Gender differences in corneal thickness values

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Summary

The aim was to study gender differences in corneal thickness. We analysed the corneal thickness of 100 corneas of 100 healthy subjects (mean age 30.87±7.76 years; range, 19 to 54 years old) with the Orbscan Topography System II (Orbscan, Inc., Salt Lake City, UT. USA). The means of five consecutive measurements of the central and paracentral corneal thickness were obtained.

No significant differences in mean corneal thickness between women and men at central (p=0.477), nasal (p=0.247), superonasal (p=0.242), inferonasal (p=0.554), temporal (p=0.538), superotemporal (p=0.524) and inferotemporal (p=0.860) corneal locations were found. In sum, there are no differences in mean central and paracentral corneal thickness values between women and men.

Key words: Corneal thickness – Morphometry – Noncontact – Orbscan – Pachymetry

Introduction

Currently, corneal thickness examination can be carry out by means of different techniques such as ultrasonic pachymetry (Rapuano et al., 1993; Higgis et al.,1993; Terry et al.,1996; Longanesi et al.,1996; Lam and Douthwaite, 1998; Marsich and Bullimore, 2000; Chang et al., 2001; Sanchis Gimeno et al., 2001; Sanchis-Gimeno et al., 2003a, b), optical pachymetry (Hitzenberger et al., 1992; Herse and Yao, 1993; Marsich and Bullimore, 2000; Erickson et al., 2002), interferometry (Hitzenberger et al., 1992), specular pachymetry (Bovelle et al., 1999; Cho and Cheung, 2000; Modis et al., 2001; Sanchis-Gimeno et al., 2004a), optical coherence tomography (Bechmann et al., 2000; Feng et al., 2001) and other experimental techniques (Doughty and Zaman, 2000).

Nevertheless, the noncontact Orbscan Topography System allows study of the living corneal anatomy (Sanchis-Gimeno et al., 2003c; Sanchis-Gimeno et al., 2004b), making it easy to analyze gender differences in corneal thickness values across the entire corneal surface. Consequently, the aim of this paper was to analyze the gender differences in corneal thickness.

Material and Methods

We carried out a prospective study involving 100 eyes of 100 healthy patients. Written informed consent was obtained from all patients.

Inclusion criteria required subjects to be 18 or over and to have had stable refraction during the previous year. Exclusion criteria included prior intraocular surgery, corneal disease, topographic alterations, clinical corneal changes and Goldmann applanation tonometry ≥ 21 mm Hg. Patients with systemic disease, taking any kind of medication, with best corrected visual acuity ≤ 20/40, and contact lens wearers were also excluded.

The mean of five consecutive measurements of corneal thickness at the center of the cornea and at temporal, superotemporal, inferotempo-

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ral, nasal, inferonasal and superonasal locations, each located 3 mm from the visual axis, were carried out using the Orbscan Topography System II (Orbscan, Inc., Salt Lake City, UT. USA) by one physician (JASG).

Corneal thickness measurements were carried out from 10 a.m. to 11 a.m. to minimise the effects of diurnal corneal thickness variations (Lattimore et al., 1999; Liu et al., 1999; Harper et al., 1996).

Only one eye was studied for statistical analysis. The normality of the data in each group was confirmed using normal probability plots. Differences between data sample means were determined by a t-test. P values of less than 0.05 were considered to be statistically significant.

Results

The mean age was 31.02±8.15 years (range, 19 to 54 years) in women and 30.42±7.56 years (range, 19 to 47 years) in men (p=0.730; Student´s t-test).

The mean manifest spherical equivalent was -5.76±3.74 diopters (range, +1.25 to -17 diopters) and -5.29±3.72 diopters (range, +0.75 to -18 diopters) in women and men respectively (p=0.636; Student´s t-test).

Table 1 shows the corneal thickness values obtained. No significant differences in mean values between women and men were found (Table 1). The minimum corneal thickness was consistently found at the center of the cornea in both women and men, the central cornea being thinner than any 6 paracentral or peripheral portions with statistical significances (p<0.001 in both genders). The maximum corneal thickness was often found at the superonasal location in women (n=29, 58%) and men (n=25, 50%).

Figure 1 shows the individual differences between the central corneal thickness and the minimum paracentral coneal thickness, and between the central corneal thickness and the maximum paracentral corneal thickness. The mean difference between the central thickness and the maximum thickness obtained in the paracentral cornea was 109±23 µm in women while it was 106±31 µm in men. The mean difference between the central thickness and the minimum thickness obtained in the paracentral cornea was 50±18 µm in women and 57±35 µm in men.

Table 1.- Corneal thickness values obtaines in women and men (microns)

	Women		Men		
	Mean±SD	Range	Mean±SD	Range	p-value *
Central	546±31	480 to 606	541±25	405 to 601	0.477
Nasal	640±34	584 to 698	632±32	562 to 697	0.247
Superonasal	648±31	582 to 711	640±32	574 to 717	0.242
Inferonasal	630±39	558 to 721	626±29	553 to 683	0.554
Temporal	605±34	526 to 670	601±35	523 to 674	0.538
Superotemporal	631±32	547 to 699	627±33	549 to 703	0.524
Inferotemporal	609±35	549 to 704	610±32	538 to 674	0.860

* Student's t-Test between women and men

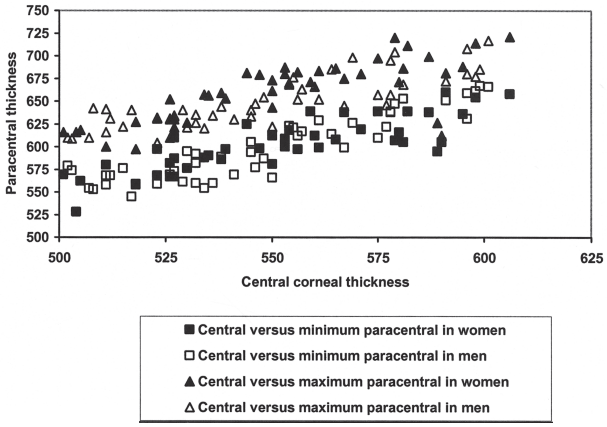

Fig. 1.- Individual differences between the central and the minimum paracentral corneal thickness, and between the central and the maximum paracentral corneal thickness (microns).

Discussion

In our work we present the results of the central and paracentral corneal thickness measurements using the noncontact Orbscan System. Recently, different authors have analysed corneal thickness using the Orbscan System (Yaylali et al., 1997; Lattimore et al., 1999; Liu et al., 1999; Liu and Pflugfelder, 1999, 2000; Marsich and Bullimore, 2000; Modis et al., 2001; Sanchis Gimeno et al., 2003c, 2004b). With this instrument, researchers have a method to measure corneal thickness across the entire corneal surface, which should aid in the study of the peripheral cornea (Marsich and Bullimore, 2000).

In the present study we found that the central cornea had the lowest mean thickness and an increase in corneal thickness toward the peripheral cornea was recorded. The same has been observed by other authors using the Orbscan System (Liu et al., 1999; Liu and Pflugfelder, 1999, 2000; Marsich and Bullimore, 2000; Sanchis Gimeno et al., 2003c, 2004b).

Lam and Douthwaite (1998) demonstrated an increase in corneal thickness toward the more peripheral regions using an ultrasound pachometer mounted on a X-Y plate. Doughty and Zaman (2000) observed that the range of values reported in the different studies indicated that more peripheral thickness values have been reported to be 9-52% greater (with an average of 21%) than central corneal values. Nevertheless, in-depth analysis of our results shows that the superonasal cornea is the thickest paracentral region, our results being consistent with pre-

vious studies (Liu et al., 1999; Liu and Pflugfelder, 1999, 2000; Marsich and Bullimore, 2000; Sanchis Gimeno et al., 2003c, 2004b).

Until recently (Ericksson et al., 2002), an explanation for these increased values of the superior cornea were attributed to the fact that the superior cornea is chronically hypoxic, this hypoxia being caused by partial coverage of the superior cornea by the upper eyelid. However, Ericksson et al. (2002) did not find that the difference between the superior and inferior cornea was directly related to the chronic hypoxia caused by partial coverage of the superior cornea by the upper eyelid.

On the other hand, the results of Lam and Douthwaite (1998) differed from those presented by the majority of authors because these authors observed that there were no significant regional differences in midperipheral or peripheral thickness.

Analysis of the differences in thickness measured at seven corneal sites showed that the central cornea consistently had the lower thickness values. Nevertheles, our central corneal thickness results gave lower values on the whole when compared to those presented by other authors using the Orbscan Topography System (Yaylali et al., 1997; Liu et al., 1999; Liu and Pflugfelder, 1999, 2000; Marsich and Bullimore, 2000; Modis et al., 2001; Sanchis Gimeno et al., 2003c, 2004b).

Analysis of our results did not reveal significant differences in corneal thickness values between females and males at each seven corneal regions studied. Previously, other studies have not detected differences in corneal thickness between females and males (Rapuano et al., 1993; Bron et al., 1999; Price et al., 1999). Nonetheless, female corneal thickness values must be affected by sexual hormones because Sorrentino et al. (1998) analysed central corneal thickness in postmenopausal women and observed a 16.6% increase in thickness three months after starting hormone replacement therapy, this effect probably being caused by the trophic effect of the estrogen.

In the present study we analysed only one eye per patient with a view to eliminating the possible intra-subject effect that would appear if both eyes of the same patient were studied (Fisher and Van Belle, 1993). Thus, we could not compare left versus right differences in corneal thickness in the same subject. Other authors have analysed the differences between the left and right corneas of the same individuals and did not find significant differences (Rapuano et al., 1993; Bron et al., 1999). Nevertheless, it is known that the findings in the left eye are likely to be similar to those in the right eye of the same individual (Murdoch et al., 1998).

In sum, our study has revealed that there are no significant differences in mean central and paracentral corneal thickness values between women and men.

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