Accuracy and Precision of Fitting Measurements with the Zeiss i.Terminal 2

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Abstract

Purpose: Compare the accuracy and precision of automated frame and lens measurements taken with the i.Terminal® 2 to manual measurement techniques.
Methods: We obtained measurements for monocular and binocular interpupillary distance, fitting height, vertex distance, wrap angle, and pantoscopic tilt angle using the i.Terminal® 2 and manual tools. We statistically analyzed the repeatability of the automated and manual measurements and compared the accuracy of one technique relative to the other.
Results: Manual techniques demonstrated better repeatability for monocular PD, fitting height, and wrap angle measurements. The i.Terminal® 2 displayed better repeatability for binocular PD, pantoscopic tilt, and vertex distance.
Conclusion: Current ophthalmic measurement techniques using manual tools and an experienced clinician have better overall repeatability and accuracy for clinically critical measurements.

Introduction

Customized free-form lenses that take into account specific frame and lens parameters provide a superior subjective wearing experience for many progressive addition lens (PAL) wearers and allow faster and easier adaptation.[1,2] To maximize the benefits of this technology, the optics of the lenses must be precisely positioned in front of the patient's eyes.

Position-of-wear measurements include monocular interpupillary distance measurements, pantoscopic tilt, wrap angle, fitting height, and vertex distance. Manual measurement tools require significant clinical skill for accuracy and reliability. New measurement technology can capture the above fitting and frame measurements, as well as eye rotation and visual behavior of the patient.[3,4]

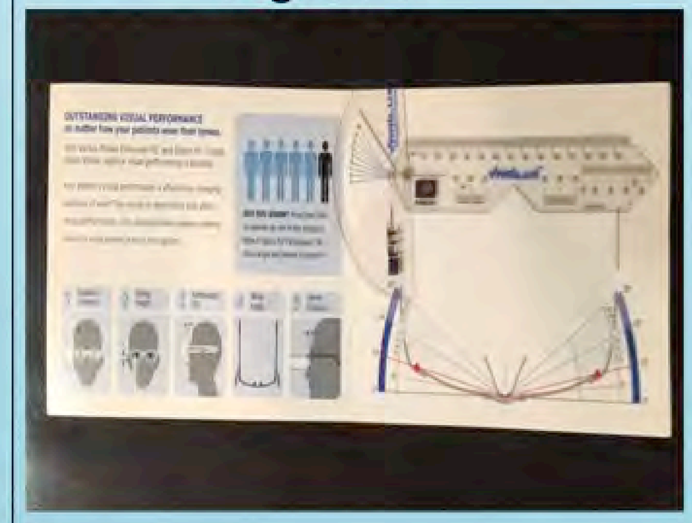
The purpose of this study is to compare manual measurements for interpupillary distance, vertex distance, pantoscopic tilt, panoramic angle, and fitting height to the same measurements taken with the i.Terminal® 2.

Methods

Following the i.Terminal® 2 Quick Reference Guide, measurements were obtained for monocular and binocular interpupillary distances, fitting height, vertex distance, wrap angle, and pantoscopic tilt angle for the subject. The same measurements were acquired using a direct corneal reflection pupillometer (DCRP) for the monocular and binocular interpupillary distances and the Essilor Personalization Measuring Tool Set for the remaining measurements. 20 subjects completed the study.

We statistically analyzed our data using Bland/Altman (mean difference) comparisons to assess the clinical equivalence of the automated vs. manual techniques for each measurement parameter. Repeatability was assessed by comparing repeated measurements using the above statistical test as well as Interclass Correlation Coefficient with Coefficient of Variation analysis.

Figure 1



Essilor Personalization Measuring Tool.

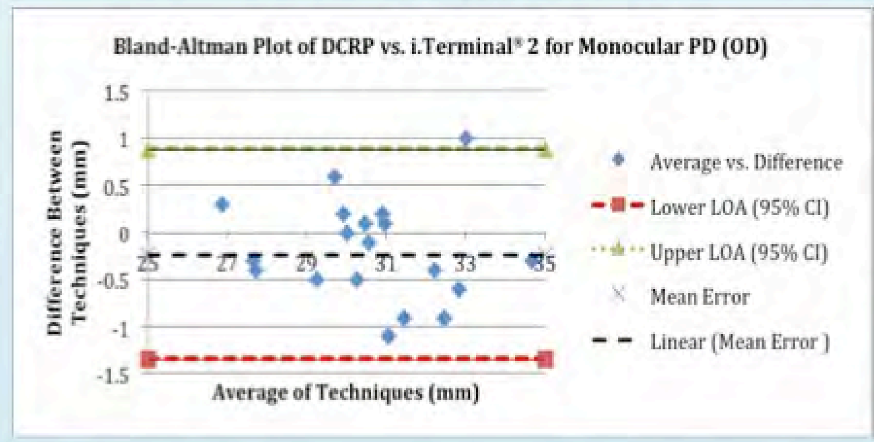
Figure 2

The i.Terminal® 2 measuring slide mounted on a selected frame and the i.Terminal® 2 tower (left).

Results

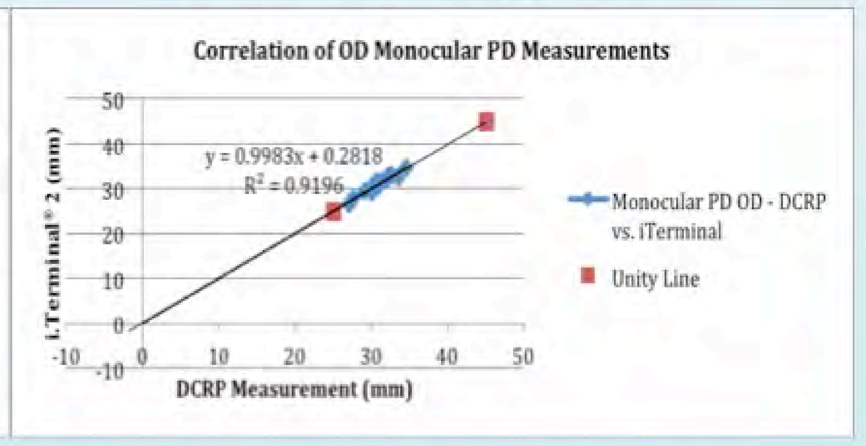
- Manual and i.Terminal® 2 measurements for right-eye monocular and binocular PD were at the upper limit of clinical equivalence based on current clinical standards.
- Fitting height measurements were not clinically equivalent.
- DCRP and i.Terminal® 2 measurements demonstrated repeatability for monocular and binocular PD measurements but not for fitting height measurements.

Table 1



Bland-Altman plot of Average OD Monocular PD for measurements taken with the direct corneal reflex pupillometer (DCRP) and i.Terminal® 2.

Table 2



Scatter plot showing correlation for OD monocular PD measurements taken with the DCRP and i.Terminal® 2.

Discussion

Only OD monocular PD and binocular PD were clinically comparable. Both techniques provided clinically reproducible measurements for monocular and binocular PD but not fitting heights. Vertex distance, pantoscopic tilt and wrap angle do not presently have clinically recognized tolerances.

The value of this research is to assist the optometric practitioner in their decision to implement the i.Terminal® 2 technology into their practice. The new technology has its appeal to patients, however at this time its measurements of clinically-significant frame parameters are in general not significantly improved compared to standard manual techniques.

Table 3

Clinical Measure	Correlation Coefficient	P-value	LLOA	ULOA	Difference in LOA	Clinically Equivalent
Monocular PD OD	0.95896	<0.01	-1.34 mm	0.884mm	2.22mm	Yes
Monocular PD OS	0.898999	<0.01	-1.462 mm	2.30 mm	3.76mm	No
Binocular PD	0.98786	<0.01	-0.76 mm	1.70 mm	2.46mm	Yes
Fitting Height OD	0.658578	<0.01	0.87 mm	16.09 mm	16.96mm	No
Fitting Height OS	0.431574	<0.06	-0.29 mm	16.83 mm	17.12mm	No
Vertex Distance	0.778994	<0.01	-4.87 mm	1.72 mm	6.59mm	N/A
Pantoscopic Tilt	0.407891	<0.01	-9.08	8.85	17.93 degrees	N/A
Wrap Angle	0.77994	<0.01	-2.68	1.24	3.92 degrees	N/A

Summary of clinical equivalence for manual and automated measurements.

References

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