ARGOS provides potentially better refractive outcome

Summary

In previous studies it has been shown that Swept-Source OCT biometers yield improvements in AL acquisition rates over conventional PCI and OLCR non-contact biometers [1]. In this white paper we report on a study at Saiseikai Kurihashi Hospital, Kuki, Saitama, Japan comparing post-op errors between two OCT biometers, the ARGOS (MOVU) and "System B", a gold-standard conventional biometer(PCI) as well as a study at Chukyo Hospital, Nagoya, Japan comparing with "System C", another SS-OCT biometer recently brought to market. These studies highlight the advantage of calculating AL using actual refractive indices of the eyes segments rather than a composite refractive index. In comparison with System B, ARGOS's prediction within 0.5D error was 89% while System B was 69% (n=42) while in longer eyes greater than 26mm, ARGOS again outperforms achieving 91% within 0.5D error and System B was 64% (n=11). In comparison with System C, ARGOS's prediction within 0.5D error was 80.3% while System C was 77.6% (n=76) while in longer eyes greater than 26mm, ARGOS outperforms achieving 77.8% within 0.5D error and System C was 55.5%(n=9).

Advantages of ARGOS

ARGOS uses Swept-Source OCT at 1050 nm to capture an image of the whole eye from the cornea to the retina. This image is then used to calculate the biometric parameters necessary for IOL power calculation. The Swept-Source OCT technique for biometry delivers advantages over other non-contact techniques. First, the 1050 nm light used experiences less scatter than shorter wavelengths leading to more photons being available to make the measurement. Second, this technique has an inherent sensitivity advantage over other interferometric techniques. In addition, for ARGOS, the measurement beam scans across the eye capturing a full 2D image of the anterior chamber. For dense localized cataracts, this scanning helps ensures light travels past the cataract to reach the retina so that AL can be measured. ARGOS uses a proprietary swept-laser source (Santec Corp, Komaki, Japan) designed for deep (>50 mm) imaging at a fast 3000 lines/sec A-line rate. ARGOS even measures the densest cataracts that usually require the use of ultrasound A-scan. Furthermore, faster real-time OCT imaging during alignment ensures the confidence of fixation and provides assurance of accurate measurement with instant validation.

Findings

Biometric measurements were taken of the same eyes using ARGOS and two other non-contact biometers and the results compared. Figure 1 shows the comparison of key parameters (AL, K, ACD) in Bland-Altman charts. While there is no clinically significant difference in ACD and K, the measured AL has a systematic difference between ARGOS and System B as seen in Figure 2. For longer AL, the other biometers tend to overestimate AL. ARGOS calculates AL as the sum of physical distances of four segments: central corneal thickness, aqueous depth, lens thickness, thickness of vitreous humor to the retina each calculated by dividing optical distance by corresponding refractive index (1.374, 1,336, 1.41, 1.336) which implies the true physical scale of AL. On the other hand, the conventional biometer uses composite refractive index where a statistically average proportion of AL to lens thickness is assumed [2]. This approach does not take into account the actual lens thickness. Thereby, conventional biometers tend to overestimate AL which is primarily the reason for not being able to predict short/long eyes with good precision in the past. Additional adjustment to the AL value calculated by tradition biometers is required to take into account the offset from true AL value before substituting to IOL power formula [3].

Post-operative refraction was measured and a comparison was made between the outcomes predicted using the biometric parameters measured by the three biometers used in the studies. Figure 3 shows post-op prediction errors compared between ARGOS and System B, and ARGOS and System C with Haigis formula and SRK/T, equations were optimized for System B and C, respectively. Results show that ARGOS retrospective evaluation using the same A constants indicates that post-op outcome is comparable or improved in some cases in comparison to that predicted by System B and C, especially, it improves the refractive outcome for the longer eyes. This could be attributed to difference in the measurement method previously described.

Conclusion

Conventional optical methods of AL measurement are based on composite refractive index extrapolated from statistical data along the range of AL. The variation discrepant from the average proportion of AL to lens thickness intrinsically limits the effectiveness of IOL power calculation even if an advanced formula is used. The results in these studies demonstrate that ARGOS's true AL measurement has the potential to improved refractive outcomes especially for long eyes that are prone to hyperopia after IOL implant. Along with the highest success rate of measurement, ARGOS has a potential to provide the benefit of an accurate measurement that leads to accurate selection of IOL power.

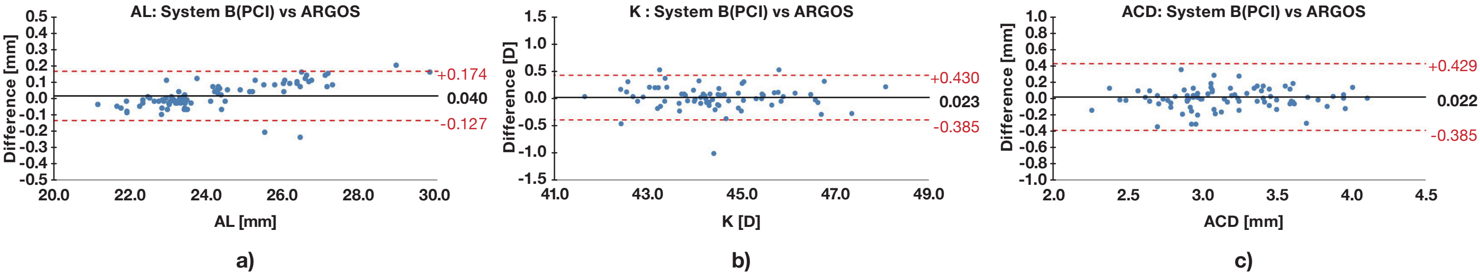
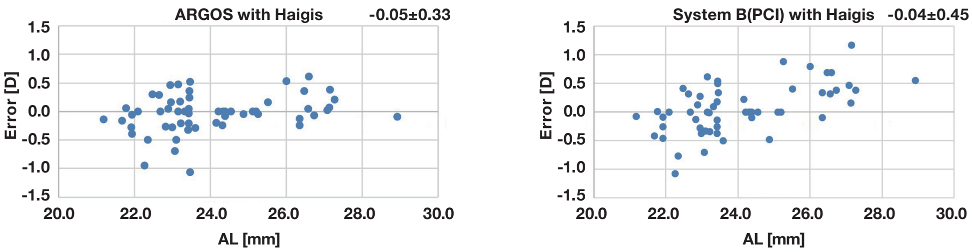
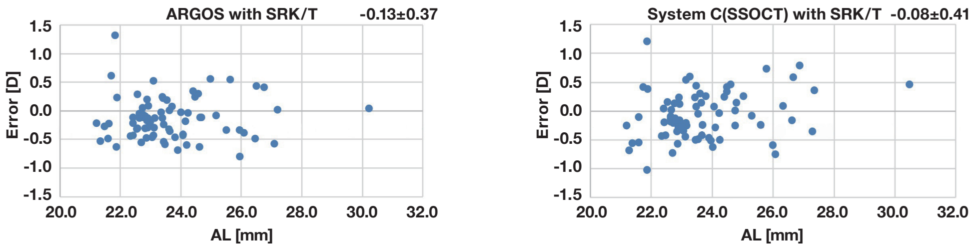


Figure 1. (a-c). Difference of AL, K and ACD between System B(PCI) and ARGOS at Location A (n=72)



d) Comparison of postoperative refractive error between ARGOS and System B(PCI)



e) Comparison postoperative refractive error between ARGOS and System C(SSOCT)

Figure 2. Comparison postoperative refractive error (d, e)

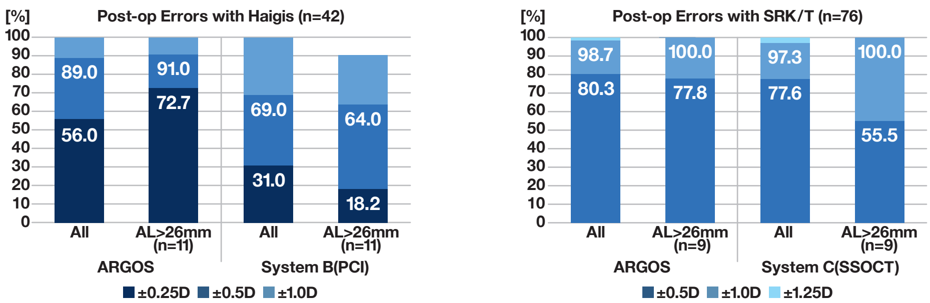


Figure 3. Post-op errors with ARGOS, System B(PCI), C(SSOCT) in normal and long eyes.

Reference

[1] H.John Shammas et al, "Biometry measurements using a new large-coherence–length swept-source optical coherencetomographer", J CATARACT REFRACT SURG - VOL 42, p50-61, JANUARY 2016

[2] http://www.doctor-hill.com/iol-main/extreme_axial_myopia.html

[3] Wang L, et al. Optimizing intraocular lens power calculations in eyes with axial lengths above 25.0 mm. JCRS 2011; 37:2018-2027.

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