

COMPARISON OF OPTICAL AND ULTRASOUND CENTRAL CORNEAL PACHYMETRY

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ABSTRACT

In 100 eyes of 50 patients central corneal thickness was measured comparing optical to ultrasound pachymetry. With optical pachymetry the values were 1 to 40 micrometer (μm) lower in 64 eyes compared to ultrasound pachymetry. With ultrasound pachymetry the values were 1 to 18 μm lower in 26 eyes compared to optical pachymetry. In 10 cases no difference in pachymetry readings was seen between both techniques. The mean difference of optical pachymetry compared to ultrasound was 9 μm . Optical pachymetry is a no-touch form of corneal thickness measurement, with quick and precise central alignment, and can easily be done by a technician.

RÉSUMÉ

L'épaisseur de la cornée centrale a été mesurée dans 100 yeux de 50 patients en comparant une pachymétrie optique et échographique. Dans 64 yeux les valeurs en pachymétrie optique étaient inférieures de 1 à 40 micromètre (μm) à celles de l'échographie. Dans 26 yeux l'échographie donnait des valeurs inférieures de 1 à 18 μm à la pachymétrie optique. Dans 10 yeux les mesures étaient égales avec les deux techniques. La déviation moyenne de la pachymétrie optique comparée à l'échographie était de 9 μm . La pachymétrie optique est une méthode qui mesure l'épaisseur de la cornée en non-contact, avec alignement central rapide et précis, et peut être facilement faite par un technicien.

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SAMENVATTING

De centrale corneale dikte werd gemeten in 100 ogen van 50 patienten. De resultaten van optische en echografische pachymetrie werden vergeleken. Optische pachymetrie gaf lagere waarden van 1 tot 40 micrometer (μm) in 64 ogen. Ultrasound pachymetrie gaf lagere waarden van 1 tot 18 μm in 26 ogen. In 10 ogen waren de metingen gelijk. De gemiddelde afwijking was 9 μm in vergelijking met echografische pachymetrie. Met optische pachymetrie dient de cornea niet aangeraakt te worden. De meting kan gemakkelijk uitgevoerd worden door een technicus en de centrale alignatie is vlug en precies.

KEY-WORDS

Pachymetry, Central corneal thickness

MOTS-CLÉS

Pachymétrie, épaisseur cornéenne centrale

INTRODUCTION

Central corneal thickness (CCT) becomes more and more important as we understand its impact in counseling refractive surgery patients or deciding for enhancement procedures (8). Central corneal thickness decreases with prolonged contact lenswear (7), which might influence our attitude towards future refractive surgery candidates. Recently, the importance of central corneal thickness has been highlighted in measuring intra-ocular pressure and in differentiating normal tension glaucoma or ocular hypertension from chronic open-angle glaucoma (1,3,4,5).

Due to the importance of these facts, pachymetry becomes an essential tool in clinical practice. Until now the standard for pachymetry has been ultrasound. At this moment different devices allowing measurement of the central corneal thickness exist: ultrasound (3,4), optical (2,9,10) and Optical Coherence Tomography (1,6,9). This study compared measurements of central corneal thickness using two different instruments: optical and ultra-sound pachymetry.

MATERIALS AND METHODS

In 100 eyes of 50 patients central corneal thickness was measured. All patients had no history of or current eyedisease besides myopia or myopic astigmatism. Myopia ranged from -1.5 Diopter (D) to -17.5 D (mean:-7.5D) and astigmatism was seen in 30 patients ranging from 0.5D to 4 D (mean:1.48D). Contactlenses were discontinued for at least one week. After a complete ophthalmological examination, central corneal pachymetry was performed. Optical pachymetry was first done using the non-contact specular microscope of Topcon (Topcon SP-2000P). Central corneal thickness was measured 3 times and the average of these three readings was calculated. Afterwards a topical anaesthetic eyedrop was instilled in each eye and 3 measurements were taken using the ultrasound Ophthasonic Pachometer of Teknar with an ultrasound frequency of 1630m/sec. Results were plotted against each other.

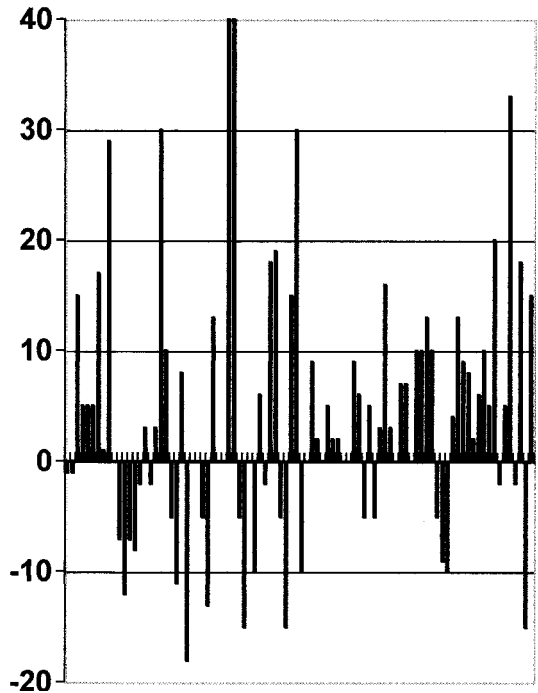


Fig 1. Graphic of results of 100 eyes deducting ultrasound pachymetry from optical Pachymetry. Y-axis in micrometer.

RESULTS

Mean CCT with ultrasound was 540 μm (range:470-615). Mean CCT with Topcon SP-2000P was 535 μm (range:440-610). In 64 eyes the central corneal thickness obtained with ultrasound pachymetry was thicker compared to the optical measurement. The differences ranged from 1 to 40 μm (mean:9.9 μm +-7). In 10 eyes results of CCT obtained with either method showed no differences. In 26 eyes CCT was thinner using ultrasound pachymetry, range 1 to 18 μm . (mean:7.9 μm +-7) (fig.1) For the whole group, the mean difference between the two methods was 9 μm . Results of both techniques were plotted against each other (fig.2). The formula of the obtained regression line was: Ultrasound pachymetry = 0.9301 Optical pachymetry + 56.659

DISCUSSION

As the knowledge of central corneal thickness becomes more important in clinical practice,

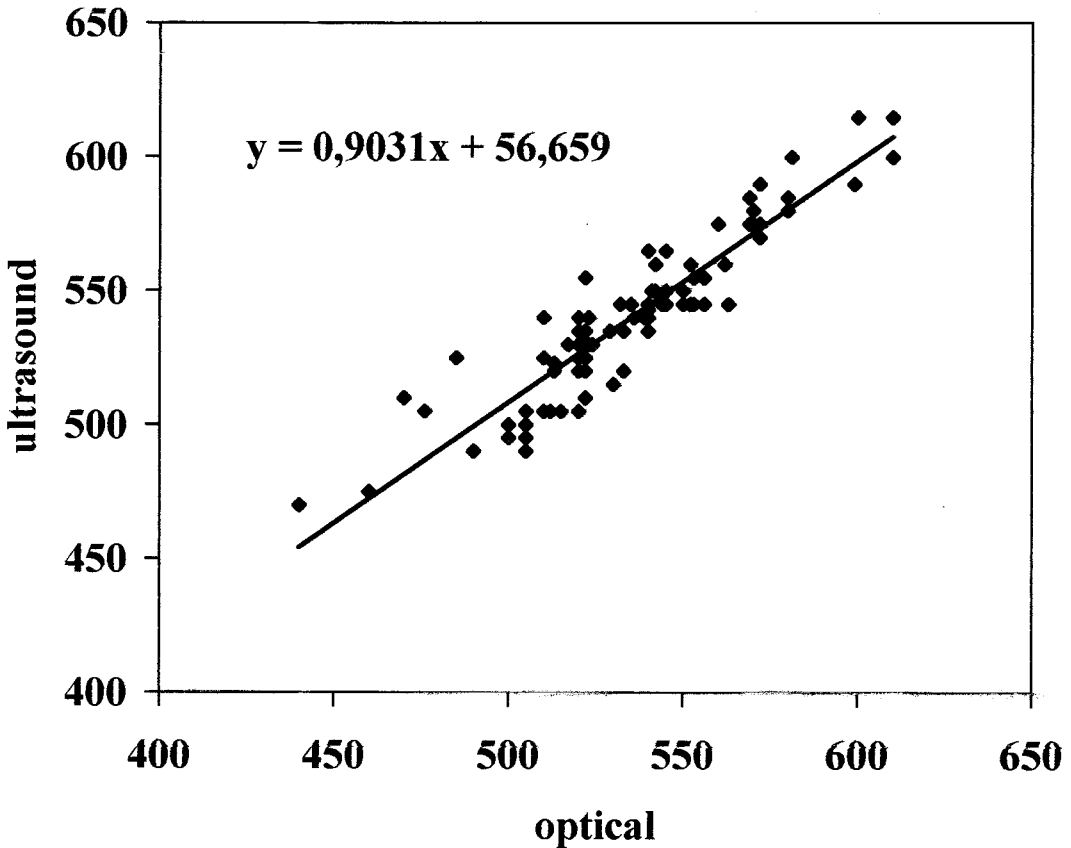


Fig 2. Scatter diagram of measurements of ultrasound and optical pachymetry with regressionline

different instruments allowing central corneal thickness measurements (1,2,4,8,9) come on the market. The gold standard for pachymetry is ultrasound and results of other devices should be compared from that perspective. In this study, the ultrasound pachymeter from Teknar was used. It has a calibration device which allows a deviation of 20 μm . This is higher than the mean difference of 9 μm between the two machines tested in this study. A mean deviation with optical pachymetry of 9 μm is less than 2% for an average corneal thickness of 550 μm .

The underestimation in 64% eyes with optical pachymetry correlates with those found by Bovell et al.(2) who found an underestimation of 32 μm between the Topcon specular microscope and ultrasound pachymetry in 40 eyes. Their results with the Topcon specular micro-

scope were more consistent as compared to ultrasound, even between several investigators. This might be due to bias induced by placing the ultrasound probe. In this study, central alignment was easy with the Topcon as this device projects a video image of the eye on a monitor, through which the pupilcentre is easily detected. Manual probe placement of ultrasound pachymetry might be influenced by misalignment of the probe as this pachymeter lacks a fixation light for precise control of patient gaze. Also the speed of sound may vary in oedematous tissue, which could be a disadvantage for ultrasound measurements. This better central alignment might explain why thinner measurements were obtained with optical pachymetry in 64 cases.

Other forms of non-contact pachymetry exists. Optical coherence tomography (OCT) (1,6,10)

is another method of non-contact pachymetry which gives a cross-sectional image of the cornea and could be of advantage for intra-operative and post-operative measurements of residual stromal bed measurements in refractive corneal procedures. Orbscan topography system gives a map of corneal thickness of the whole cornea. This system measured 23 to 28 μm greater compared to ultrasound according to Yaylali et al. (10). This overestimation seemed to be by a constant amount. These non-touch devices are however more expensive.

Advantages of non-contact pachymetry are: 1. The technique is easily mastered by a technician. 2. There is no risk of transmitting infectious diseases. 3. Central alignment is easily achieved. 4. Finally as it is a non-contact form of pachymetry, no topical anaesthesia is needed.

In conclusion we could state that Optical pachymetry, using Topcon SP 2000P is comparable to ultrasound pachymetry.

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