axis values from the automated keratometry should be confirmed by manual keratometry readings when using them for suture removal and astigmatic corrections where axis measurements play important role and it was concluded that the automated K readings are accurate. Ramakrishnan R and Naik Abhijit (2014) and Khan L. *et al*., (2018) revealed the same findings[14, 15], whereas this study finding was contradictory to the report of Muhammed. *et al*, (2017) who found that there was no significant difference between automated and manual keratometric readings[16].

CONCLUSION

The Automated Keratometry was found to be the most accurate, reliable, simple and easier to use. It also required less skill and less time to operate, that is significantly quicker than Manual Keratometry. Values are not influenced by the skill of operating person and therefore interobserver variations are eliminated. Patient cooperation is better due to shorter duration and therefore Automated Keratometer is preferable. The only disadvantage is the cost of the machine.

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