Comparative study evaluating the post phacoemulsification refractive predictive accuracy using Sirius+ Scheimpflug tomography and Nidek optical biometer AL-scan

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Received: 18-5-2024, Accepted: 6-11-2024, Published online:16-3-2025

EJO(MOC) 2024;5(1):35-47.

Short title: Evaluating the post phaco refractive predictive accuracy using Scheimpflug tomography and Nidek biometer.

Abstract

Setting and design: prospective cohort comparative study, which was performed at the Department of Ophthalmology of Ain Shams University Hospitals during the period between April 2023 till December 2023.

Materials and methods: Forty eyes of twenty-eight patients were enrolled to compare the accuracy of predictability of postoperative refraction of Sirius+ (CSO, Italy) Scheimpflung tomography with Nidek optical biometer AL-scan (Nidek CO., Tokyo, Japan). The patients underwent complete ophthalmological examination and did biometry with both Sirius tomography and Nidek optical biometer, then postoperative refraction was done using autoref (Shin-Nippon accuref 8001, Japan. Comparison between predicted refraction by Sirius and Nidek with postoperative refraction was done.

Results: There was statistically significant difference between the Nidek postoperative predictive refraction and the postoperative spherical equivalent of the studied patients with p-value < 0.05, while there was statistically non-significant difference between the Sirius postoperative predictive refraction and the postoperative spherical equivalent with p-value > 0.05.

Conclusion: Sirius tomography is more accurate in IOL power calculation than Nidek optical biometry**.**

Keywords: Cataract, Biometry, Corneal tomography, IOL power, Refraction.

INTRODUCTION

Advancements in ophthalmic technology have significantly enhanced the quality of vision for patients undergoing cataract surgery, with expectations for accurate refractive outcomes continuing to rise. Precise biometry measurement and intraocular lens (IOL) power calculation have become integral to achieving optimal refractive results[1]. Corneal power measurement, essential for determining IOL power, can be performed through various methods, including manual and automated keratometry, optical biometry, and Placido disc-based corneal topography, with or without Scheimpflug imaging[2].

The introduction of Scheimpflug imaging has provided an advanced approach to measuring both the anterior and posterior corneal curvatures, thereby enhancing the accuracy of IOL power calculations by eliminating the reliance on standard keratometric indices. This technology enables a more comprehensive analysis by incorporating the full curvature of the cornea, thus improving refractive outcomes[3,4]. Recent studies have also highlighted the importance of incorporating posterior corneal curvature in calculations, as neglecting this parameter can lead to errors in IOL power determination, particularly in patients with significant corneal irregularities[5].

Another crucial factor in IOL power calculation is the accurate measurement of axial length (AL), which can be performed using either optical or ultrasound biometry. Optical biometry, which relies on partial coherence interferometry (PCI), is now considered the gold standard due to its non-contact nature and higher precision in measuring ocular parameters such as corneal thickness, anterior chamber depth (ACD), lens thickness (LT), and axial length (AL)[6,7]. Moreover, optical biometry has shown greater accuracy and consistency when compared to ultrasound biometry, especially in challenging cases such as dense cataracts[8]. Optical coherence tomography (OCT)-based devices have also emerged, further improving the precision of AL measurements[9].

On the other hand, A-scan contact ultrasound biometry remains a viable alternative, especially in cases where optical biometry is unsuitable, such as in eyes with severe media opacities. However, contact methods carry the risk of corneal compression, which may introduce measurement errors[10,11]. Additionally, factors such as the misalignment of the ultrasound probe and variations in corneal applanation can affect the accuracy of AL measurements in ultrasound biometry[12].

To meet the growing demands for accurate refractive outcomes following cataract surgery, IOL calculation formulas have evolved. Classic regression-based formulas such as SRK/T, Holladay 1, and Hoffer Q have been the mainstay for decades, but newer-generation formulas, such as Haigis and Barrett Universal II, have introduced improvements by incorporating additional biometric variables like anterior chamber depth, lens thickness, and white-to-white measurements[13]. Recent advancements in IOL formula development have also integrated artificial intelligence and ray-tracing techniques, offering further refinements in predicting refractive outcomes[14].

Present study aimed to compare the accuracy of Sirius+ Scheimpflug tomography and Nidek optical biometer AL-scan in predicting postoperative refraction after cataract surgery. The rationale for this comparison was based on the advancements in biometry technology, the differences in measurement techniques between the two devices, the potential impact on refractive outcomes, and the contribution to clinical practice. By comparing the accuracy of these devices, the study provides valuable insights into the current state of biometry technology and its impact on cataract surgery outcomes.

PATIENTS AND METHODS

Forty eyes of twenty-eight patients were enrolled in this prospective cohort comparative study, which was performed at the Department of Ophthalmology of Ain Shams University Hospitals during the period between April 2023 till December 2023. The study was conducted in accordance with the ethical standards stated by the ethical committee of Ain Shams University Hospitals (FMASU MS 93 / 2023). The study was approved by the Research Ethics Committee of the Faculty of Medicine, Ain Shams University on 26/2/2023. All patients were informed of the procedures involved and provided the written informed consent.

The committee reviewed the study protocol from the ethical point of view and approved it requiring a progress report every 3 months. The FMASU REC was organized and operated according to guidelines of the International Council on Harmonization (ICH) and the Islamic Organization for Medical Sciences (IOMS), the United States Office for Human Research Protections and the United States Code of Federal Regulations and operates under Federal Wide Assurance No. FWA 000017585.

Included patients were complaining of drop of vision due to development of non-dense cataract, with average axial length (22–25mm) and average K readings (42-47 diopters {D}), who did phacoemulsification surgery and posterior capsule positioned monofocal IOL implantation.

Patients with opaque media including corneal opacity, dense cataract, vitreous hemorrhages that influence topography reading were excluded, also patients with any corneal irregularity including pterygium, corneal dystrophies, severe dryness, any intraoperative complication including posterior capsule rupture, descemet's detachment, IOL drop, any postoperative complication such as corneal edema, macular edema or severe reaction were excluded. Patients with axial length less than 22 mm or higher than 25mm, or patients with K readings outside 42-47D, or with astigmatism more than 2 D were excluded as well. All cases were subjected to full ophthalmological examination and biometry with both Nidek optical biometer using Haigis formula and Sirius tomography. Phacoemulsification and single piece IOL power implantation was done for all patients by the same surgeon. Postoperative refraction was done for the patients by using autoref (Shin-Nippon accuref 8001, Japan) at 2 weeks and 4 weeks postoperatively. The spherical equivalent (SE) was calculated from the subjective refraction with best corrected visual acuity.

Surgical Procedure

Phacoemulsification: Cataract surgery was performed using phacoemulsification technique.

IOL implantation: The selected IOL was implanted in the capsular bag, posterior to the iris.

Surgical technique: The surgical procedure was performed by a single experienced surgeon using standardized techniques to minimize variability.

Postoperative Follow-up

Refraction assessment: Postoperative refraction was evaluated at 2- and 4-weeks following surgery using an autoref (Shin-Nippon accuref 8001, Japan).

Calculation of spherical equivalent: The spherical equivalent (SE) was calculated from the subjective refraction with best corrected visual acuity.

Statistical analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges**.** Also, qualitative variables were presented as number and percentage. The comparison between two paired groups with quantitative data and parametric distribution were done by using Paired t-test**.**

While the comparison between two paired groups with quantitative data and non-parametric distribution was done by using Willcoxon test**.** Spearman correlation coefficients were used to assess the correlation between two quantitative parameters in the same group**.** Bland and Altman figure was used to compare measurement between Nidek and sinus. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: P > 0.05: Non-significant, P < 0.05: Significant and P < 0.01: Highly significant.

RESULTS

Forty eyes of twenty-eight patients were enrolled in this prospective cohort comparative study. The mean age was 60.2 years +/- 8.16 years. There were 24 right eyes and 16 left eyes with mean AL 23.45 +/- 0.77mm. The mean IOL power was 20.30 +/- 2.65.

Comparison between K readings (K, K2 and Km) of Nidek optical biometer and Sirius tomography was done.

Table (1): Comparison between Nidek technique and Sirius technique regarding K1

K1 (D)	Nidek No. = 40	Sirius No. = 40	Difference 95% CI	Correlation R	Correlation P-value	Test value•	P-value	Sig.
Mean ± SD	44.11 ± 1.18	43.83 ± 1.21	-0.28 ± 0.46	0.938**	<0.001	3.860	0.000	HS
Range	41.78 – 46.68	41.63 – 47.07	0.13 – 0.43v					

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

•: Paired t-test

The previous table shows that there was statistically highly significant difference found between Nidek and Sirius regarding the reading of K1 of the studied patients with p-value <0.01 while there was statistically significant positive correlation found between the readings of the two techniques with p-value <0.001 and r = 0.938.

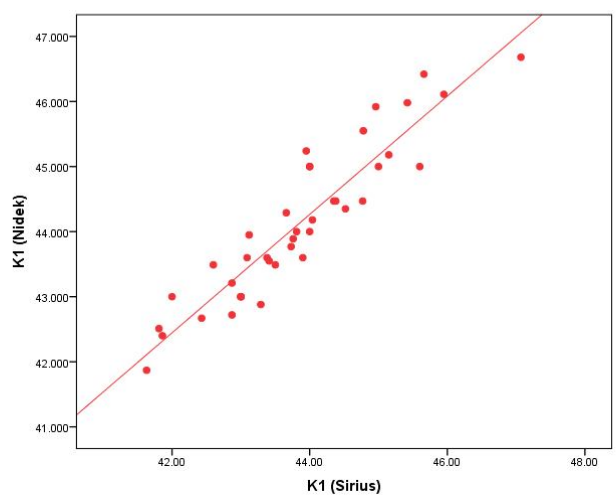

Fig. 1: Correlation of K1 (Nidek) with K1 (Sirius)

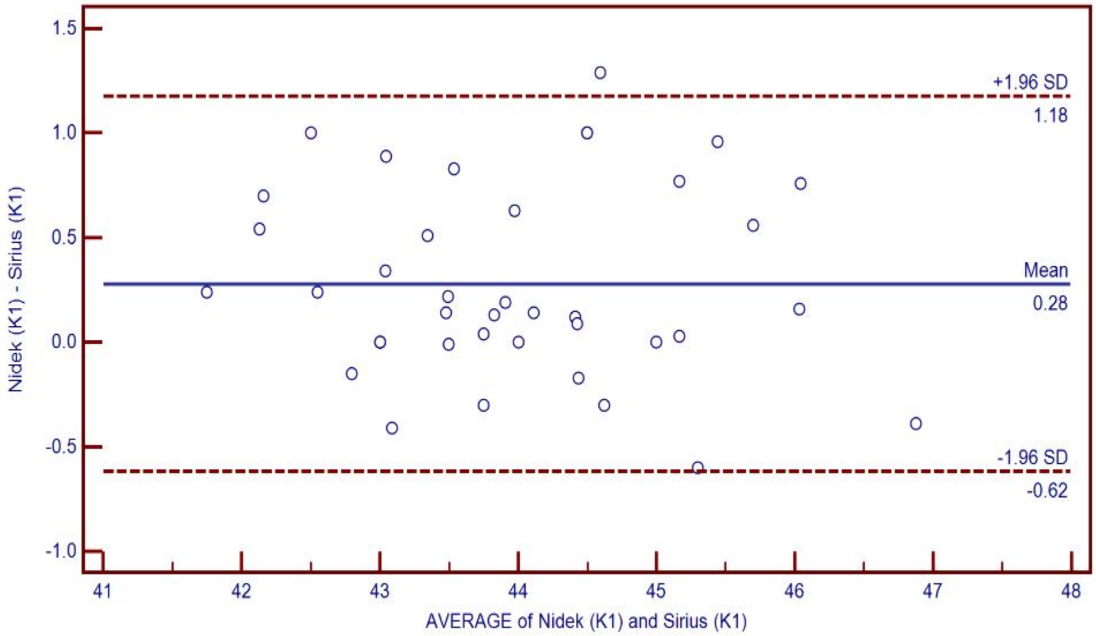

Fig. 2: Bland and Altman plot curve of K1 (Nidek) and K1 (Sirius)

Table 2: Comparison between Nidek technique and Sirius technique regarding K2

K2 (D)	Nidek No. = 40	Sirius No. = 40	Difference 95% CI	Correlation R	P-value	Test value•	P-value	Sig.
Mean ± SD	45.1 ± 1.17	44.78 ± 1.19	0.32 ± 0.47	0.910**	<0.001	4.208	0.000	HS
Range	42.83 – 47.34	42.21 – 47.7	0.17 – 0.47					

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

•: Paired t-test

The previous table shows that there was statistically highly significant difference found between Nidek and Sirius regarding the reading of K2 of the studied patients with p-value <0.01 while there was statistically significant positive correlation found between the readings of the two techniques with p-value <0.001 and r = 0.910.

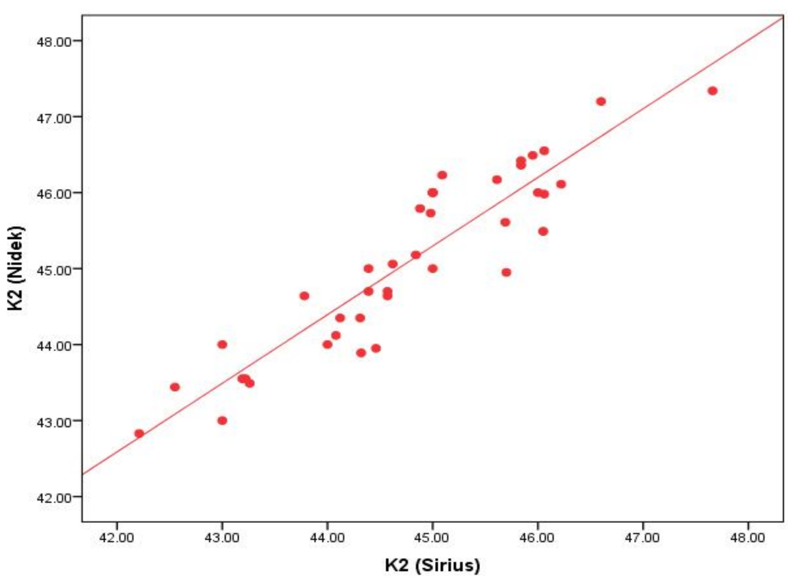

Fig. 3: Correlation of K2 (Nidek) with K2 (Sirius)

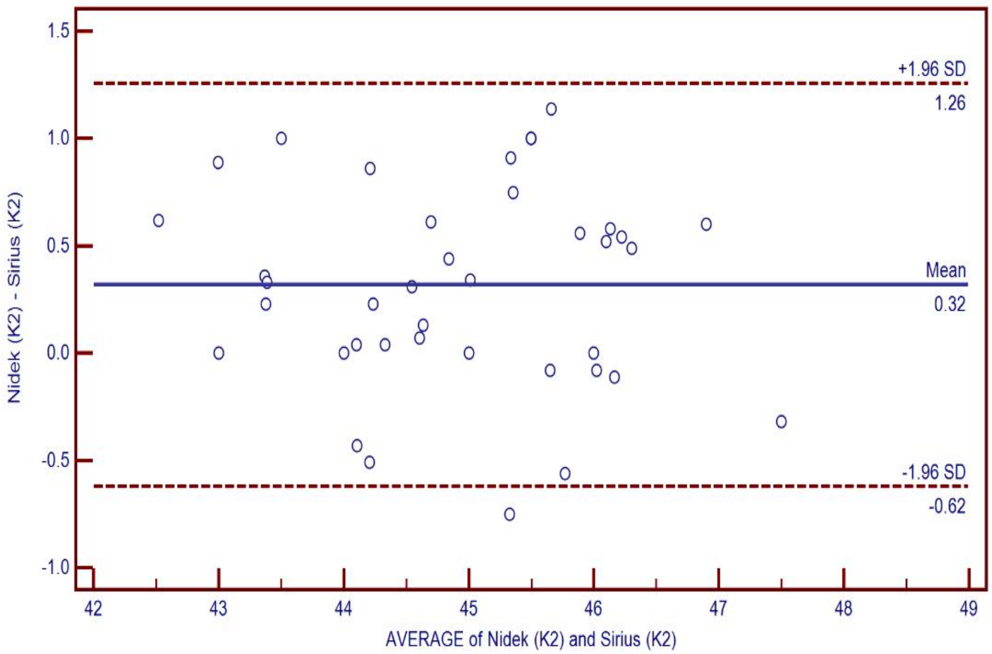

Fig. 4: Bland and Altman plot curve of K2 (Nidek) and K2 (Sirius)

Table 3: Comparison between Nidek and Sirius regarding Km

Km (D)	Km (Nidek) No. = 32	Km (Sirius) No. = 32	Difference	Correlation r	Correlation p-value	Test value	P-value	Sig.
Mean±SD	44.65 ± 1.16	44.38 ± 1.21	-0.26 ± 0.41	0.939**	<0.001	3.694	0.001	HS
Range	42.62 – 47.01	42.04 – 47.37	-1.10 – 0.58					

P>0.05: Non-significant (NS); P <0.05: Significant (S); P <0.01: Highly significant (HS)

Paired t-test

The previous table shows that there was statistically highly significant difference found between Nidek and Sirius regarding the reading of Km of the studied patients with p-value <0.01 while there was statistically highly significant positive correlation found between the readings of the two techniques with p-value <0.001 and r = 0.939.

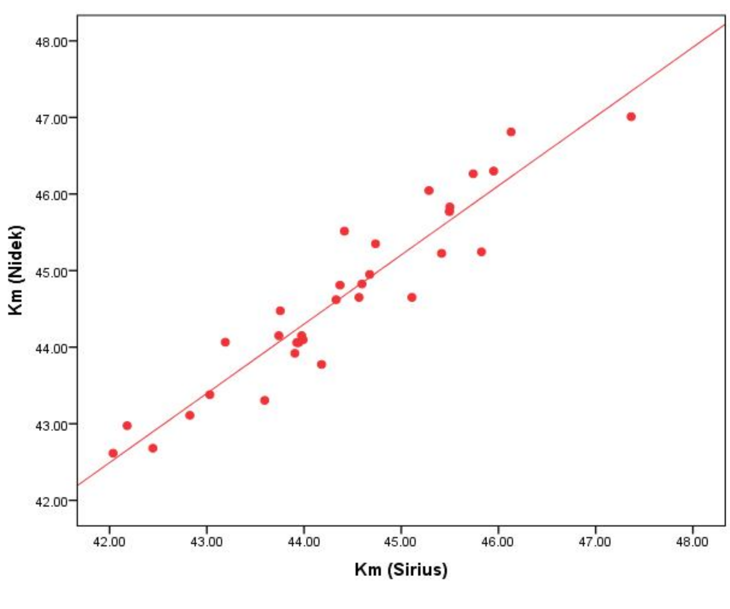

Fig. 5: Comparison between Nidek and Sirius regarding Km

Postoperative predictive refraction (PPR): Comparison between Nidek and Sirius postoperative predictive refraction was done.

Table 4: Comparison between Nidek technique and Sirius technique regarding postoperative predictive refraction (PPR)

PPR (D)	Nidek No. = 40	Sirius No. = 40	Difference No. = 40	Correlation R	Correlation P-value	Test value‡	P-value	Sig.
Mean ± SD	-0.43 ± 0.42	-0.75 ± 0.72	0.33 ± 0.73	0.235	0.192	-2.846	0.007	HS
Range	-1.08 – 0.64	-2.11 – 1.0	0.095 – 0.559					

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

‡: Wilcoxon Rank test

The previous table shows that there was statistically highly significant difference found between Nidek and Sirius regarding the reading of PPR of the studied patients with p-value <0.01 while there was statistically non-significant positive correlation found between the readings of the two techniques with p-value >0.05 and r = 0.235.

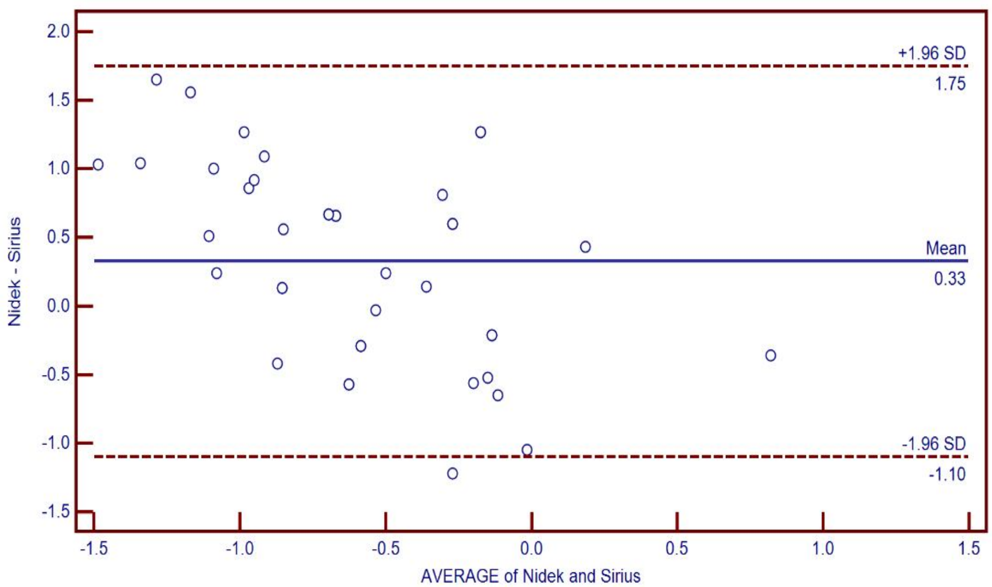

Fig. 6: Bland and Altman plot curve of refraction (Nidek) and refraction (Sirius)

Spherical error**:** Comparison between Nidek PPR and Sirius PPR with postoperative spherical error

Table 5: Comparison between Nidek PPR and the postoperative spherical error

Sphere (D)	Nidek PPR (D) No. = 40	Spherical error (D) No. = 40	Difference 95% CI	Correlation r	Correlation P-value	Test value‡	P-value	Sig.
Mean ± SD	-0.43 ± 0.42	0.07 ± 0.97	-0.45 ± 1.01	0.077	0.685	-2.436	0.021	S
Range	-1.08 – 0.64	-1.75 – 2.25	-0.83 ± -0.07					

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

‡: Wilcoxon Rank test

The previous table shows that there was statistically significant difference found between Nidek PPR and the postoperative spherical error of the studied patients with p-value <0.05 while there was statistically non-significant positive correlation found between the two readings with p-value >0.05 and r = 0.077.

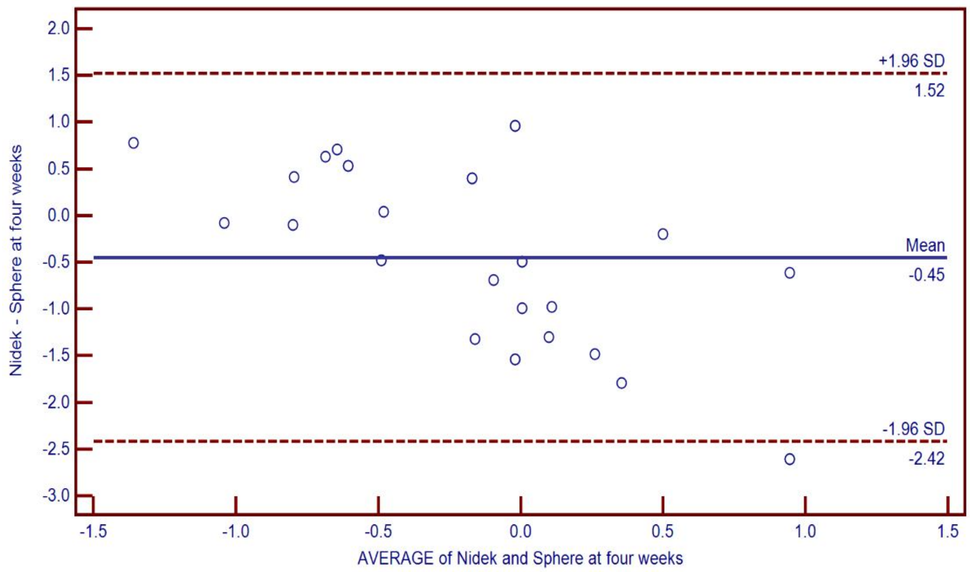

Fig. 7: Bland and Altman for refraction by (Nidek) and postoperative spherical error.

Table 6: Comparison between Sirius PPR and the postoperative spherical error

Sphere (D)	Sirius PPR (D) No. = 40	Spherical error (D) No. = 40	Difference	Correlation R	Correlation P-value	Test value‡	P-value	Sig.
Mean ± SD	-0.75 ± 0.72	0.07 ± 0.97	-0.87 ± 1.01	0.268	0.152	-4.679	0.000	HS
Range	-2.11 – 1.0	-1.75 – 2.25	-1.25 – -0.49					

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

‡: Wilcoxon Rank test

The previous table shows that there was statistically highly significant difference found between Sirius PPR and the postoperative spherical error of the studied patients with p-value <0.01 while there was statistically non-significant positive correlation found between the two readings with p-value >0.05 and r = 0.268.

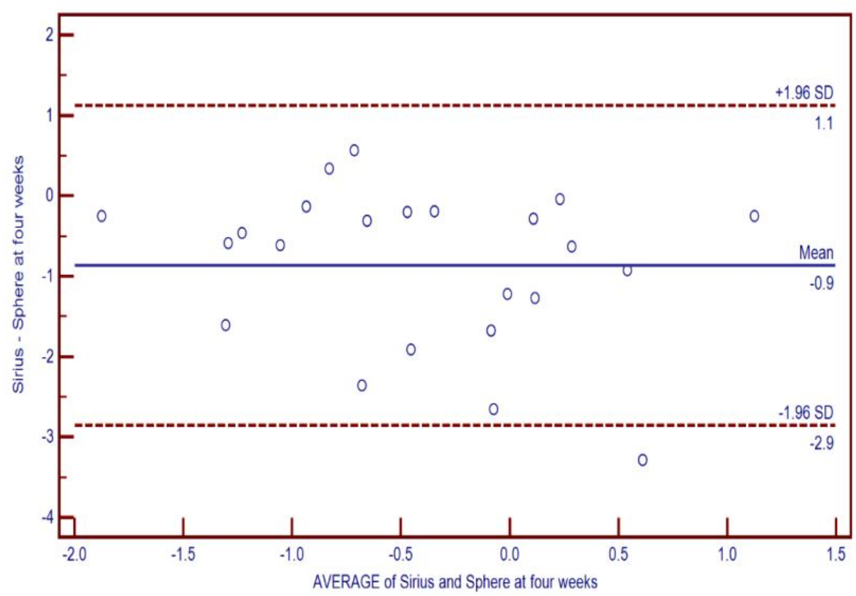

Fig. 8: Bland and Altman for refraction by (Sirius) and postoperative spherical error

Spherical equivalent (S.E.):

Comparison of Nidek PPR and Sirius PPR with postoperative spherical equivalent

Table 7: Comparison between Nidek PPR and postoperative S.E

S.E (D)	Nidek PPR (D) No. = 40	S.E. (D) No. = 40	Difference 95% CI	Correlation r	Correlation P-value	Test value‡	P-value	Sig.
Mean ± SD	-0.43 ± 0.42	-0.65 ± 0.64	0.20 ± 0.61	0.183	0.271	2.057	0.047	S
Range	-1.08 – 0.64	-2.25 – 1.25	0.003 – 0.404					

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

‡: Wilcoxon Rank test

The previous table shows that there was statistically significant difference found between Nidek PPR and the postoperative S.E. of the studied patients with p-value <0.05 while there was statistically non-significant positive correlation found between the two readings with p-value >0.05 and r = 0.183.

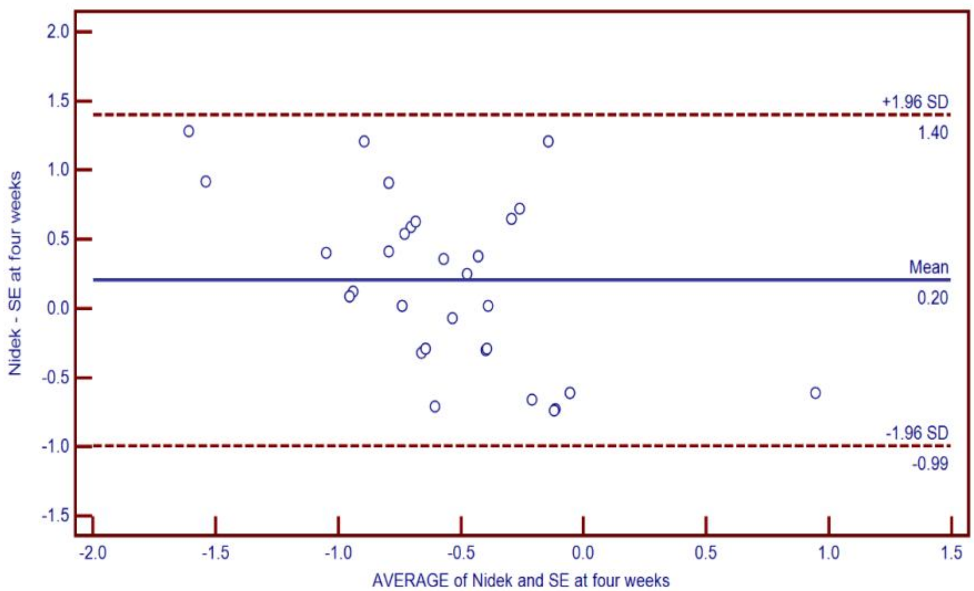

Fig. 9: Bland and Altman for refraction by (Nidek) and postoperative S.E.

Table 9: Comparison between Sirius PPR and postoperative S.E

S.E. (D)	Sirius PPR (D) No. = 40	S.E. (D) No. = 40	Difference	Correlation R	Correlation P-value	Test value‡	P-value	Sig.
Mean ± SD	-0.75 ± 0.72	-0.65 ± 0.64	-0.15 ± 0.81	0.079	0.637	-1.115	0.272	NS
Range	-2.11 – 1.0	-2.25 – 1.25	-0.41 – 1.12					

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

‡: Wilcoxon Rank test

The previous table shows that there was statistically non-significant difference found between Sirius PPR and the postoperative S.E. of the studied patients with p-value >0.05 while there was statistically non-significant positive correlation found between the two readings with p-value >0.05 and r = 0.079.

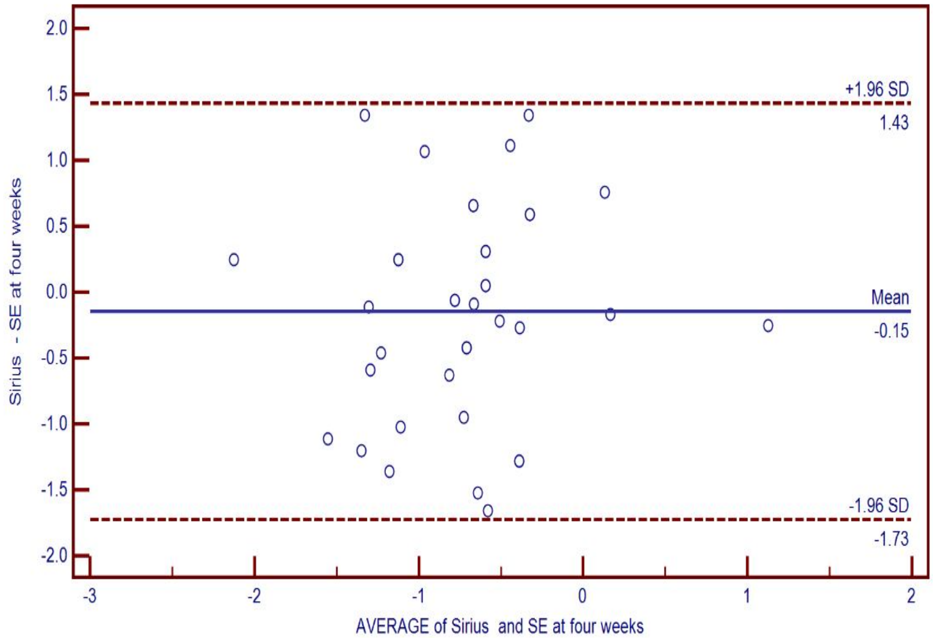

Fig. 10: Bland and Altman for refraction by (Sirius) and postoperative S.E

Prediction Error**:** ***Comparison between Nidek and Sirius prediction error***

Table 10: Comparison between Nidek predeiction error (PE) and Sirius prediction error (PE)

	Difference		Test value	P-value	Sig.
	Nidek PE (D)	Sirius PE (D)			
Mean ± SD	-0.21 ± 0.58	0.13 ± 0.78	-3.071•	0.004	HS
Range	-1.28 – 0.74	-1.34 – 1.66			

P-value > 0.05: Non-significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant

•: Paired t-test

The previous table shows that there was statistically highly significant difference found between Nidek PE and Sirius PE of the studied patients with p-value <0.01.

DISCUSSION

Cataracts are one of the most common causes of vision loss and blindness across the world, advances in technology and innovations allowed the treatment of this pathology to be very safe and efficacious [15]. The advancement of modern technology made the cataract surgeries and the used IOL a treatment for refractive problems not only media opacities. Patients have higher expectations for accurate refractive outcomes and consequently, biometry measurement and IOL power calculations have become increasingly important in ophthalmic practice [15].

Success of modern-day cataract surgery is increasingly defined by the refractive outcome. Refractive surprises are a common reason for IOL exchange. With improving surgical equipment and biometry technology, precise preoperative planning and IOL selection are required and expected **[15].**

In our study we compared the accuracy of refraction prediction of two devices using two different techniques in calculating the IOL power, the Sirius tomography and the Nidek AL scan. Duman et al. **[12]** stated that high repeatability of the anterior segment measurements was achieved on comparing those obtained with Sirius topographer and Nidek AL-scan in patients with cataract. Although mean keratometry (Km), flat keratometry (K1), and steep keratometry (K2) measurements of the Sirius and the AL-Scan showed good agreement, white to white distance (WTW), central corneal thickness (CCT), and anterior chamber depth (ACD) measurements significantly differed between two devices. Thus, anterior segment measurements except for Km, K1, and

K2 cannot be used interchangeably between Sirius and Nidek AL-Scan devices [16].

The difference in CCT, WTW, ACD and Km and K2 in 3.3 mm zone values was statistically significant. The smallest range of agreement was in CCT (mean difference: 19.75 ± 8.25, P = 0.00), whereas the largest was in K1 in zone 3 (mean difference: −0.013 ± 0.32, P = 0.782). Keratometric values obtained from 2.4 mm to 3.3 mm with Nidek AL-Scan and the values with Sirius were investigated and compared. However, good agreement was found for all of the parameters in zone 2.4, the keratometry values obtained from 2.4 mm, and Sirius was found to be closer [16].

The study also stated that there is still lack of a gold standard method for analyzing anterior segment parameters. Thus, further studies are needed to standardize anterior segment measurement parameters obtained using CSO Sirius Topographer (CSO, Italy) and Nidek AL-Scan (Nidek CO., Gamagori, Japan) [16].

These results differ from our results, which showed statistically significant difference between the k readings (K1, K2 and Km) obtained by Nidek and Sirius devices.

Çağlar et al. [17] compared the measurements of the Nidek AL scan with that of the Sirius and ultrasound biometry (UB). Average K 2.4, average K 3.3, CCT (central corneal thickness), WTW (white to white distance), ACD (anterior chamber depth) and AL (axial length) were obtained from the AL-Scan and compared with average SimK, CCT, WTW (horizontal anterior chamber diameter) and ACD obtained from Sirius and also compared with ACD and AL obtained from UB. The statistically significant difference was found between all of the measurements (p\0.001) except the average keratometry values (K2.4, K3.3, SimK) (p=0.083).

There was a perfect correlation between keratometry, CCT and AL measurements of the devices (ICC (intraclass correlation) =0.977, 0.954, 0.923, respectively) and there was a strong correlation between the WTW measurements of AL-Scan and Sirius (ICC =0.865). While ACD parameter of AL-Scan and UB showed a perfect correlation (ICC =0.977), there was a moderate correlation between AL-Scan and Sirius and also between UB and Sirius (ICC =0.608 and 0.664, respectively). There was a high correlation between the all measurements, besides ACD, of AL-Scan and Sirius and they can be used interchangeably for average keratometry and WTW confidently. However, ACD and CCT have a broader 95 % LoA (limits of agreements) (-0.039 to0.744 and -24.985 to 3.691, respectively). In addition, AL-Scan and UB were in good agreement regarding ACD, while differences in AL measurements of UB and AL-Scan were clinically important (95 % LoA =-0.091 to 0.703). Furthermore, UB and Sirius have a moderate agreement regarding ACD (95 % LoA =-0.047 to 0.680) [17].

These results agree with ours in that there is statistically significant difference between K1 and K2 of both devices, while it differs from our results in that Km in our study differs significantly between Nidek and Sirius devices.

In another study, Wei et al. [18] showed that the original Sirius ray tracing method is not satisfactory enough. Less accuracy was shown using the Sirius ray-tracing method compared with SRK-T and Haigis formula. The difference in mean absolute prediction error (MAPE) (predicted refraction – post operative refraction) was statistically significant between Sirius ray-tracing method and SRK-T formula and Haigis formula (P=0.001). However, it was thought that this difference may be due to the difference between the effective lens position (ELP) and the predicted lens position (PLP). To study if the inaccuracy of Sirius ray-tracing method was related to the drift of ELP, we input ELP to Sirius soft to calculate the IOL power instead of PLP. As expected, the MAPE of the ELP-inputted Sirius ray-tracing method was reduced. And there was no statistical difference in MAPE of ELP-inputted Sirius ray-tracing method, SRK-T, or Haigis formula. So, it was concluded that in normal eyes, the optimized Sirius ray-tracing method (obtained by re-entering the ELP instead of PLP and recalculating the IOL power) was as accurate as SRK-T and Haigis formulas in IOL power calculation [18].

Besek et al.[19] evaluated the accuracy of keratometric values obtained from Scheimpflug (Sirius) topography using Nidek AL-Scan optical biometry for intraocular lens (IOL) power calculating after penetrating keratoplasty (PK). He found that both devices correctly calculated IOL power after PK; however, Sirius SimK (3mm) gave the lowest mean absolute error (MAE) results and can be safely used for IOL power calculation [19].

Kirgiz et al. [20] also conducted a study that compared Sirius with another optical biometer Lenstar for IOL power calculation. The study shows that the corneal power measurements provided by Sirius, a Scheimpflug camera combined with placido-disk corneal topography, can be successfully used for IOL power calculation to achieve the target refraction. The results obtained with the simK, K at 3-, 5-, and 7-mm zones (MAE ranging between 0.36 ± 0.32 and 0.39 ± 0.32 D), were better than those achieved by Lenstar K (0.42 ± 0.33 D), an optical biometry. Although there was no statistically significant difference, simK at 5-mm zone gave the better refractive outcome and the study concluded that the Sirius 5-mm zone K readings were the best in predicting a more precise IOL power among the other K readings of Sirius and Lenstar [20].

Accurate IOL power calculation is the most important point for better visual outcome after cataract surgery. One of the major sources of error in IOL power calculation is keratometry which contributes to the 6% of total errors. And since the Sirius combines both Scheimpflug camera and placido disk corneal topography, it provides tangential and axial curvature data of the anterior and posterior corneal surfaces and the global refractive power of the cornea giving more accurate IOL power results.[20]

In our study, there was a highly significant difference between the prediction error of the Sirius and that of the Nidek, the Sirius gave less MAPE than that of the Nidek. The Sirius PPR was more accurate than that of the Nidek when compared with the postoperative spherical equivalent of the studied patients, which means that it gives more accurate IOL power calculation.

Advantages of Sirius Tomography

Comprehensive corneal analysis: Sirius tomography provides a comprehensive analysis of the cornea, including anterior and posterior corneal curvature, corneal thickness, and astigmatism. This comprehensive data can lead to more accurate IOL power calculations.

Detection of corneal irregularities: Sirius tomography is capable of detecting subtle corneal irregularities, such as early keratoconus, which can significantly impact refractive outcomes. Early identification of these conditions allows for appropriate management and potentially prevents refractive surprises.

Improved accuracy in complex cases: Sirius tomography may be particularly beneficial in complex cases, such as eyes with irregular corneas or previous refractive surgery. The additional information provided by Sirius can help to refine IOL power calculations and improve refractive outcomes in these challenging situations.

Limitations and Considerations

Operator dependence: The accuracy of Sirius tomography can be influenced by operator skill and adherence to proper imaging techniques. Consistent training and adherence to standardized protocols are essential to maximize the benefits of this technology.

Image quality: Image quality can be affected by factors such as patient cooperation, tear film stability, and the presence of opacities in the ocular media. Poor image quality can compromise the accuracy of corneal measurements.

Integration with IOL power calculation formulas: The integration of Sirius tomography data with various IOL power calculation formulas is essential for optimal results. Further research is needed to evaluate the performance of different formulas in combination with Sirius tomography.

Future Directions

Comparison with additional biometry devices: Future studies could compare Sirius tomography with other advanced biometry devices, such as swept-source optical coherence tomography (SS-OCT), to evaluate their relative accuracy and clinical outcomes.

Integration with advanced IOL technologies: Research is needed to explore the integration of Sirius tomography with advanced IOL technologies, such as toric IOLs and multifocal IOLs, to optimize refractive outcomes in patients with astigmatism or presbyopia.

Evaluation in specific patient populations: The performance of Sirius tomography could be evaluated in specific patient populations, such as patients with previous refractive surgery, corneal ectasia, or ocular surface disease, to assess its effectiveness in these challenging cases.

CONCLUSION

Sirius tomography represents a valuable tool for IOL power calculation, offering advantages in terms of comprehensive corneal analysis, detection of corneal irregularities, and potential for improved accuracy in complex cases. However, further research is needed to fully understand its limitations and optimize its integration with IOL power calculation formulas and advanced IOL technologies. By addressing these areas, the clinical impact of Sirius tomography can be further enhanced, leading to improved refractive outcomes for cataract patients.

ACKNOWLEDGEMENT: None

Data Availability: The authors declare that all data supporting the findings of this study are available within the article.

Competing interests: The authors declare no competing interests.

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Ethics declarations: All procedures performed in the study followed the 1964 Helsinki declaration and its later amendments, University Ethics Committee approved the project.

Conflict of interest

All authors have no conflicts of interest that are directly relevant to the content of this review.

Funding: No sources of funding were used to conduct this review.

Reviewer disclosures: No relevant financial or other relationships to disclose.

Declaration of interest: No financial affiliations or financial involvement with any organization or entity with a financial competing with the subject matter or materials discussed in the review.

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