ORIGINAL RESEARCH PAPER

Ophthalomology

A CROSS-SECTIONAL ANALYSIS OF THE IMPACT OF MENSTRUAL CYCLE PHASES ON CENTRAL CORNEAL THICKNESS IN INDIAN WOMEN.

KEY WORDS: Central corneal thickness, Menstrual phase, Ovulation Phase, Refractive surgery.

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ABSTRACT

Introduction: An important consideration for refractive surgeries is corneal thickness. Cornea is a hormone-responsive tissue. Central corneal thickness (CCT) varies with menstrual phase. Cornea is thickest around ovulation and thinnest at menses or late luteal phase. **Aim:** To determine the different values of CCT & timing for performing refractive surgery. **Materials & Methods:** Hospital based cross -sectional study was conducted among 50 women, between 15-45 years (Menarche to Menopause) were examined in the Department of Ophthalmology ,Tertiary care Hospital, Bangalore Rural. Menstrual history was collected & routine Ophthalmic examinations was done. **Results:** The mean age of the participants was 27.6 + 3.3 years (range: 18–45 years). The mean duration of the cycle was 28.2 + 2.6 days (range: 25–34 days). The mean CCT of right eye is 534±10.43µm & left eye is 539.44±10.76µm in follicular phase, mean CCT of right eye is 553 ±11.17µm & left eye is 554.32 ±7.46µm in ovulatory phase. **Conclusion:** CCT being significantly higher during ovulation phase, menstrual history seems to be an important consideration during refractive surgery workup.

INTRODUCTION

An important consideration for refractive surgeries is corneal thickness.[1] Cornea is a hormone-responsive tissue.[2] Central corneal thickness (CCT) varies with menstrual phase. Cornea is thickest around ovulation and thinnest at menses or late luteal phase.[3]

Refractive procedures from radial keratotomy to the modern-day laser-assisted surgeries, have evolved over the years. Cornea expresses receptors for estrogen, progesterone, and other gonadal hormones in multiple layers (epithelium, stroma, endothelium).[3,4] Consequently, physiological fluctuations in sex hormones (as occur during the menstrual cycle) can affect corneal properties. In women, fluctuating hormone levels due to menstruation, pregnancy, and menopause can influence the corneal thickness.[3] Previous studies have observed that CCT varies with menstrual phase.

Physiological changes in the hormone milieu, oral contraceptive use, or hormonal replacement therapy can influence the alterations in the central corneal thickness. To monitor these physiological events, such as identifying the ovulation timings include urinary luteinizing hormone (LH) levels & basal body temperature monitoring.[4,5,6] Central cornea was thinnest at beginning of the cycle and increases at the ovulation and end of the cycle. Corneal refractive surgery requires precision calculations.

Many reports find the cornea to be thickest around ovulation and thinnest at menses or late luteal phase.[3,6]Significant CCT increases (≈5–6%) at mid-cycle in Indian population. Such changes likely reflect estrogen-driven increases in corneal hydration, possibly mediated by corneal endothelial function or systemic fluid shifts.[1,4]

Objectives

- To evaluate the variations in central corneal thickness (CCT) across different phases of the menstrual cycle (Follicular, Ovulatory, and luteal).
- To determine the phase of the menstrual cycle during which CCT is highest, and assess its significance in the context of refractive surgery planning.
- To emphasize the importance of menstrual history as a clinical consideration during preoperative evaluation for refractive procedures.

MATERIALS & METHODS

A hospital based cross -sectional study was conducted among 50 women, between 15-45 years (Menarche to Menopause) were examined in the Department of Ophthalmology in a tertiary care hospital, Bangalore Rural, Karnataka, India. Study was conducted for 6 months from March 2024 to August 2024. Simple random sampling method was used to select the study subjects. Institutional, Scientific & Ethical Clearance was taken.

Inclusion Criteria

1) Women of menarche to menopause {15 to 45 years of age} will be included

Exclusion Criteria

1) Pregnant Women.
2) Women with corneal dystrophies and degeneration's.
3) Women with gynaecological problems.
4) Women with diabetes mellitus

Self reported dates of menstrual cycle by participants were noted, but ovulation was confirmed by Basal Body temperature.

50 patients who met the criteria were taken as study samples after obtaining informed consent. Data was collected by taking menstrual history & other relevant information. All participants underwent comprehensive Ophthalmological examination, which includes best corrected visual acuity using snellen visual acuity chart, anterior segment examination of eye using slit lamp biomicroscope. CCT was measured at pre-ovulatory, ovulatory & post-ovulatory intervals using pachymetry (Quantel medical compact touch). Fundus examination was done to rule out any posterior segment disease.

Statistical analysis was done by using SPSS (Statistical Package for Social Sciences) version 29. Descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation. Bar charts was used for visual representation of the analysed data.

RESULTS

Out of 50 study subjects examined during different phases of their menstrual cycle. The mean age of the participants was 27.6 + 3.3 years (range: 18–45 years). The mean duration of the cycle was 28.2 + 2.6 days (range: 25–34 days).

Table 1- Association of Different Phase of Menstrual Cycle & Mean Central Corneal Thickness.

Phases of the menstrual cycle	Mean Central Corneal thickness (in µm)		T-test value	P - Value
	Right Eye (n=50)	Left Eye (n=50)		
Follicular phase (1st-3rd day)	534±10.43	539.44±10.76	-2.566	0.012
Ovulation phase (14th-16th day)	553.58±11.17	554.32±7.46	-0.389	0.698
Luteal phase (17th- 28th day)	540.48±9.19	538.06±10.52	1.225	0.223

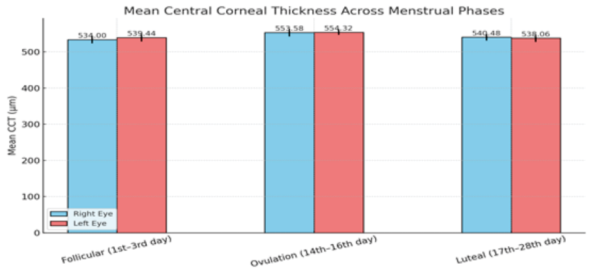

Fig 1-Variation of CCT in Different Menstrual Phase

In our study, we found that the mean CCT of right eye is 534±10.43µm & left eye is 539.44±10.76µm in Follicular phase. Association between Follicular phase & mean corneal thickness shows statistical significance (p-0.012). Mean CCT of right is eye 553.58±11.17µm & left eye is 554.32±7.46µm in ovulatory phase and in luteal phase mean CCT of right eye is 540.48±9.19µm & left eye 538.06±10.52µm. The Mean CCT values were higher during ovulation compared to the beginning and end of the menstrual cycle.

Table 2- Comparison of Mean CCT of Both the Eyes

Comparison of the mean central corneal thickness (CCT) of the right and left eye (in µm) during the different phases of menstrual cycle.					
Eye	Comparison of different phases of measurements of CCT	Means of paired diffe-rences of CCT	Paired t-test	Degree of freedom (df)	P-Value
Right	Between follicular and ovulatory phase	-19.58	-7.272	49	<0.001
	Between ovulatory and luteal phase	13.01	10.085	49	<0.001
Left	Between follicular and luteal phase	- 6.48	3.739	49	<0.001
	Between follicular and ovulatory phase	-14.88	-9.183	49	<0.001
	Between Ovulatory and luteal phase	16.26	9.091	49	<0.001
	Between follicular and luteal phase	1.38	-0.763	49	0.449

In our study we found that, in the right eye, the mean central corneal thickness (CCT) significantly decreased by 19.58 µm between the follicular and ovulatory phase ($t = -7.272$, $p < 0.001$). This was followed by a significant increase of 13.01 µm between the ovulatory and luteal phase ($t = 10.085$, $p < 0.001$). The difference between follicular and luteal phases was not statistically significant (mean = 1.38 µm, $t = -0.763$, $p = 0.449$).

In the left eye, a similar trend was observed. The CCT decreased by 14.88 µm between the follicular and ovulatory phase ($t = -9.183$, $p < 0.001$) and then increased by 16.26 µm between ovulatory and luteal phase ($t = 9.091$, $p < 0.001$). Additionally, the difference between follicular and luteal phases was statistically significant, with a mean change of -6.48 µm ($t = 3.739$, $p < 0.001$).

DISCUSSION

In the present study, we observed significant cyclic variations in central corneal thickness (CCT) during the menstrual cycle. The mean CCT was highest during the ovulatory phase for both eyes—553.58±11.17 µm in the right eye and 554.32±7.46 µm in the left eye—compared to the follicular and luteal phases. This trend was consistent with previous studies reporting hormonal influence on corneal hydration and structure.

Ghahfarokhi et al. also reported significant CCT changes during the menstrual cycle, with a peak in thickness during the ovulatory phase, supporting the hypothesis of estrogen-induced stromal hydration and collagen modulation.[1] Similarly, Mishra et al. found that CCT increased around ovulation and then decreased in the luteal phase, closely aligning with our findings.[5]

Tripathi and Prabha reported statistically significant CCT variations across all three phases, observing maximum CCT during mid-cycle, consistent with our results where the CCT increased by 19.58 µm in the right eye and 14.88 µm in the left eye from the follicular to ovulatory phase ($p < 0.001$).[4] In contrast, the difference between the follicular and luteal phase was not significant in the right eye (mean = 1.38 µm, $p = 0.449$), suggesting a return to near-baseline values, while a significant difference was still observed in the left eye (mean = -6.48 µm, $p < 0.001$), indicating mild asymmetry in physiological response.

The findings by Vyas et al. further support these fluctuations, reporting thickest corneas during ovulation and thinner values in the luteal phase.[3] Kelly et al. provided a broader context on how sex hormones, especially estrogen and progesterone, impact the cornea across the female lifespan, attributing mid-cycle thickness to peak estrogen levels.[2] These hormonal changes likely explain the 13.01 µm (right eye) and 16.26 µm (left eye) decrease in CCT from ovulatory to luteal phase observed in our cohort ($p < 0.001$).

Our findings are also supported by Leach et al., who, even in their early 1971 study, noted cyclic corneal hydration changes correlating with menstrual phases.[9] Kurtul et al. also emphasized that exogenous hormones (e.g., oral contraceptives) influence CCT, reinforcing the role of endogenous hormonal changes seen in our naturally cycling subjects.[8]

Kazama et al. and Kim et al. discussed broader implications of CCT variability in the diagnosis and management of ocular diseases, noting that such fluctuations might impact IOP readings and refractive surgery planning.[6,10] This underlines the clinical significance of our findings: measuring CCT without considering the menstrual phase may introduce variability, especially in glaucoma and preoperative evaluations.

Finally, the use of ovulation tracking, as validated by Leiva et al., strengthens the reliability of ovulation timing in menstrual-phase-based studies like ours.[7]

CONCLUSION

The results of our study confirm that CCT significantly varies with menstrual cycle phase, with peak values during ovulation and lower values during the follicular and luteal phases. These findings are consistent with multiple national and international studies[10] and suggest that menstrual cycle phase should be considered during clinical CCT assessments in reproductive-age women.

Conflict Of Intrest - None

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