

Evaluation of corneal thickness alterations during menstrual cycle in productive age women

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Purpose: To determine the change in corneal thickness through different phases of menstrual cycle in women who are in their productive age. **Materials and Methods:** Fifty healthy women with normal past medical history were enrolled in this prospective study. Central corneal thickness was measured with ultrasound pachymeter three times during a menstrual cycle: Beginning of the cycle (days 1-3), ovulation time, and at the end of cycle (days 27-32). We confirmed ovulation time with determining a peak in luteinizing hormone in urine. To avoid the diurnal variation of the corneal thickness which is well recognized, we checked all our subjects at 10 in the morning. **Results:** In days 1 to 3 of menstruation, mean corneal thickness was 541.40 ± 11.36 and 540.82 ± 11.70 microns for left and right eyes respectively. At ovulation time the mean thickness changed to 556.50 ± 7.11 and 555.98 ± 7.26 microns for left and right eyes respectively, and at the end of the cycle, the corneal thickness turned in to 536.38 ± 12.83 and 535.48 ± 13.08 microns for left and right eyes respectively. The difference of corneal thickness was statistically significant relating to the different stages of menstrual cycle. **Conclusion:** The thickest cornea during the menstruation cycle is achieved at the ovulation time and the thinnest at the end of the cycle and this should be taken in to account whilst plan to do a corneal refractive surgery.

Key words: Corneal thickness, menstrual cycle, pachymetry, refractive surgery

Laser refractive surgery is becoming increasingly popular as people are turning to alternative to traditional spectacles and contact lenses for vision correction. The corneal thickness is one of the important factors for inclusion of patients for refractive surgery and its outcome.^[1-4]

Considering the previous studies, corneal thickness changes occur in women during the menstrual cycle.^[5-9] These cyclic changes are attributed to the hormonal influences, as suggested by the recent demonstration of estrogen receptors in the human cornea.^[10-13]

In this study, we measured the central corneal thickness in a group of 50 healthy women in productive age for three times during their menstrual cycle using an ultrasonic pachymeter, by confirming the ovulation time with urine test.

Materials and Methods

We recruited 50 women among employees of our hospital. The range of their ages was 21 to 43. All subjects had regular menstrual cycles of about 24 to 32 days; they had no refractive errors, no ophthalmic or hormonal diseases and diabetes. In addition, the subjects who are using oral or parenteral contraceptive drugs excluded from study.

Self-reported history of menstrual cycle by participants documented; they were asked to contact us 3 times, on days

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Manuscript received: 22.02.11; Revision accepted: 21.01.12

Access this article online

Website:
www.ijo.in

DOI:
10.4103/0301-4738.151463

Quick Response Code:



1 to 3 of the cycle and at ovulation time and on days 27 to 32 of the cycle. For determining the time of ovulation, we utilized Luteinizing hormone (LH) ovulation prediction urine test. This test was done on days 11 to 15 of subjects' menstrual cycles. When the test became positive, (it meant that the LH peak occurred and it was ovulation time), patients underwent pachymetry within 24 h. To avoid the diurnal variation of the corneal thickness which is well recognized, we checked all our subjects at 10 am. This manages to obviate the confounding factor of diurnal variation of corneal thickness in our study.

We used an ultrasonic pachymeter to determine the corneal thickness (Echoscan US-4000, Nidek). Three measurements made at each exam for both eyes, and the mean value recorded. The central corneal thickness determined at the beginning of the cycle, within 24 h after the LH peak (ovulation) and at the end of the cycle.

In order to compare the corneal thickness between different times, we used paired samples *t*-test, as the thickness of the cornea shows a normal distribution in the general population^[14,15] and the distribution of our data proved to fit normal curve. Independent-samples *t*-test utilized to compare left and right eyes. Probability values of less than 0.05 considered statistically significant. In processing our data, the difference among corneal thicknesses should also be evaluated by measures analysis of variance (ANOVA) and we finalized our final results. This could be a good way to generalize our test results.

Results

The mean values of the central corneal thickness at days 1 to 3 was 541.40 ± 11.36 and 540.82 ± 11.70 microns respectively for left and right eyes (mean \pm standard deviation). At ovulation,

the corneal thickness was 556.50 ± 7.11 and 555.98 ± 7.26 for left and right eyes. The mean values on days 27 to 32 were 536.38 ± 12.83 and 535.48 ± 13.08 microns for left and right eyes [Fig. 1].

Corneal thickness was not statistically different between right and left eyes at any time ($P > 0.05$ for all comparisons). Statistical analysis revealed a significant difference of corneal thickness at days 1 to 3 and ovulation phase ($P < 0.001$). The difference was statically significant comparing means of ovulation and days 27 to 32 ($P < 0.001$). There was also a significant difference between days 27 to 32 and days 1 to 3 ($P = 0.012$). Fig. 1 demonstrates corneal thickness distribution for right and left eyes at different phases of menstrual cycle.

Discussion

Changes in the corneal thickness during the menstrual cycle are reported in previous studies. However, no agreement has been reached with regard to when the cornea is thickest.

Soni PS,^[5] studied in a group of 8 women and reported that the minimal corneal thickness happened just before ovulation and the thickest cornea was at the beginning and end of the menstrual cycle. The study of Feldman *et al.*,^[6] showed similar results. His group included 11 women and he reported that the cornea was thinnest just before ovulation but he did not find correlation between the blood level of hormones and corneal thickness.

The study of Kiely *et al.*,^[7] included 6 women and showed that the cornea was thickest on the second day of the cycle, at ovulation time and on day 21 of the cycle. Leach *et al.*,^[8] studied in a group of 6 women and found that the greatest corneal thickness happened just before ovulation that paralleled the bimodal nature of plasma estrogen levels. Giuffrè *et al.*,^[9] studied in a group of 16 women and reported that the cornea is thinnest at the beginning of the cycle and thickest at the end and these changes could be secondary to hormonal influences.

Thus, considering these conflicting results, it is unclear when the cornea has its greatest or lowest thickness in a menstrual cycle. These differences may have occurred because these studies used optical pachymeters attached to slit lamp that

are not exact as compared with ultrasonic pachymeter.^[16,17] In addition, they determined the time of ovulation by measuring basal body temperature. Giuffrè *et al.*,^[9] used ultrasonic pachymeter and LH test to determine the ovulation time but his subjects were fairly few.

We studied the thickness of the central cornea by using an ultrasonic pachymeter that is more exact than the optical pachymeters.^[16,17] We used a sensitive urine test to recognize the LH peak as an indicator of ovulation. In addition, we recruited 50 women of productive age and found the thickest size of cornea is at ovulation and the thinnest at the end of the menstrual cycle.

These changes could be secondary to hormonal influences; estrogen receptors can be found in human corneas, suggesting that estrogen may have a role in corneal physiology;^[9] Another study demonstrated that there is a significant change in corneal hydration during the normal menstrual cycle. Apparently, the change is associated with the effects of estrogen more than with progesterone. The authors believe one might assume ready access of these hormones via the aqueous humor or tear film because of their high lipid solubility. They suggest that another possibility would be an indirect action of hormones on the cornea via their effects on tear film osmolarity.^[8]

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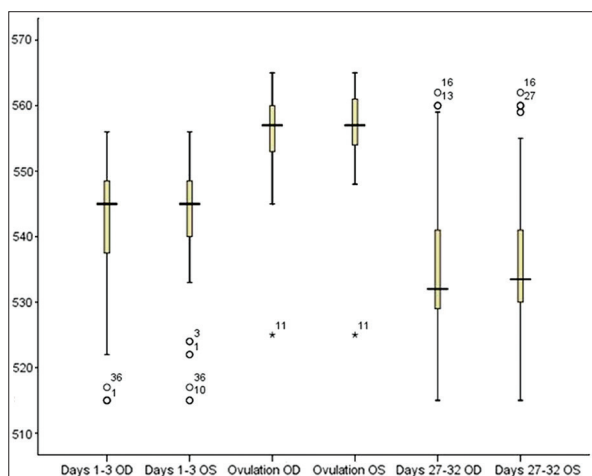


Figure 1: Corneal thickness distribution for right and left eyes at different phases of menstrual cycle

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Cite this article as: Ghahfarokhi NA, Vaseghi A, Ghahfarokhi NA, Ghoreishi M, Peyman A, Dehghani A. Evaluation of corneal thickness alterations during menstrual cycle in productive age women. *Indian J Ophthalmol* 2015;63:30-2.

Source of Support: Nil. **Conflict of Interest:** None declared.