# Evaluation of Choroidal Thickness in Different Degrees of Myopia at Ophthalmology Department - Qena University Hospital

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**Abstract**

**Background:** Patients with high myopia are at a greater risk of developing retinal degeneration and CNV. The choroid is an important structure involved in the pathophysiology of high myopia

**Objectives:** To evaluate choroidal thickness in myopia and to correlate it with axial length, age and spherical equivalent.

**Patients and methods:** A prospective study of 40 eyes of 40 myopic patients was performed from July 2017 to February 2018 at Qena University Hospital. Choroidal thickness was measured using SD-OCT.
Patients were divided to two groups group A(<-6 D) and group B(>-6 D).

**Results:** Our study demonstrated differences between group A and group B, with respect to choroidal thickness, axial length and spherical equivalent. The mean SE was -3.2± 2.29 D (range,-0.25 to -6) in group A and -10.2±3.75 D (range,-6.5 to -16) in group B. The mean AL was 23.56±0.42 mm (range,22.6 to 24 mm) in group A and 26.56± 1.64 mm (range,23.7 to 28.8 mm) in group B. The mean CT was 190± 65.16 µm (range,107- 331 µm) in group A and 161.9± 97.338 µm (range, 40- 391 µm) in group B (P=0.00123). The mean SFCT was 206.7±66.7 µm (range,111-331 µm) in group A and 158.4± 39.16µm (range,43- 345 µm) in group B (P=0.0002). The BCVA was changed logMAR scale, with an average 0.858±0.35 and 0.65±0.287 in group A and B respectively.

**Conclusion:** Choroidal thickness was significantly lower in high myopic eyes at different locations. As age, spherical equivalent, and axial length increase the choroidal thickness decreases.

**Keywords:** Choroidal thickness; Myopia, Optical Coherence Tomography.

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## Introduction

The choroid, one of the most highly vascularized tissues of the body, plays an important role in the nourishment of the outer retina with oxygen and nutrients, modulation of temperature in the retina, adjustment of the retinal position, and secretion of growth factors **(Nickla and Wallman.,2010)**, so a healthy choroid is essential for normal retinal function, Choroid interposed between the retina and sclera. Until recently, information regarding choroidal thickness in normal eyes was based primarily on histologic results, which do not necessarily reflect the true measurements of this dynamic tissue **(Chen et al.,2006)**. Based on histologic study, choroidal thickness ranges from 170 to 220 µm **(Guyer et al.,2006).** Myopia may be associated with structural changes as axial elongation, thinning of retina and choroid **(Lim et al.,2005)**. Recent interest has focused on the choroid as an important structure involved in the pathophysiology of high myopia **(Ikuno and Tano ,2009).**

## Patients and Methods

This prospective, analytic study includes 40 eyes of 40 patients to evaluate choroidal thickness in different degrees of myopia. The subjects in this study were selected from the Outpatient Clinic of Ophthalmology Department, Qena University Hospital from July 2017 to February2018. The nature of the study was explained to the subjects.

***Study Patients***

- **Inclusion criteria:**

**a.** Myopia, precise
**b.** Clear ocular media.
**c.** Clear image obtained to enable precise choroidal thickness

- **Exclusion criteria:**

1-Patients who had history of intraocular surgery
2-History of intravitreal injection.
3-Patient with systemic diseases.
4-Patient presented with diabetic retinopathy, age related macular degeneration, choroidal neovascularization and uveitis.

- Both sex was included in the study
- Patients in this study divided into two groups;
  - Group 1: -20 eyes with myopia less than -6.
  - Group 2: -20 eyes with myopia more than -6.
- The average age of the studied cases was from 18 years old to 60 years old.

***Study design***

All patients subjected to the following: - Uncorrected and best corrected visual acuity, manifest and cycloplegic refraction after application of cyclopentolate hydrochloride1%, fundus examination with indirect ophthalmoscopy after pupillary dilation with 1% tropicamide. Axial length measured using A-Scan ophthalmic ultrasound device (OTI; Ophthalmic Technologies INC, Canada).

Choroidal thickness measurements performed using Spectral domain optical coherence tomography (SD-OCT) device (Spectralis; Heidelberg Engineering, Heidelberg, Germany) using enhanced depth imaging. Manual measurement was done on each image at subfovea and at 1000 micro temporal and nasal to fovea, using caliber tool in the OCT from outer part of the hyper-reflective line of the retinal pigment epithelium (RPE) to the line corresponding to the choroidal-scleral junction (CSJ) (**Fig.1**).

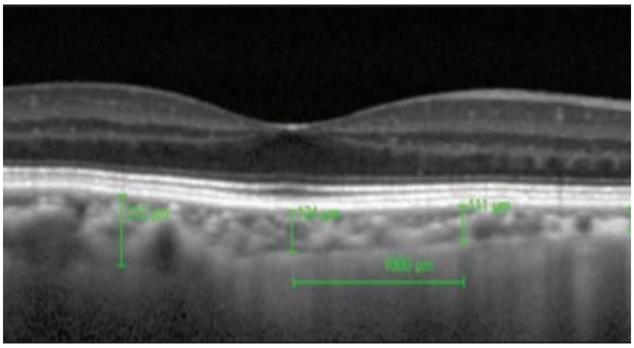

**Fig.1**. Manual measurement of choroidal thickness using SD-OCT with enhanced depth imaging, using caliber tool in the OCT from outer part of the hyper-reflective line of the retinal pigment epithelium (RPE) to the line corresponding to the choroidal-scleral junction at subfovea and at 1000 micro temporal and nasal to fovea.

## Results

This study included 40 eyes of 40 subjects (20 in each group). Patients comprised 28 females (70 %) and 12 males (30 %). The mean age of all studied cases was 35.5 ± 19.902 years (range 18-60 years).

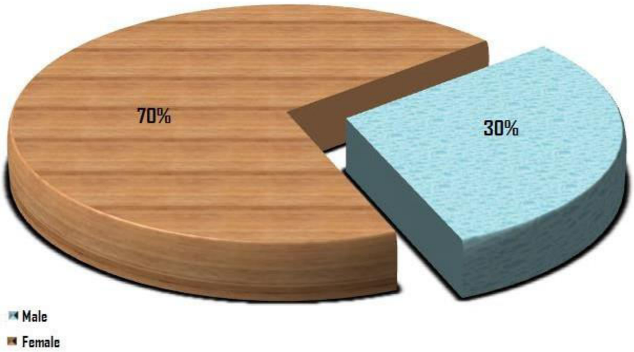


**Fig.2.** The overall Sex distribution for both groups.

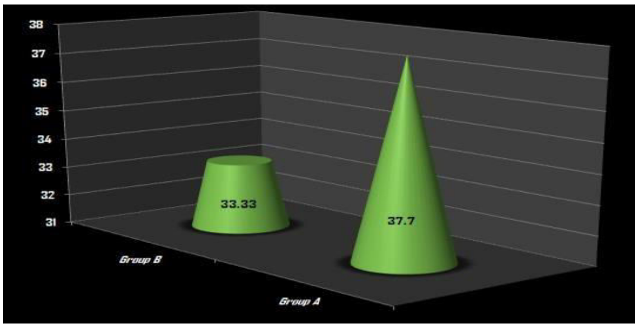


**Fig.3.** The mean age for group A Vs group B

**Table 1. Descriptive statistics of both groups**

| Variables | Group A | | | Group B | | | P Value |
|---|---|---|---|---|---|---|---|
| | Min | Max | *Mean ± SD* | Min | Max | *Mean ± SD* | |
| **BCVA(logMAR)** | 0.3 | 1.2 | 0.858 ± 0.35 | 0.2 | 1.2 | 0.65 ± 0.287 | 0.0034* |
| **SE (diopters)** | -0.25 | - 6 | -3.2 ± 2.293 | -6.5 | -16 | -10.22 ± 3.75 | 0.00095** |
| **AL (mm)** | 22.61 | 24 | 23.56 ± 0.422 | 23.7 | 28.81 | 26.56 ± 1.64 | 0.00264* |
| **Mean CT (µm)** | 107 | 331 | 190.1 ± 65.16 | 40 | 391 | 161.91 ± 97.338 | 0.00123* |
| **SFCT (µm)** | 111 | 331 | 206.7 ± 66.72 | 43 | 345 | 158.4 ± 39.161 | 0.0002** |
| **Nasal CT (µm)** | 107 | 291 | 161.7 ± 59.64 | 40 | 386 | 150.45 ± 102.78 | 0.00145* |
| **Temporal CT (µm)** | 109 | 323 | 201.9 ± 62.37 | 49 | 391 | 176.9 ± 98.93 | 0.00736* |
| **Age (years)** | 18 | 60 | 37.7 ± 14.64 | 18 | 49 | 33.3 ± 10.824 | 0.082 |

CT=Choroidal thickness, SFCT=Subfoveal choroidal thickness, AL=Axial length, SE=Spherical equivalent, BCVA=best corrected visual acuity.

**Table 2. Choroidal thickness in comparison to gender in both groups**

| .Sex | SFCT Mean ± SD | Temporal CT Mean ± SD | Nasal CT Mean ± SD |
|---|---|---|---|
| **Males (n=12)** | 186.33 ±110.40 | 204.833 ± 114.34 | 155.167 ± 96.198 |
| **Females (n= 28)** | 181.551±70.381 | 186.534 ± 66.419 | 161.429 ± 81.026 |
| **P-value** | 0.396 | 0.0494* | 0.0196* |

**Table 3. Choroidal thickness in comparison to axial length in both groups**

| Group B | | | |
|---|---|---|---|
| **Variables** | **Subfoveal** | **Nasal** | **Temporal** |
| | **Mean ± Standrd deviation *(SD)*** | | |
| **22–24mm [ N=2] –10%** | 310 ± 0.00 | 386 ± 0.50 | 314 ± 1.00 |
| **>24-26mm [N=6] - 30%** | 207 ± 106.928 | 179.6 ± 86.35 | 236 ± 120.36 |
| **>26mm [N=12]-60%** | 108.8 ± 40.58 | 96.58 ± 33.82 | 127.25± 46.43 |
| **P –VALUE** | **0.001**** | **0.00457*** | **0.0793** |
| **Group A** | | | |
| **22–23mm [ N=2 ] 10%** | 294.5 ± 0.707 | 232.5 ± 2.121 | 278 ± 1.414 |
| **>23–24 [ N=18 ]- 90%** | 196.89 ± 62.9 | 153.67±57.38 | 193.33 ± 59.76 |
| **P –VALUE** | **0.000117**** | **0.00084**** | **0.0601** |

**Table 4. Choroidal thickness in comparison to spherical equivalent in both groups**

| Group B | | | |
|---|---|---|---|
| **Variables** | **Subfoveal** | **Nasal** | **Temporal** |
| | **Mean ± Standrd deviation *(SD)*** | | |
| **> -6 : - 10 D [ N=11 ] 55 %** | 152.76 ± 17.03 | 143 ± 12.45 | 146.38 ±21.92 |
| **> -10 : -14 D [ N= 3] 15 %** | 126 ± 6.119 | 114.33 ± 52.31 | 124.33 ± 13.74 |
| **>-14 D [N=6] 30 %** | 89 ± 13.16 | 94.707 ± 8.19 | 101 ± 4.932 |
| **P –VALUE** | **0.0064*** | **0.00012**** | **0.0001**** |
| **Group A** | | | |
| **0 : -2 D [ N=10 ] 50 %** | 227.23 ± 22.61 | 209.46 ± 9.71 | 197.31± 2.906 |
| **>-2: -4 D [ N=2 ] 10 %** | 192.18 ± 73.01 | 181.43 ± 28.53 | 184.21 ± 7.49 |
| **>-4 : -6 D [N=8] 40%** | 171.83 ± 54.78 | 152.5 ± 8.402 | 164 ± 9.21 |
| **P –VALUE** | **0.0041*** | **0.00069**** | **0.0013*** |

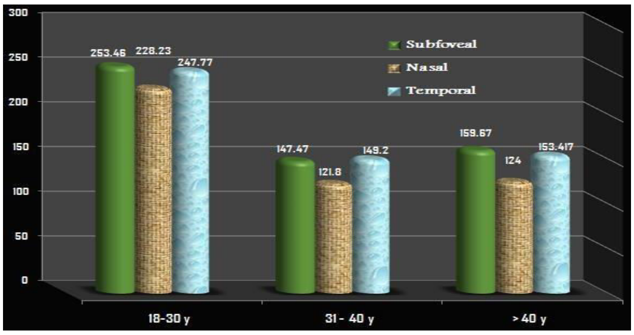


**Fig.4.** The relationship between the mean choroidal thickness and age in both groups

Regarding gender, there was no statistical significant difference between subfoveal choroidal thickness and gender in our study(P =0.396)(**Table 2, Fig.2).**

Regarding age, statistical significant difference was found between age and choroidal thickness at different measured areas subfoveal, temporal and nasal area (P=0.0361, 0.0047 and 0.0162 respectively). CT tend to decrease with advance of age( **Fig.3).**

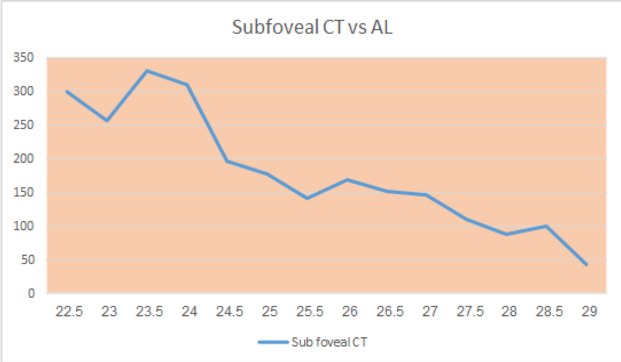


**Fig.5.** The relation between axial length and subfoveal choroidal thickness

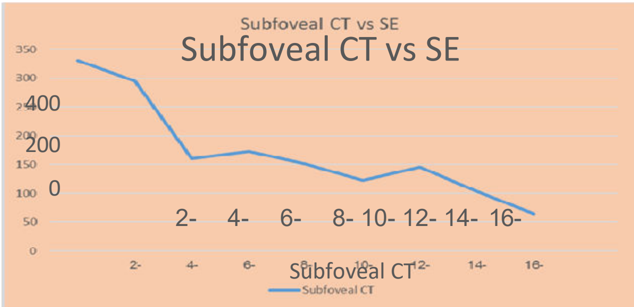


**Fig.6.**The relation between subfoveal choroidal thickness and spherical equivalent.

A negative correlation was found between the subfoveal choroidal thickness, axial length (r= - 0.681)(**Fig. 4**)and between subfoveal choroidal thickness , spherical equivalent (r=-0.6249)(**Fig.5**). SFCT decreased as axial length or spherical equivalent increased.

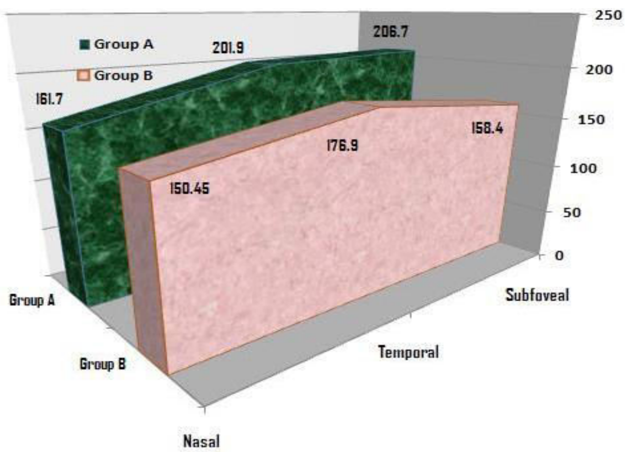


**Fig.7.** The mean choroidal thickness at nasal, temporal and subfoveal location in both groups.

As shown in (**Fig.6**), the thickest choroid in group B was temporal 176.9 ± 98.93 µm, then subfoveal 158.4 ± 39.161 µm and finally nasal choroid 150.45 ± 102.78 µm. In group A, SFCT was universally the maximum with an averge 206.7 ±66.72 µm then temporal 201.9 ± 62.37 µm. In both groups, the nasal area had the thinnest choroidal thickness 161.7 ± 59.64 µm , 150.45 ± 102.78 µm in group A and B respectively.

**Table 5.** Comparison between this study and different studies regarding the mean SFCT in high myopes

| **Study** | **(N)** | **Mean Age (Years)** | **AL, mm** | **SE, diopters** | **OCT Machine** | **EDI (yes/no)** | **Mean SFCT, (µm)µm** |
|---|---|---|---|---|---|---|---|
| **Current study (group B)** | 20 | 33.3 | 26.56 | -10.218 | Spectralis SD-OCT | YES | 158.4 |
| **(Flores-Moreno et al., 2013)** | 120 | 54.4 | 29.17 | -14.34 | Topco 3D-2000 OCT | NO | 115.5 |
| **(Fujiwara et al. ,2009]** | 55 | 59.7 | ------- | -11.9 | Spectralis SD-OCT | YES | 93.2 |
| **(Ikuno & Tano .,2009)** | 31 | 51.7 | 29.6 | -15.5 | Cirrus SD-OCT | NO | 99.3 |
| **(Takahashi et al. ,2012)** | 20 | 63.4 | 28.37 | -10.8 | Cirrus SD-OCT | NO | 68.1 |
| **(Chen et al.,2012)** | 20 | 28.8 | -------- | -9.29 | Spectralis SD-OCT | YES | 156.7 |

**Discussion**

Recent interest has focused on the choroid as an important structure involved in the pathophysiology of high myopia **(Ikuno and Tano ,2009).** This study was done to evaluate choroidal thickness in different degrees of myopic eyes and to determine if it could be affected with age, sex, axial length and degree of spherical equivalent. It included 40 eyes of 40 subjects. The patients divided into 2 groups according to degree of myopia.

Enhanced depth imaging technique (EDI- OCT) was employed in this study to measure choroidal thickness. EDI-OCT, which is a simple modification of the conventional spectral domain (SD-OCT) technique, facilitates accurate visualization of the chorioscleral interface. Thus, CT can be measured.

Our study demonstrated differences between eyes with high myopia (group B) and eyes with lesser degrees of myopia (group A), with respect to choroidal thickness, axial length and spherical equivalent.In our study, the mean CT was in group A (190.1 ± 65.16 µm) higher than mean CT in group B (161.91 ± 97.338 µm), that means CT in highly myopic group significantly thinner than that of control group at any location.

Thinning of choroid in highly myopic eyes had been reported by **(Gupta et al.,2014)** and also by several other studies **(Chen et al.,2015** ; **Ohsugi et al.,2013).** This was not surprising, it had been reported that in high myopic eyes excessive axial elongation of eyeballs could cause biomechanical stretching and thinning of choroid, retina and sclera **(Wu,2008).**

The mean SFCT of high myopic group in our study was 158.4± 39.161 µm, which was thicker than those reported in previous studies that showed a mean CT of 93.2 µm **(Fujiwara et al.,2009),** 115.5 µm (**Flores-Moreno et al.,2013**), 99.3 µm (**Ikuno & Tano, 2009)** and 68.1µm (**Takahashi et al.,2012**). This difference in mean CT may be due to the younger mean age of patients in our study than the previous mentioned studies. But (**Chen et al.,2012**) showed a mean SFCT of 156.7 µm which nearly went with our study, as it included younger aged subjects **(Table 5).** Our study showed that there was decrease in CT with advance of age. Statistical significant difference of CT was found comparing three age groups at temporal, nasal and subfoveal CT. This comes in agreement with (**Margolis and Spaide, 2009)** that showed CT reduction every year. Similarly,(**Ozdogan Erkul et al.,2014**) reported decrease in CT with age.

This change with age should be considered in assessment of progression of diseases that can change choroidal thickness (**Lehmann et al.,2015**). Regarding sex, neither statistical significant difference nor correlation was found between sex & SFCT.

This was also reported in many previous studies. But (**Barteselli et al.,2012; Li et al.,2011; Ding et al.,2011;Tuncer et al.,2015**)found that males had significant thicker choroid than females.

Comparing CT to axial length, there was statistical significant difference at nasal and subfoveal area in both groups (P <0.001), but no statistical significant difference found at temporal area (P>0.05). Negative correlation between AL and SFCT was found, this came with (**Li et al.,2011;Flores- Moreno et al.,2013; Tuncer et al.,2015).** There was statistical significant difference between SE and CT at temporal, nasal and subfoveal area (P value < 0.05)**.** The CT decreased as spherical equivalent increased. This agree with (**Tuncer et al . ,2015**) and (**Flores-Moreno et al.,2013)** that reported spherical equivalent negatively correlated with high myopia choroidal thickness. Unlike (**Michalewski et al.,2014; Ozdogan Erkul et al.,2014)** that found no significant correlation between SE and SFCT.

Macular choroidal thickness distribution follows a different profile in high myopia than in normal eyes. In our study, the choroid was thickest at temporal area in group B (high myopic) and at subfoveal area in group A (less myopic) with the nasal choroid the thinnest in both groups. This agree with (**Flores-Moreno et al.,2013; Tuncer et al.,2015)** found also that in normal eyes, the choroid was thicker at fovea than at temporal and nasal

## Conclusion

Our study showed that CT was significantly lower in high myopic eyes at different locations. There are many factors affecting the thickness of the choroid including age, axial length and spherical equivalent. As age, spherical equivalent, and axial length increase the choroidal thickness decreases.

SFCT one of important predictive factors of visual acuity in highly myopic eyes. Macular CT distribution followed a different profile in high myopia compared to normal eyes

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