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Assessment of Sub Foveal Choroidal Thickness during Pregnancy by Optical Coherence Tomography

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Short title: Assessment of SFCT by OCT.

Abstract

Purpose: The refinement of Advanced depth imaging-Optical Coherence Tomography has substantially enhanced choroidal image resolution by reducing the signal behind the RPE. This study aimed to assess SFT in healthy pregnant women and compare it to that of healthy non-pregnant women using Advanced depth imaging - Optical Coherence Tomography.

Methods: 40 eyes of 20 pregnant women aged 20 to 40 underwent both EFS and optical coherence tomography. Group 1 consisted of healthy women with no ocular or systemic diseases while Group 2 comprised pregnant women in their second trimester.

Results: Pregnant women had a considerably lower mean intraocular pressure (IOP) than the normal control group ($P < 0.05$). The thickness of the central foveal stayed constant in both groups. The Sub foveal Choroidal Thickness measurement in expectant mothers was significantly higher than that in the control group ($P < 0.05$). The relationship between Sub foveal Choroidal Thickness, EFC, and BCVA correlated positively but not statistically.

Conclusions: In the second trimester of pregnancy, SFCT thickness was significantly greater than in non-pregnant controls, while there were no significant correlations between BCVA, CFT, or Sub Foveal Choroidal Thickness.

Keywords: Sub Foveal Choroidal Thickness; Pregnancy; Optical Coherence Tomography; Intraocular Pressure.

INTRODUCTION:

Pregnancy is a natural state of physiological changes throughout the body; these changes promote fetal development and prepare mother and child for birth[1,2]. The eye undergoes significant changes during pregnancy, including temporary refractive error, a decrease in intraocular pressure (IOP) and reactive changes in the retinal vessels [3]. This method uses Spectral Domain (SD) - Optical Coherence Tomography instruments to target deeper structures in the eye, including the choroid[4,5]. Vascular choroid essentializes the pigmented epithelium of the retina, the outer layers of the retina, the avascular fovea, and part of the optic nerve by providing oxygen and nutrients [6]. The significantly greater blood flow per unit weight in the choroid compared to any other tissue in the body (about 20 to 30 times that of the retina) accounts for more than 70% of the eye's blood flow; therefore, changes in this tissue can lead to eye problems[1,3,7].

Only the previously used image modes could accurately measure the choroidal thickness. Advanced depth imaging optical coherence tomography (EDI-OCT) is a noninvasive diagnostic tool to observe and measure choroidal changes in real-time. Many previous studies have focused on the measurement of sub foveal choroidal thickness (SFCT) in healthy participants and also in those with several pathologies[8,9] such as retinal vein occlusion (RVO) where the thickness sub foveal choroidal was greater than that of normal sedentary subjects. the eyes Ten days after intravitreal injection of bevacizumab[10]. Myopic CNV with decreased SFCT post-anti-VEGF but showing increased recurrence[11]. The decrease of SFCT in diabetic retinopathy (DR) is

significant after the onset of severe DR and is proportional to its severity[12].

Advanced depth imaging-Optical Coherence Tomography enabled visualization and measurement of choroidal anatomical features. The reduction in signal strength after EPR improves the resolution of choroidal images. This imaging method is performed with Spectral Domain Instruments (SD) – OCT focused on the deeper structures of the eye, such as the choroid[2,13]. This study aims to evaluate sub foveal heart thickness in pregnant women and compare it with non-pregnant women using Advanced depth imaging-Optical Coherence Tomography.

SUBJECTS AND METHODS:

This cross-sectional, prospective, comparative, non-interventional research was carried out on 40 eyes of 20 participants females aged from 20 to 40 years old, with sub foveal choroidal thickness during pregnancy undergoing optical coherence tomography. Following clearance from the Tanta University Hospitals Ethical Committee in Tanta, Egypt, the study was conducted from March 2020 to March 2021 (approval code: 33723/3/20). The patients gave their informed written permission.

Individuals with high myopia (spherical equivalent >-6.00 D or axial length >26 mm) were excluded. Patients with a history of retinal pathology, including RVO, CNV, AMD, DR, previous laser photocoagulation or intravitreal injection, IOP higher than 21 mmHg, prior intraocular inflammation, retinal dystrophy, and dense media opacity, should be carefully evaluated. A thorough history, eye examination, and radiographic investigations were performed for each patient. Group 1 consisted of healthy females without ocular or systemic disorders, whereas group 2 included pregnant women in their second trimester.

Choroidal thickness measurement

Using the EDI-SD-OCT (Spectralis HRA) device from Heidelberg Engineering, Heidelberg, Germany, the scan was centred on the fovea. To measure choroidal thickness, oblique line scans passing through the fovea centre on the Heidelberg spectralis SD-OCT can be used to measure sub foveal and central macular thicknesses. Measurements were taken between 9:00 a.m. and 12:00 p.m. to minimise diurnal variations and guarantee a single measurement for each participant. The choroid thickness was manually measured using a calliper to the vertical distance between the inner surface of the sclera and the hyperreflective line of the RPE. To measure the choroidal thickness, the initial segmentation lines for the superior and inferior retinal boundaries were adjusted to fit along the choroid. To measure retinal and choroidal thicknesses, the lower segmentation line was shifted from the RPE-Bruch's membrane complex edge to the choroid-scleral border. The choroidal thickness was measured from the lower edge of the RPE-Bruch's membrane complex to the upper segmentation line, which had been moved up from the internal limiting membrane Figure 1**.**

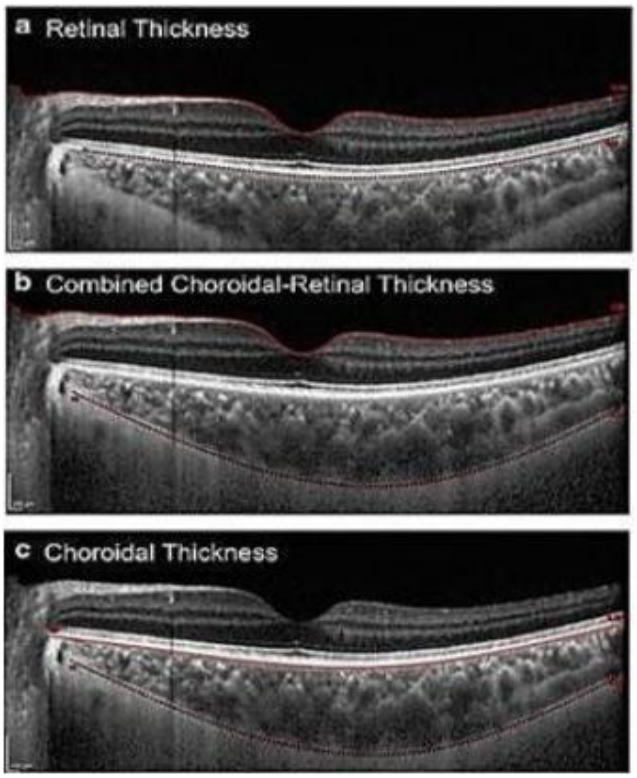


Figure 1: Automated segmentation lines' locations (a) At the level of the choroid-scleral border and the RPE-Bruch membrane complex (choroidal thickness); (b) At the level of the choroid-scleral border and the internal limiting membrane (choroid-retina); and (c) At the level of the integrated choroid-scleral border and the RPE-Bruch membrane complex.

Statistical analysis

IBM Inc., based in Chicago, IL, USA, provided the SPSS v26 software for the statistical analysis. Quantitative data from the two groups were compared using the unpaired Student's t-test. The standard deviation (SD) and mean of the variables were given. Frequency and percentage (%) were used to

represent the qualitative variables, and the Chi-square test or Fisher's exact test was used for analysis where necessary. A p-value of less than 0.05 on both sides was declared statistically significant.

RESULTS:

The mean IOP of the pregnant women was significantly lower than that of the normal control group (P<0.05), and there was no significant difference between the two groups in terms of age, refraction, or BCVA. Table 1.

There was no discernible difference in CFT between the two groups. Pregnant women's SFCT was much thicker than that of the normal control group (P<0.05). Table 2 There was an insignificant positive correlation between BCVA with CFT and SCFT and between CFT with SFCT. Table 3.

Table 1: displays the age distribution, log MAR measurement of BCVA, IOP, and refraction for each research group.

	Group 1 (n=10)	Group 2 (n=10)	T. test	P
Age (years)	27.90 ± 2.33	29.10 ± 2.69	1.067	0.300
IOP	13.0 ± 1.49	10.90 ± 1.91	2.739	**0.013***
Refraction	-0.50 ± 0.29	-0.55 ± 0.33	0.361	0.722
BCVA (log MAR)	0.08 ± 0.10	0.10 ± 0.11	0.429	0.673

The mean ± SD of the data is displayed. * Significant p value <0.05. Best Corrected Visual Acuity (BCVA) is the best corrected visual acuity (IOP). IOP: intraocular pressure.

Table 2: CFT and SFCT measurement among the study groups

	Group 1 (n=10)	Group 2 (n=10)	T. test	P
CFT	203.60 ± 7.39	203.10 ± 14.64	0.136	0.892
SFCT	229.40 ± 30.44	335.55 ± 53.86	7.673	**0.001***

* Significant p value <0.05; data are shown as mean ± SD. CFT stands for central foveal thickness; SFCT is for sub foveal choroidal thickness.

Table 3: Correlation of (BCVA with CFT and SFCT) and (CFT with SFCT) among the study groups

	BCVA by log MAR	
	r	**P**
CFT	0.079	0.677
SFCT	0.098	0.605
	CFT	
SFCT	0.271	0.085

r: Pearson coefficient, * significant p value <0.05. CFT: Central foveal thickness, SFCT: Subfoveal choroidal thickness. BCVA: Best Corrected Visual Acuity.

Group A,

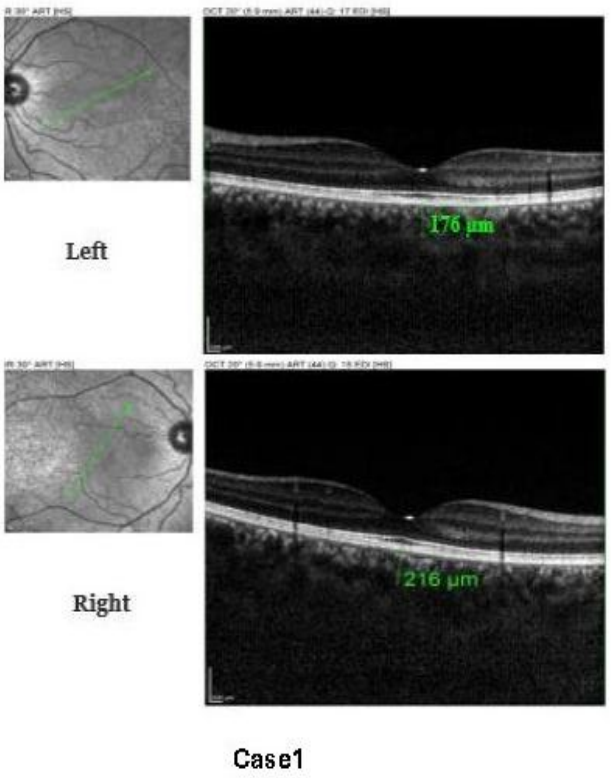
Case 1: Female aged 26 years old. Left eye: IOP: 14 mm HG, BCVA by log MAR: 0.00, Central foveal thickness: 192 mm, Sub foveal choroidal thickness 176 µm. Right eye: IOP: 15 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 194 µm, Sub foveal choroidal thickness 216 µm. Figure 2.

Case 2: Female aged 27 years old, left eye: IOP: 13 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 211 µm, Sub foveal choroidal thickness: 214 µm. Right eye: IOP: 13 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 214 µm, Sub foveal choroidal thickness: 233µm. Figure 2.

Group B,

Case 3: Female aged 26 years old, gestational week: 19th. Left eye: IOP: 11 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 205 µm, Subfoveal choroidal thickness: 241 µm. Right eye: IOP: 12 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 206 µm, Sub foveal choroidal thickness: 278 µm. Figure 3.

Case 4: Pregnant Female aged 27 years old, gestational week: 18th. Left eye: IOP: 12 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 191 µm, Subfoveal choroidal thickness: 278 µm. Right eye: IOP: 12 mmHg, BCVA by log MAR: 0.00, Central foveal thickness: 193 µm, Sub foveal choroidal thickness: 314 µm. Figure 3.



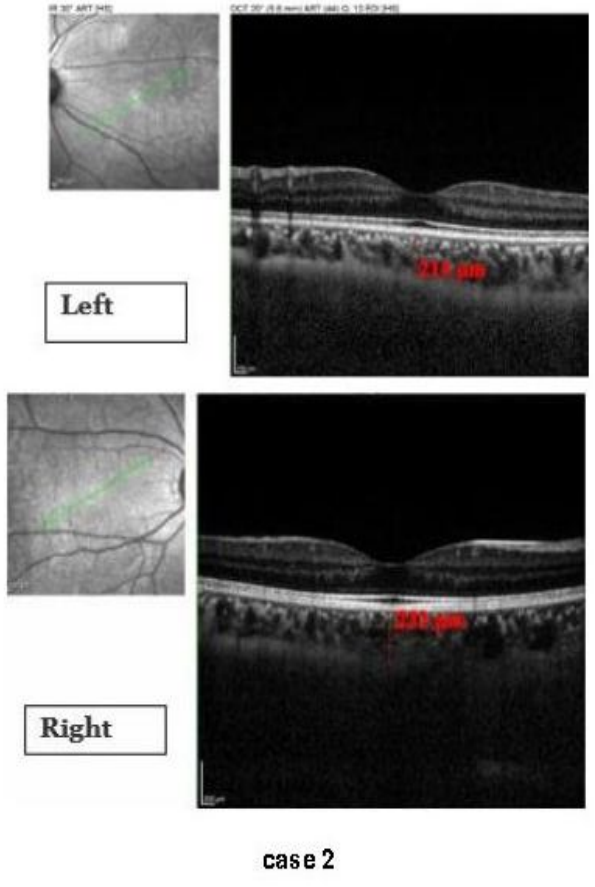
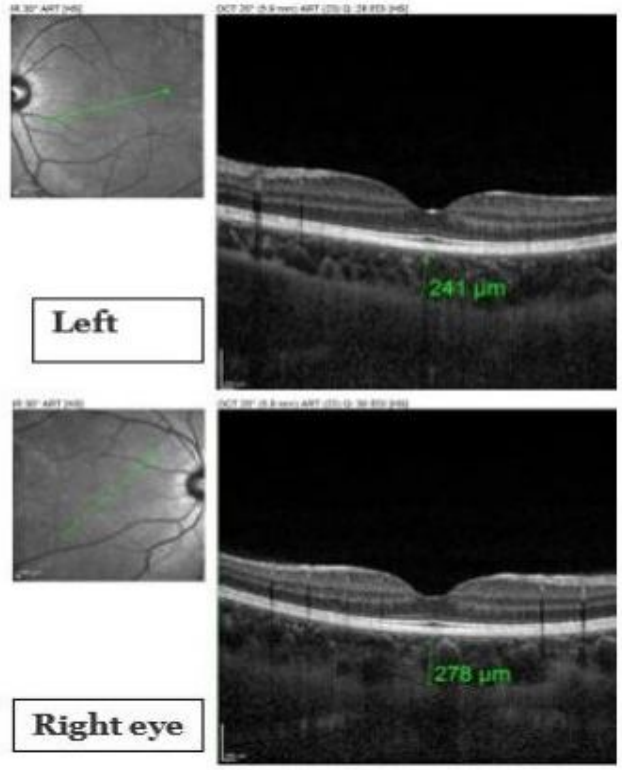


Figure 2: EDI-OCT image of case 1,2: showing sub foveal choroidal thickness of the both eyes



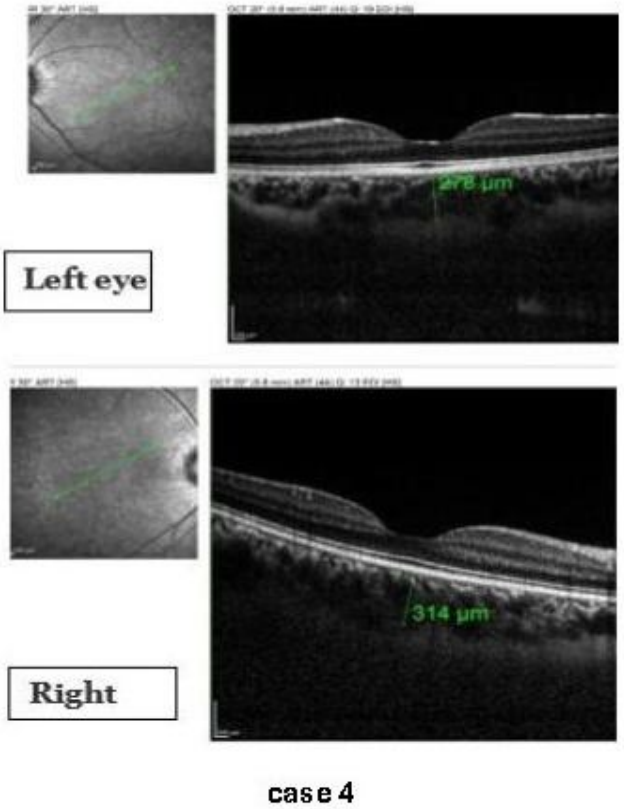


Figure 3: EDI-OCT image of case 3,4: showing sub foveal choroidal thickness of the both eyes

DISCUSSION

Pregnancy is a time when many important physiological changes occur throughout the body.

These modifications are meant to accommodate the growing foetus and get the mother ready to give birth. The immune, endocrine, circulatory, metabolic, and hematological systems are all affected by these modifications[2].

Our study found that the sub-SFCT significantly rose during the second trimester of pregnancy relative to non-pregnant women, aligning with Liu et al.'s [14] findings of a total 71 eyes in 71 non-pregnant women and 46 eyes in 46 pregnant women. A possible explanation for pregnant women's choroidal thickening is suggested by some studies, which propose a link between hypotony and the condition [15]. The mean ages and IOPs of both groups remained statistically similar throughout pregnancy.

During pregnancy, IOP decreases significantly compared to non-pregnant women in all trimesters. The decrease in IOP can be attributed to reductions in episcleral venous pressure due to lessened total systemic vascular resistance, as well as a softening of sclerotic tissue from increased tissue elasticity, water flow, and acidity during pregnancy. Some research suggests that hypotony causes choroidal thickening, indicating that IOP may explain changes in choroidal thickness during pregnancy [15]. According to Agrawal et al. [16] and Qureshi [17], when comparing the second and third trimester participants to the non-pregnant control group, the mean IOP was lower.

According to Sundaram et al. [18], increased fluid retention during pregnancy leads to changes in IOP. During pregnancy, IOP monitoring is essential for managing glaucoma patients and their treatment. The majority of changes are reversible and resolved during or following the postpartum period and breastfeeding cessation. The recognition of changes during pregnancy and the routine prenatal examinations should be improved. In the third trimester, [19] showed that VA was poorer than it was during the second and first trimesters and found that VA was worse in the third trimester than in the second and first trimesters.

The results were even worse in the second quarter than in the first.Our results showed that BCVA has no significant direct correlation with CFT and SCFT. CFT did not show a significant direct correlation with SCFT. The research by Evcimen et al.[20], which found that there was no discernible change in CMT between the pregnant group and the healthy group, supported our findings. According to Farahat et al. [19], the third trimester had a higher CMT than the second and first trimesters. Compared to the first quarter, it is much higher in the second. The same pregnant women were assessed three months after giving birth in the superior, temporal, inferior, and nasal quadrants' macular thickness in the foveal area (1 mm) and parafoveal area (3 mm), according to Ulusoyet al.[21]. No statistically significant difference was observed in the foveal and parafoveal macular thickness of all quadrants when data obtained during pregnancy and 3 months postpartum were compared. In our study, CFT showed a non-significant direct correlation with SFCT.

The limitations of the study include the relatively small sample size, which prevents the elaboration of definitive conclusions that are necessary to establish the change in SFCT during the different trimesters of pregnancy. However, we could not collect data during all periods of pregnancy due to the non-compliance of pregnant women in participating in the prenatal monitoring program and the cross-sectional design of the study. Blood pressure was not measured, so the relationship between SFCT and blood pressure was not determined. A small number of participants and a lack of measurement of postnatal SFCT.

The SFCT assessment is missing in the different trimesters of pregnancy. However, only one line of EDI-OCT pictures was obtained, and the whole macular region was not covered by the choroidal thickness measurement. As a result, there might be a little inaccuracy in our measurements of the sub foveal choroid thickness.

Conclusions:

Compared to healthy, non-pregnant controls, the SFCT of pregnant women was much thicker in the second trimester. When assessing choroidal thickness in disorders during pregnancy or in clinical research, this finding should be considered. A negligible direct association was seen between BCVA CFT and SCFT. There was a negligible direct association between CFT and SCFT.

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Data Availability: The authors declare that all data supporting the findings of this study are available within the article and its supplementary information file.

Competing interests: The authors declare no competing interests.

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Conflict of interest

All authors have no conflicts of interest that are directly relevant to the content of this review.

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