



Agreement of Rebound (ic200) and Applanation (Perkins Mk3) Tonometry In a Healthy Pediatric Population

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Learning Objective

Validation of iCare IC200 tonometer against Perkins Mk3 tonometer in a healthy pediatric population.

Background

Intraocular pressure (IOP) is fundamental in diagnosing a variety of ophthalmic pathologies including glaucoma and orbital compartment syndrome¹. Traditionally, IOP is measured using applanation tonometers (such as the Goldmann and Perkins models). Applanation tonometry requires direct contact with the corneal surface for 5-10 seconds and topical anesthesia drops while the patient sat upright in the examination chair. This limitation proved difficult in pediatric settings where infants and toddlers may present reclined at various angles in their parent's arms (unknown angles between 0-90°), car seats (30-45°), or strollers.

The introduction of rebound tonometers has transformed the care provision in pediatric ophthalmology as newer models can measure IOP at a variety of angles. One of the most commonly used rebound tonometers is the iCare platform which can measure IOP using a light-weight probe that makes only momentary contact with the cornea. Thus, topical anesthesia is not required. (iCare USA, Raleigh, NC). The iCare IC200 is a new FDA approved device for use between -10° to 190° that has been demonstrated in the past 3 years to have clinically relevant agreement with applanation tonometers in both pediatric and adult populations^{2,3,4,5}. Interestingly, IC200 has never been assessed among normal children, even though they are much more common to be encountered by pediatric ophthalmologists and among whom it is essential to recognize suspected or new-onset glaucoma in a timely manner.

Methods

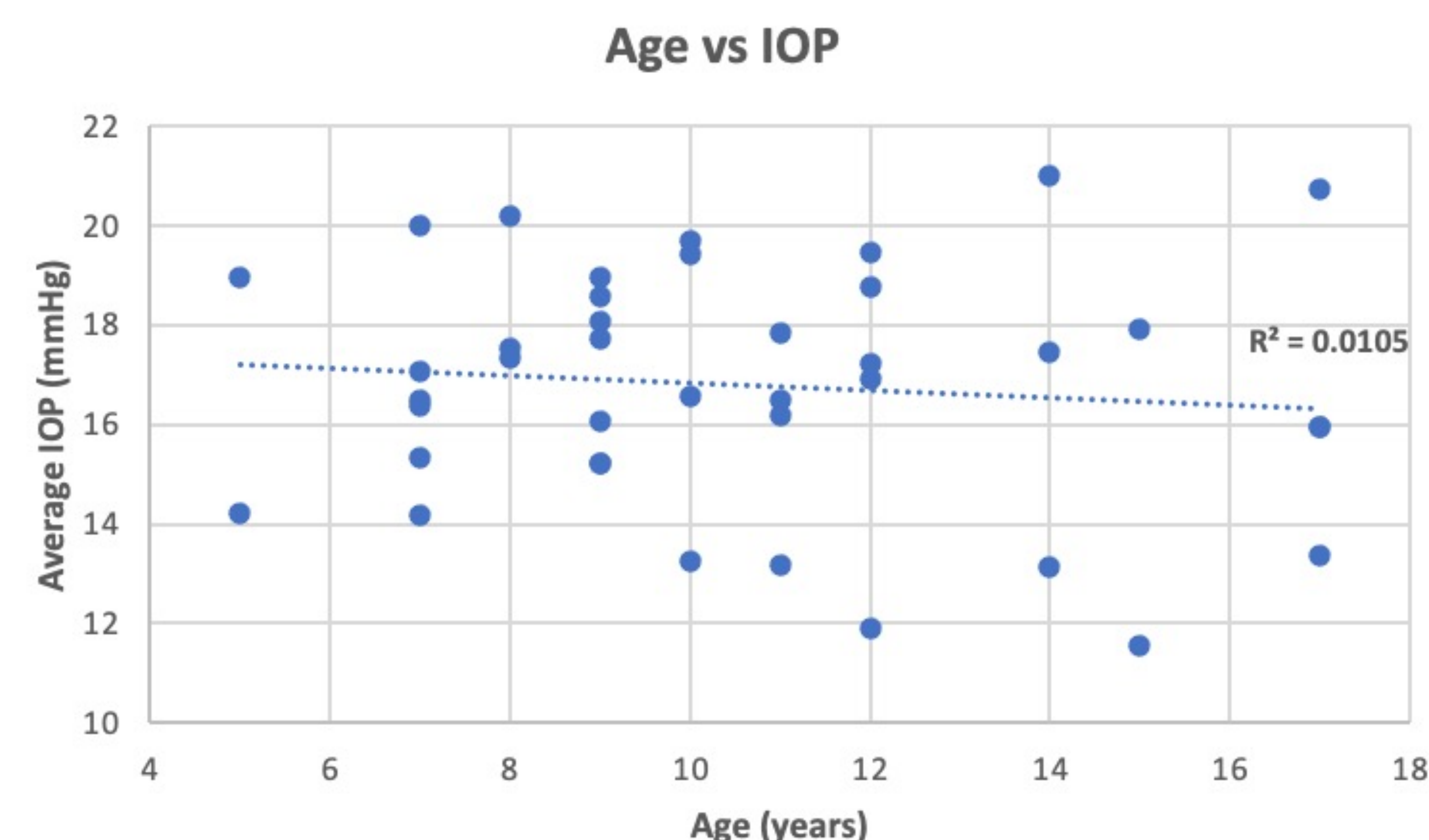
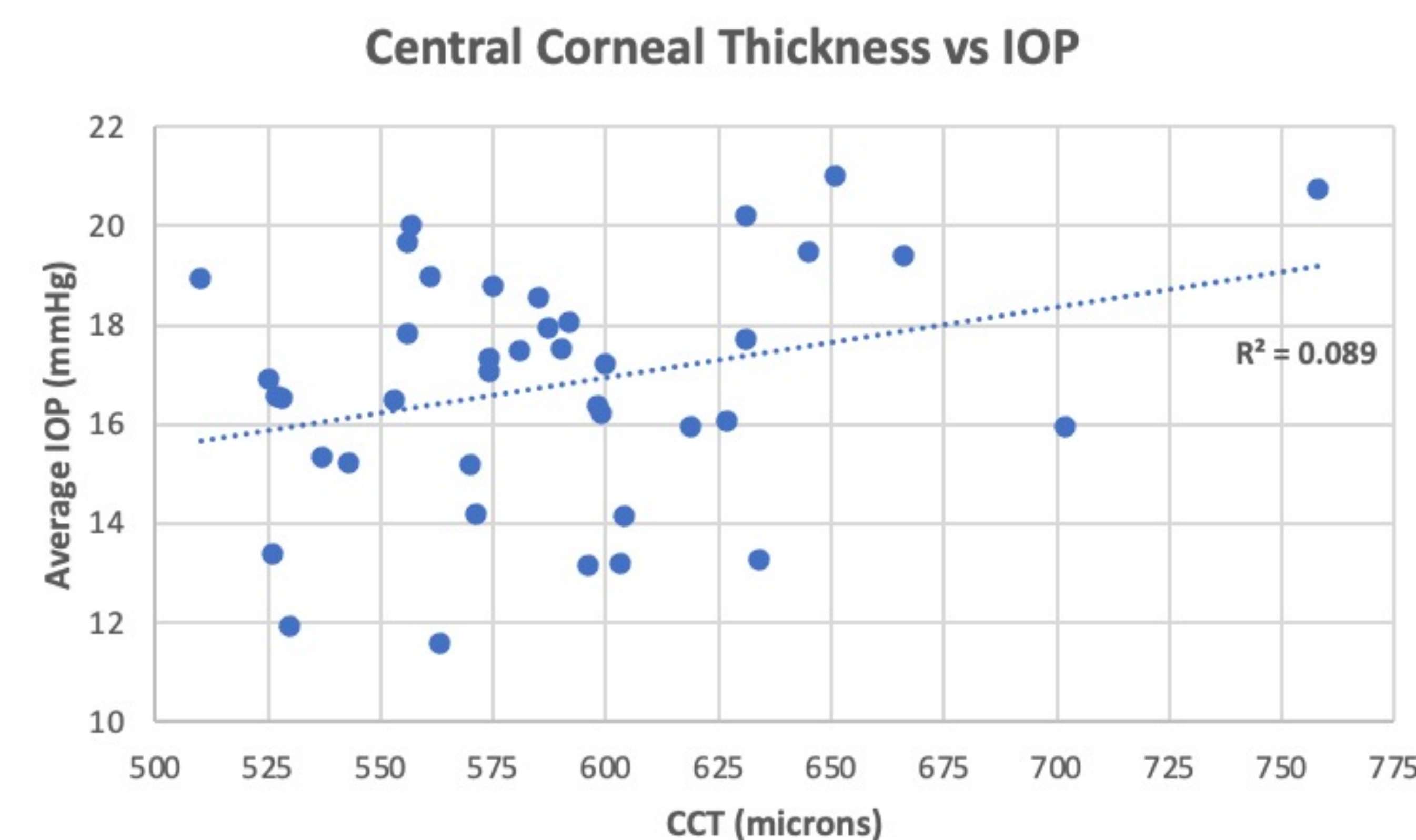
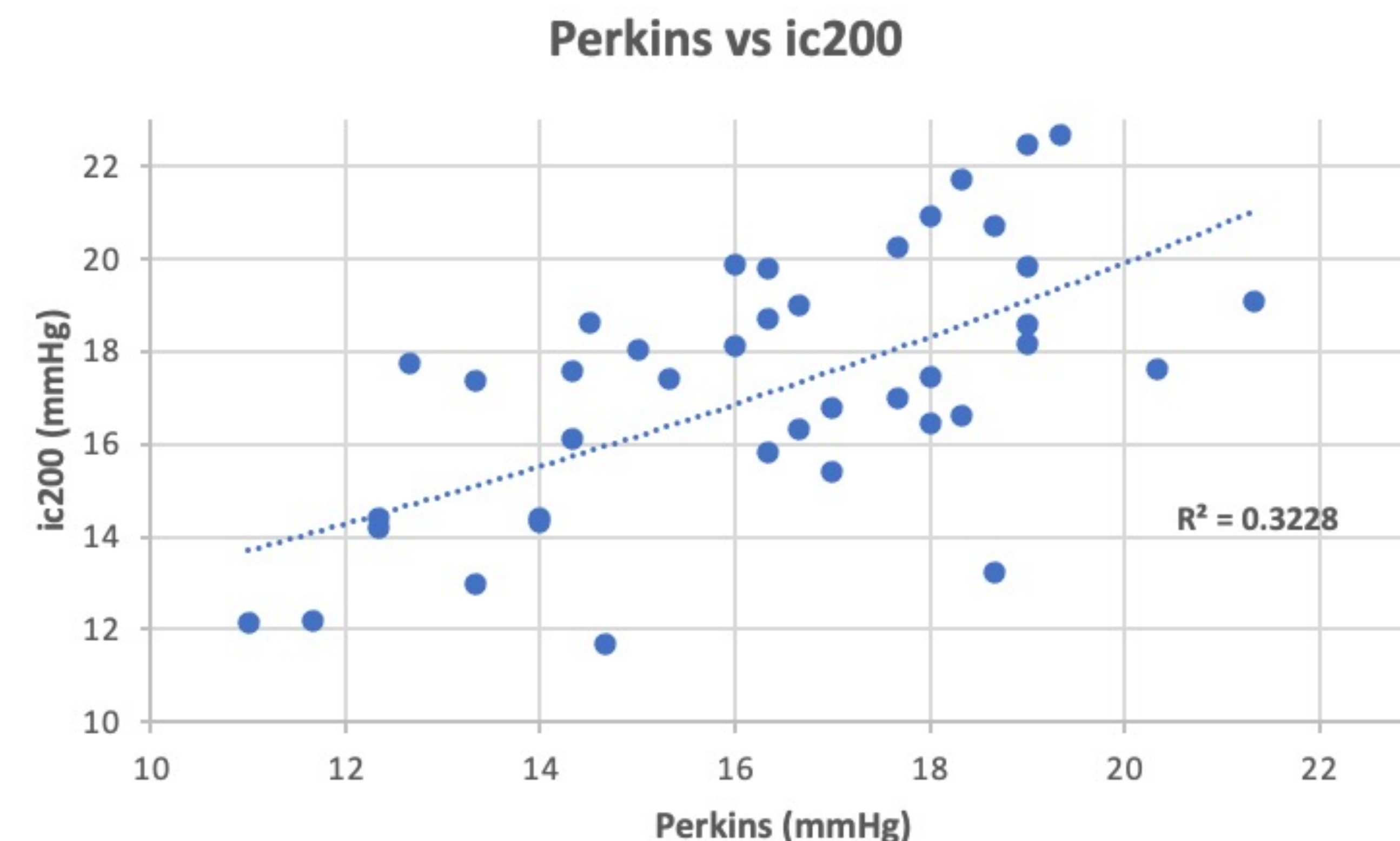
Enrolled participants were randomized in a 1:1 ratio with respect to the tonometer initially used to obtain IOP measurements (IC200 vs. Perkins). In participants with bilaterally healthy eyes, the study eye will be selected randomly using the same web response system; in participants with only one healthy eye as determined by the inclusion and exclusion criteria, only the healthy eye will be included in the study.

Demographic data, including age and gender, the laterality of the study eye, and the corresponding best-corrected visual acuity (BCVA) using the Snellen scale were recorded. Participants were assessed in the seated upright position. Once sitting in the exam chair, the study participant were given one drop of local anesthetic (proparacaine 0.375%/fluorescein 0.25% eyedrop mixture) in the study eye. The central corneal thickness (CCT) of the study eye were measured using an ultrasonic pachymeter (Pachmate 2, DGH Technologies, PA) with the measurement tip placed at the corneal apex.

Measurements using the iCare IC200 were performed with the device held perpendicularly to the patient's forehead and the tip of the probe 5 mm from the corneal center of the study eye. IOP measurement were performed to capture 6 individual measurements, which allows the intradevice software to assess the measurements' variability. The series with low variability were recorded as the study finding. This process took up to 5 minutes to complete.

For applanation tonometry, the handheld Perkins Mk3 tonometer were used. As viewed through the lens, the researcher then adjusted the device until the semicircular mires are clearly visible and equal in size, at which point the IOP will then be read off manually. The assessment were repeated a total of three times to generate three measurements.

Figures/Tables



Results

Overall, 42 healthy children were analyzed. All measurements were conducted between the hours of 8 AM and 3 PM as IOP has been found to vary diurnally. The mean age of the total number of subjects included in the study was 10.4 years with a range of 5-17 years. The group mean BCVA was 0.856 on the Snellen scale. The average number of drugs required at the time of the study was .78. The mean IOP obtained by IC200 was 17.29 mmHg and GAT was 16.28 mmHg. A statistically significant correlation was observed between IOP measures between ic200 and Perkins tonometers ($r^2 = 0.38$; $p = 1.92 \times 10^{-5}$).

Differences in IOP values obtained with both tonometers were analyzed with the linear regression test to determine if they were influenced by central corneal thickness (CCT). We found that while CCT influences the mean IOP between tonometers ($r^2 = .089$), these results were not significant ($p = .062$). Similar results were seen with the effects of age on IOP ($r^2 = .102$, $p = .528$). Similar results were seen in the effects of CCT and When comparing the average IOP and the differences between ic200 and Perkins, we similarly found that average IOP does not significantly influence the differences between instruments ($r^2 = .01$, $p = .445$). This indicated that mean difference does not vary by IOP in healthy, non-glaucomatous eyes.

Discussion

Accurate measurement of IOP in patients with PCG is essential. In these patients, the method considered to be the gold standard continues to be applanation tonometry. However, rebound tonometry offers some advantages in this group, such as not requiring topical anesthesia, greater speed of measurement, less discomfort for the patient, fewer previous attempts to obtain a correct measurement, does not require collaboration, which it is advisable to minimize in children under 3 years due to possible adverse effects. The present study compared IOP measures with IC200 and Perkins applanation tonometry, finding a tendency to overestimate IOP measured with IC200 in healthy children.

This data is consistent with that of previous studies of iCare. The IC200 was compared against the Goldmann applanation tonometer earlier this year in 156 healthy adults. The researchers concluded that although IC200 overestimates IOP compared to Goldmann tonometry, the agreement between the two was less than 2 mmHg at IOP ranging from 6 to 50mmHg as determined by the latter.⁴ In children, data concerning the accuracy of IC200 in IOP measurement are primarily derived from children with pediatric glaucoma.⁵ Morales-Fernandez compared the IC200 against Perkins Mk3 handheld tonometer in 86 children with primary congenital glaucoma.⁵ They found that the two tonometers have good agreement (ICC = 0.73) and the mean IOP difference between the two was only 1.26mmHg. A similar study among pediatric glaucoma patients with different corneal status was performed by Angmo et al. in India recently, who found that while IC200 tended to overestimate the IOP among children with higher IOP.

Limitations

This study was limited in scope, both in the sample size and patient population. Our sample used only healthy participants without any frontal eye pathologies, therefore we cannot recommend screening for glaucoma in all children using the ic200 based on the merits of this study alone. Furthermore, a sample bias was introduced as only children with maturity to have their IOP examined multiple times participated. IOP has been known to be influenced by children holding their breath and these participants would follow instructions to breathe deeply. This study was conducted by 2 clinicians which could introduce user differences. Also, IOP has been known to vary throughout the day and this could be another source of variation as measurements were conducted throughout the course of both morning and afternoon clinic.

Conclusion

While further testing is warranted, our findings add to a growing body of evidence that the ic200 provides valid IOP measurements. While IOP is significantly greater using the ic200 in healthy children, this difference is not clinically relevant. We recommend screening children using the ic200 and if IOP is found to warrant suspect for glaucoma, the IOP readings should be followed up using applanation tonometry using either the Goldmann or Perkins techniques. We are excited by these findings as they justify the use of easier, less invasive methods. We will further our investigation by examining the effects of position on IOP using the ic200. Once a mathematical model is developed for the effects of position on IOP, eye pressure can then be measured at a variety of degrees if patients present in strollers or a mother's arms.

References

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