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Repeatability of Measures of Corneal and Anterior Segment Scheimpflug-Based Tomography on Normals and Keratoconus

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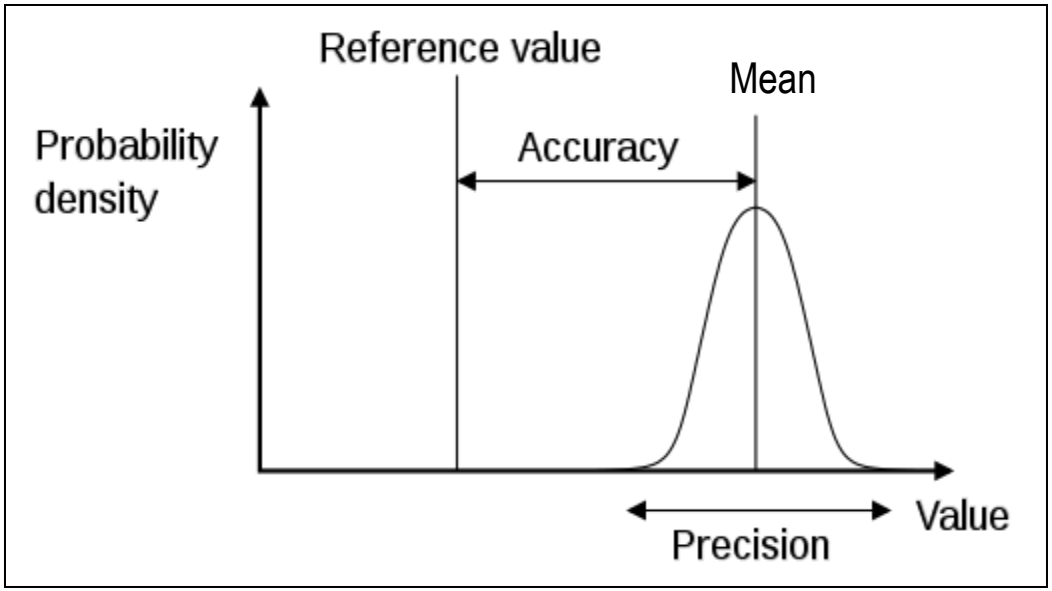
Introduction

To quantify the error measures, we need to perform repeated measurements on various subjects. Repeated measurements on the same person vary around the true value due to measurement error. To reduce the variance of each individual and to minimize environmental interference, it is better to perform consecutive measurements of the same person to perform the calculations of repeatability. The standard deviation of these repeated measurements of the same individual allows us to quantify the size of the measurement error, and it is named Standard Deviation Intrinsic to the Individual.

The mean is a measure of central tendency and corresponds to the arithmetic average of the values found. The standard deviation (SD) is a measure of dispersion of the individual measurements from the average. It is the square root of the variance; has the same unit of data.

Introduction



ACCURACY is the proportion of successes of a diagnostic test, that is, the degree of veracity; quantifies the closeness between the measurements and the true value.

PRECISION, also known as reproducibility and repeatability, as is the repeated measurements under unchanged conditions, you get the same results. The smaller the standard deviation of repeated consecutive measurements, the more accurate the test.

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Purpose

To analyze and compare the repeatability of various corneal tomography parameters from a corneal and anterior segment Scheimpflug-based tomography in normal and keratoconic eyes.

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Methods

Patients treated at the Renato Ambrósio Institute (Rio de Janeiro, Brazil) were invited to participate and voluntarily accepted. We studied 10 eyes randomly selected from 10 patients with normal corneas and 10 eyes randomly selected from 10 patients with keratoconus. Each eye was examined five consecutive times with the Pentacam HR (Oculus, Wetzlar, Germany). The standard deviation (SD [index of repeatability]) was calculated for the main parameters. Only p-values ≤ 0.05 were considered as statistical significant.

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Methods

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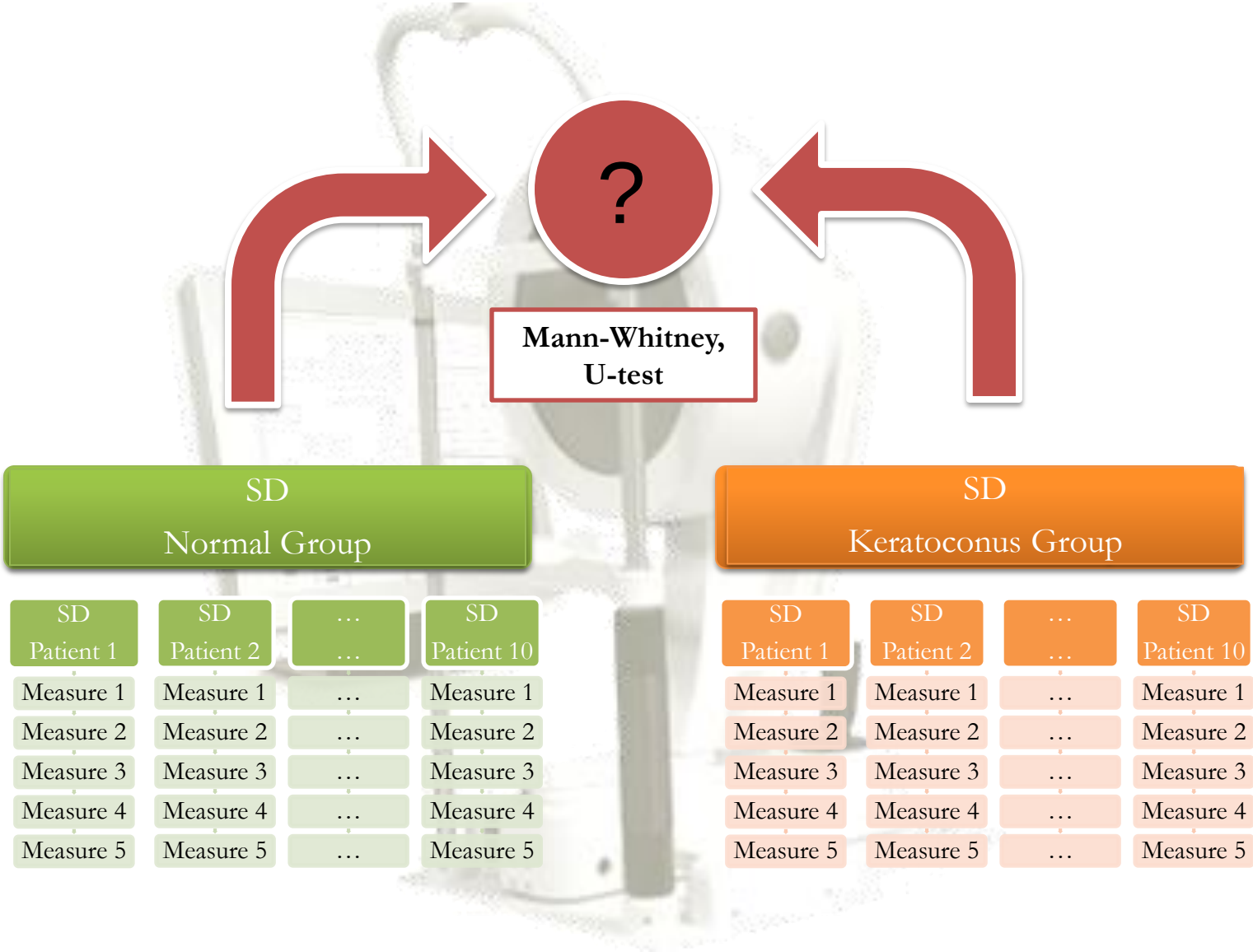

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Results

Table 1 – Mean of standard deviation in main parameters

Parameter	Mean of SD Normal Group	Mean of SD Keratoconus Group	p-value* (Mann-Whitney, U-test)
K1 (flat curvature) (D)	0,070	0,130	**0,014**
K2 (steep curvature) (D)	0,105	0,172	**0,045**
Axis (K1)	23,258	3,126	0,650
Astigmatism (D)	0,109	0,223	**0,011**
AC Depth (Anterior Chamber Depth)	0,020	0,015	0,496
AC Volume (Anterior Chamber Volume)	3,027	3,467	0,226
Ch. Angle (Chamber Angle)	2,104	1,661	0,450
BFS (Best Fit Sphere) Front 8mm:	0,010	0,012	0,521
BFS (Best Fit Sphere) Back 8mm:	0,024	0,030	0,791
RPI (Relative Pachymetric Progression) minimum	0,047	0,119	**0,016**
RPI (Relative Pachymetric Progression) maximum	0,074	0,179	**0,010**
RPI (Relative Pachymetric Progression) average	0,020	0,092	**0,008**
ART (Ambrosio relational thickness) minimum	76,485	32,984	0,226
ART (Ambrosio relational thickness) maximum	29,361	12,841	**0,002**
ART (Ambrosio relational thickness) average	12,613	11,901	0,762
Pachymetry Minimum	3,395	2,066	0,131
Pachymetry Apex	3,301	2,456	0,364

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Results

- The repeatability of measurements on keratoconic eyes was statistically significantly higher than normal eyes respectively (Mann-Whitney U test, $p < 0.05$) for the parameters: flat curvature (K1) 0.13 and 0.07; steep curvature (K2) 0.17 and 0.10; astigmatism 0.22 and 0.11; maximum Ambrosio relational thickness (ART max) 12.84 and 29.36; average of relative pachymetric progression (RPI ave) 0.09 and 0.02; minimum relative pachymetric progression (RPI min) 0.12 and 0.05; maximum relative pachymetric progression (RPI max) 0.18 and 0.07.

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Discussion

- Cornea and Anterior Segment Scheimpflug-Based Tomography are currently a key part for evaluation of corneal surgeries. Measurements of corneal pachymetry and tomographic accuracy and reproducibility are very important for corneal surgery. We need to know how accurate your measurements are, so how reliable is the test.
- Due to our purpose was to determine the repeatability of Pentacam and not to confirm the accuracy of the equipment, we did not compare the thickness values with that of ultrasonic pachymeter.
- Pentacam showed good repeatability. The repeatability of K1, K2, Astigmatism, RPI and ART maximum showed statically significant values (Mann-Whitney U test, $p < 0.05$). Pentacam provides reliable information for patients with normal eyes, however showed no statistically significant in Pachymetry and Anterior Chamber Depth (ACD) and Volume between normal and keratoconic eye.

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Conclusions

- Pentacam is a non-contact, quick, repeatable, easy to use instrument which makes it a potentially versatile tool for studying the corneal parameters.

- The tomographic measurements among keratoconic eyes present higher variability than in normal eyes.

- Nowadays, tomographic data are used for evaluation of keratoconus diagnosis and progression. It's important analysing the data very carefully and consider the repeatability of the device.

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