Assessment of central corneal thickness in extreme myopic eyes

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SUMMARY

Purpose: To study the central corneal thickness values in two groups of extreme myopic patients (cycloplegic spherical equivalent refraction ≥ -12 diopters) and in a control group.

Methods: We carried out ultrasonic pachymetry with the DGH 2000 AP ultrasonic pachymeter (DGH Technology, Inc., San Diego, CA, USA). Group I (n=45) was made up of patients with spherical equivalent refraction ranging from -12.00 to -18.00 diopters; group II (n=25) with spherical equivalent refraction > -18.00 diopters, and the control group (n = 34) was made up of patients with spherical equivalent refraction ranging from -0.25 to -3.00 diopters.

Results: Mean central corneal thickness (mean±SD) was 531±42 µm, 551±52 µm and 538±35 µm in groups I, II and controls, respectively (p=0.193). No significant differences between women and men were found in group I (p=0.314), group II (p=0.071) and the control group (p=0.113). No significant differences among age subgroups were found in group I (p=0.989), group II (p=0.641) or in the control group (p=0.397).

Conclusions: In extreme myopic eyes there is a slight tendency for central corneal thickness to increase in the presence of higher degrees of myopia. Nevertheless, central corneal thickness in extreme myopic patients is similar to that noted in non-extreme myopic patients.

Key words: Extreme myopia – Morphometry – Ultrasonic – Pachymetry – Corneal thickness

INTRODUCTION

Refractive surgery by means of stromal ablation with the excimer laser has kindled great interest in corneal anatomy because before carrying out laser in situ keratomileusis it is essential to carry out a preoperative central corneal thickness measurement in order to avoid the possible risk of postsurgical keratectasia (Wang et al., 1999; Schmitt-Bernard et al., 2000).

At present, whenever it is possible to combine laser in situ keratomileusis with intraocular lens implantation to correct extreme myopia (Güell et al., 1999; Zaldívar et al., 1999), it is very important to study the corneal thickness of extreme myopic eyes.

Nevertheless, we have not found specific studies addressing central corneal thickness in extreme myopic eyes, possibly because population-based epidemiological studies have shown that extreme myopics (spherical equivalent refraction ≥ -10.00 diopters) account for less than 0.5% of the population (McCarty et al., 1997).

Following on from this, the aim of the present work was to study central corneal thickness in extreme myopic patients and in a "*normal*" control group using ultrasonic pachymetry.

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Materials and methods

We carried out a prospective study in accordance with the principles of the Helsinki Declaration. Detailed consent forms were obtained from each of the patients.

Exclusion criteria included age < 18 years, active corneal disease, active ocular disease, systemic disease, previous corneal or ocular surgery (including retinal photocoagulation), central applanation tonometry ≥ 21 mm Hg, and the use of any kind of ophthalmic and systemic drugs. Patients who had been treated previously for ocular hypertension or glaucoma were not included. Contact lens wearers and patients with non-stable refraction in the course of the previous year were also excluded.

Extreme myopic patients were subdivided into groups I and II. Group I was made up of patients with cycloplegical spherical equivalent refraction ranging from -12.00 D to -18.00 D (n = 45). Group II was made up of patients with cycloplegical spherical equivalent refraction > -18.00 D (n = 25).

As a "normal" control group, we analysed 34 patients (n=34) with cycloplegical spherical equivalent refraction ranging from - 0.25 to - 3.00 D.

Corneal thickness measurements were carried out by the same physician (JCI). After anaesthetising the cornea with oxybuprocaine 0.4% tear drops each patient was asked to blink before corneal thickness measurement to avoid any bias due to corneal drying. The patient was required to look straight ahead while the pachymeter probe was placed on the centre of the cornea. We measured central corneal thickness with the DGH 2000 AP ultrasonic pachymeter (DGH Technology, Inc., San Diego, CA, USA), using the same method that previously employed (Sanchis Gimeno et al., 2001). The ultrasonic probe was sterilized with alcohol after each patient.

Examinations were performed at the same time of the day (the interval between 10:00 and 11:00 AM) to avoid diurnal variations in corneal thickness (Harper et al., 1996; Lattimore et al., 1999).

The pachymeter was placed in the excimer laser room in order to establish standard conditions of temperature and relative humidity. Temperature ranged from 18º to 22º C and relative humidity ranged from 38% to 45%.

Statistical analysis was carried out using one eye per patient. The statistical analyse used were the Kolmogorov-Smirnov test, after which different parametric and non-parametric tests were applied. *P* values of less than 0.05 were considered to be statistically significant.

Results

Group I:

In this group, 45 eyes from 45 patients were studied. Mean spherical equivalent refraction (mse) was - 14.80±1.54 D (ranging from -12.00 to -18.00 D). Mean age was 33.00±8.00 years (ranging from 21 to 49 years). There were 22 women (48.9%) with a mse of -14.88±1.66 D and a mean age of 30.68±8.12 years (ranging from 21 to 47 years). There were 23 men (51.1%) with a mse of -14.73±1.45 D and a mean age of 35.22±7.39 years (ranging from 24 to 49 years).

Mean central corneal thickness was 531±42 µm (ranging from 425 µm to 621 µm).

The women had higher mean central corneal thickness values than men (Table 1). Nevertheless, the differences between women and men were not significant (*t*-test; p=0.314).

Group II:

The mse in this group of 25 eyes (25 patients) was -20.70±1.89 D (ranging from -18.25 to -24.00 D). Mean age was 37.16±9.25 years (ranging from 23 to 54 years). There were 17 women (68.0%) with a mse of -20.17±1.57 D and mean age of 36.41±8.65 years (ranging from 23 to 50 years). Eight patients were men (32.0%), with a mse of - 21.81±2.14 D and mean age of 38.75±10.85 years (ranging from 23 to 54 years).

Mean central corneal thickness was 551±52 µm (table 1). Differences in the mean values between women and men were not significant (Mann-Whitney test; p=0.071).

Table 1.- Central corneal thickness values obtained in group I, group II and control group (µm).

	Group I			Group II			Control group		
	All	Women	Men	All	Women	Men	All	Women	Men
n	45	22	23	25	17	8	34	16	18
Mean	531	538	525	551	562	527	538	545	525
SD	42	45	40	52	58	25	35	28	34
Minimum	425	479	425	450	450	479	480	515	480
Maximum	621	621	616	675	675	560	600	600	600

Control group

Thirty-four eyes from 34 patients were studied. The mse was -2.16±0.84 D (ranging from -0.25 to -3.00 diopters). The mean age for the group was 28.57±4.82 years (ranging from 21 to 38 years). There were 16 women (47.05%) with a mse of -2.20±0.68 D and mean age of 29.18±5.06 years (ranging from 21 to 38 years). Eighteen were men (52.94%), with a mse of -2.00±0.96 D and mean age of 27.52±3.44 years (ranging from 23 to 38 years).

The central corneal thickness values of this group can be seen in table 1. The differences between sexes were not significant (*t*-test; p=0.113).

No significant differences as a function of the age of the participants were noted (Table 2).

Finally, the differences in mean central corneal thickness among groups I, II and controls were not significant (one-way Anova test; p=0.193). Also, there were no significant differences in mean corneal thickness between group I and II (*t*-test; p=0.094).

Table 2.- Mean central corneal thickness values as a function of age of participants (µm(SD).

	≤ 28 years	29-36 years	≥ 37 years	p-value
Group I	531±43	533±56	531±31	0.989 *
Group II	559±43	530±57	559±54	0.641 **
Control Group	544±40	531±28	546±16	0.397 **

* One-way Anova test; ** Kruskal-Wallis test

Discussion

To our knowledge, this is the first study to report the values of central corneal thickness specifically in extreme myopic patients.

We used ultrasonic pachymetry in order to obtain central corneal thickness values. Ultrasonic pachymeters require corneal contact and use the Doppler effect to determine thickness. Nevertheless, ultrasonic pachymetry requires exhaustive previous training because a high degree of pressure must be avoided as this would lead to an underestimation of corneal thickness. Furthermore, using ultrasonic pachymetry Bovelle et al. (1999) reported significant differences in the mean values of central corneal thickness that had been obtained by two different practitioners in the same sample. For this reason, and as followed in recent studies (Fakhry et al., 2002), here pachymetric measurements were carried out by one investigator experienced in ultrasonic pachymetry.

We excluded patients with tonometric or glaucomatous pathologies because it is known that patients with ocular hypertension present higher corneal thickness values than healthy patients (Copt et al., 1999; Bron et al., 1999; Shah et al., 1999). Furthermore, patients with normal tension glaucoma give lower corneal thickness values than healthy subjects (Copt et al., 1999; Shah et al., 1999).

Corneal thickness is subject to variations due to a multitude of physiological and pathological causes. One of these causes is corneal hydration (Liu and Pflugfelder, 1999).

We believe that differences in environmental conditions, such as temperature and relative humidity, when carrying out corneal morphometric studies can affect corneal hydration. This is why we carried out ultrasonic pachymetry in the excimer laser room with a temperature ranging from 18º to 22º C and with relative humidity between 38% and 45%.

Several studies using ultrasonic pachymetry in non-extreme myopic patients have found similar results to those obtained here (Longanesi et al., 1996; Terry and Ousley, 1996; Bovelle et al., 1999; Copt et al., 1999; Bron et al., 1999; Shah et al., 1999; Price et al., 1999; Sanchis Gimeno et al., 2001; Fakhry et al., 2002) but in the present work a slight tendency for central corneal thickness to increase was observed in the presence of higher degrees of myopia; in spite of this, in our study this increase was not accompanied by any significant difference in mean values between group I and II. Previously, Price et al. (1999) failed to find any correlation between central corneal thickness and the degree of myopic refractive error.

Our results did not reveal significant differences in mean central corneal thickness values between women and men. Nevertheless, in a previous study we observed that hyperopic women had higher corneal thickness values than hyperopic men (Sanchis Gimeno et al., 2001).

We did not find differences as a function of the age of the participants, possibly because in our work the patients were young, with a relatively small age range. Only studies carried out on large samples can confirm whether or not there is a decrease in central corneal thickness as a function of ageing. However, even then the results obtained in such studies seem to be contradictory (Foster et al., 1998; Price et al., 1999).

In sum, ultrasonic pachymetry showed that central corneal gross anatomy in extreme myopic patients is similar to that presented by patients not affected by extreme myopia. Nevertheless, there is a slight tendency for central corneal thickness to increase in the presence of higher degrees of myopia.

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