Original Article

Macular Thickness in Healthy Libyan Adults Measured by Optical Coherence Tomography

Samar A. Bukhatwa[1], Sabah S. Eldressi[1], Naeima M. Elzlitni[1]

[1]Department of Ophthalmology, Faculty of Medicine, University of Benghazi, Benghazi, Libya

Abstract

Objectives: Management of various macular diseases depends on macular thickness which is measured quantitatively by optical coherence tomography. Studies have reported variations in the macular thickness by race and gender. The aim of this study was to determine the normal macular thickness measurements in healthy eyes of Libyans. **Subjects and Methods:** This study was conducted at the Ophthalmology Outpatient Department at Alkeish polyclinic in the period between January and December 2018. This study included 243 healthy eyes of 131 Libyan adults of both genders who underwent a complete ophthalmic examination including spectral domain optical coherence tomography to measure the macular thickness at the nine areas corresponding to Early Treatment Diabetes Retinopathy Study map (ETDRS). **Results:** The mean age of the study population was 48.3 ± 16.6 years (ranged between 21 and 79 years), the thickness in the foveola/center point of macula (CPT) was 192 ± 22.4 μm, the central foveal thickness was 230.3 ± 18.3 μm, and the average thickness was 270.1 ± 9.4 μm. Males were having more thickness than females. **Conclusions:** Foveola's thickness (CPT) in Libyan adults measured by spectral domain optical coherence tomography is thinner than that of previously published studies. Moreover, the central foveal thickness is less than that of many other studies and males have more thickness than females in all the areas of ETDRS map, which indicates that gender must be taken into consideration while interpreting macular retinal thickness data.

Keywords: Libya, normal macular thickness, optical coherence tomography, spectral domain

INTRODUCTION

Macular thickness is key to the treatment and follow-up of patients with various ocular diseases.[1] Nussenblatt *et al.* claimed that the thickness of macula and not the occurrence of macular edema is correlated with changes in visual acuity.[2]

Optical coherence tomography (OCT) is a valuable technique that measures retinal thickness quantitatively and provides information helping in the diagnosis, management, and follow-up of patients with retinal diseases.[3-5]

Many studies reported an association between macular thickness and demographic variations such as different races, gender, and age, which should be taken into consideration when diagnosing macular diseases.[6-9] However, there is no data for normal macular thickness for the Libyan population. Our report is the first for the measurement of macular thickness in healthy Libyans' eyes.

SUBJECTS AND METHODS

The study was conducted at the Ophthalmology Outpatient Department at Alkeish polyclinic, Benghazi, Libya, between January 1 and December 31, 2018. During the study period, the clinic was serving patients from all around Benghazi city as well as the population from the east and some parts of the south of Libya.

This study included 243 healthy eyes of 131 Libyan adults of both genders. The chosen adults were Arab Libyans attending the clinic complaining of dry eye, headache, reading problems, and some volunteering 4th-year medical students. All the participants underwent complete medical and ophthalmic

Address for correspondence: Dr. Samar A. Bukhatwa, Department of Ophthalmology, Faculty of Medicine, University of Benghazi, Benghazi, Libya.
E-mail: samar.bukhatwa@uob.edu.ly

Access this article online

Quick Response Code:

Website:
www.ijmbs.org

DOI:
10.4103/ijmbs.ijmbs_75_19

How to cite this article: Bukhatwa SA, Eldressi SS, Elzlitni NM. Macular thickness in healthy Libyan adults measured by optical coherence tomography. Ibnosina J Med Biomed Sci 2019;11:181-4.

history and examination, including best-corrected visual acuity and assessment of intraocular pressure (by Goldman applanation tonometry). Slit-lamp biomicroscopic evaluation using +90 D lens was performed to exclude any posterior segment pathology.

Exclusion criteria were any history of diabetes mellitus or any other systemic disease that could affect the eye, history of glaucoma, intraocular pressure higher than 21 mmHg, previous intraocular surgery, eyes with media opacity that might obscure OCT view, evidence of vitreoretinal disease, amblyopia, visual acuity <6/9 Snellen, or refractive errors of > +4.00 or <−4.00 D.

The study was conducted in accordance with the Declaration of Helsinki recommendations. An approval by the Martyr Sohail Al-Atrash Eye Hospital authorities was obtained. The participants were informed of the purpose of the study, and consent was obtained from all participants before the examination.

All participants were examined by the same OCT technician after instilling a dilating eye drops (tropicamide 1%). The macular thickness was measured by Topcon spectral-domain 3D OCT-2000 (ver. 8.01) (scan mode 3D [6.0 mm × 6.0 mm – 512 × 128]), and only the good images that were centered on the fovea were accepted.

Macular scans were assessed with the basic program, demonstrating the results in three concentric circles. Regarding the thickness of the center point of the macula/foveola (CPT), the first circle was 1-mm circle (fovea), the second was the internal ring of the macula (3 mm), and the third was the external rings of the macula (6 mm); these two last rings were divided into four quadrants (superior, temporal, inferior, and nasal zones), corresponding to the nine areas of the Early Treatment Diabetic Retinopathy Study (ETDRS) map.[10] An average retinal thickness (mean macular thickness) was declared for all the nine regions, along with the total macular volume. Macular thickness was defined as the distance between the vitreoretinal interface and the outer border of the retinal pigment epithelium.

Data were presented as mean ± standard deviation. Statistical analyses were performed using Statistical Package for the Social Sciences (Windows version 23.0; SPSS Inc., Chicago, IL, USA). $P < 0.05$ was considered statistically significant.

RESULTS

Out of 131 adults (243 healthy eyes) included in this study, 52 adults (40.0%) were male with 101 eyes and 79 adults (60.0%) were females with 142 eyes (when the media was clear, both eyes were chosen, but sometimes, due to media opacity [cataract or corneal opacity], only one eye was chosen). The mean age of the study population was 48.3 ± 16.6 years (range: 21–79 years). The mean ± Sd of retinal thickness by sector is shown in Table 1. The mean thickness is lower centrally, and then it increases in the internal perifoveal ring and subsequently decreases in the external

perifoveal ring. In addition, the thickest quadrant is the internal nasal followed by the internal superior. The thinnest quadrant is the external temporal.

Table 2 illustrates the mean normality values by gender. Values of all male eyes are higher than those of female eyes, and most of these values were statistically significant ($P < 0.05$) (except for the external superior, inferior, and nasal).

DISCUSSION

OCT device provides a noninvasive measurement for studying the structure and physiology of the eye with repeatability and reliability.[5,11] Many studies demonstrated changes in macular thickness with race and gender,[1,7,12-15] and to our knowledge, this is the first study to be done in Libyan adults.

Table 1: Mean retinal thickness and macular volume for the whole study population

	Minimum	Maximum	Mean±Sd
CPT (µm)	130	310	192±22.4
Average thickness	242	294.7	270.1±9.4
Central foveal thickness	167	320	230.3±18.3
Total volume	6.85	8.3	7.6±0.3
Internal ring (µm)			
Superior	227	329	301.9±12.4
Temporal	243	320	288.9±12.0
Inferior	218	326	299.1±14.0
Nasal	256	333	303.1±12.0
External ring (µm)			
Superior	231	290	264.4±11.2
Temporal	196	279	250.95±10.73
Inferior	205	288	258.07±11.93
Nasal	251	305	280.26±11.70

CPT: Thickness of the center point of the macula/foveola, Sd: Standard deviation

Table 2: Results of macular thickness and volume by gender

	Males	Females	*P*
Number of eyes	101	142	
CPT (µm)	195.8±21.5	189.3±22.7	0.025
Average thickness	272.3±9.3	268.6±9.2	0.002
Central foveal thickness	237.8±18.7	225.0±15.9	0.000
Total volume	7.7±0.3	7.6±0.3	0.002
Internal ring (µm)			
Superior	305.1±13.9	299.6±10.8	0.001
Temporal	293.7±11.7	285.6±11.1	0.000
Inferior	303.6±14.0	295.8±13.2	0.000
Nasal	306.8±11.5	300.8±11.9	0.000
External ring (µm)			
Superior	265.4±10.4	263.6±11.7	0.216
Temporal	254.0±9.7	248.75±10.9	0.000
Inferior	258.2±12.6	257.99±11.5	0.895
Nasal	280.9±12.5	279.84±11.1	0.510

CPT: Thickness of the center point of the macula/foveola

The present study included 243 healthy eyes of 131 Libyan adults of both genders; as expected, the internal perifoveal ring is the thickest. Similarly, the nasal area was the thickest, whereas the temporal area was the thinnest part of the macular area; this is consistent with many previous studies and is explained well by the normal anatomy of the macula.[13,16-18]

There are variations in the retinal thickness among different ethnic populations. Grover *et al*.[13] reported a higher central foveal thickness in caucasian compared to Africans. In the present study, the central foveal thickness was 230.3 ± 18.3 μm, which is comparable to the foveal thickness of 229.0 ± 20.5 μm reported by Adhi *et al*.[19] On the other hand, this result was less compared to that reported by many studies (which ranged between 244 and 270 μm)[1,13,16-18,20,21] and thicker than (221.9 μm) what was reported by Ooto *et al*.[22] The variations in retinal thickness among different races can be explained based on the hypothesis of the "attenuation of incident optical radiation by the increased pigment in the apical portion of the retinal pigment epithelium cells, leading to a decreased signal of posterior retinal segments and concomitant underassessment of retinal thickening in darkly pigmented persons."[13]

The foveola's thickness (CPT) for the total study population in the present study (192 ± 22.4 μm) was thinner than other studies' reports.[13,16] Nevertheless, the average thickness in this study was also less than what was described by many studies (range: 275.7–305.6 μm),[1,16,20] but thicker than what was reported by Adhi *et al*. (262.7 ± 13.3 μm).[19]

The thickness in all the ETDRS areas, as well as the total volume, was higher in males compared to females, and the thickness values were statistically significant for most of the areas except for the external ring, although this is not consistent with Grover *et al*.,[13] but it goes in agreement with many other studies[1,7,17,18] and may be consistent with the observation that women having higher risk of developing macular hole.[23,24] The limitations of the study include the lack of evaluation of some of the parameters that may affect the retinal thickness such as age, race, and axial length, which should be taken into considerations in future studies.

Conclusion

This report is a first study for normative data for macular thickness in healthy Libyans. These data should be taken into consideration when diagnosing macular diseases. The report demonstrated that the thickness in the foveola (CPT) is 192 ± 22.4 μm, the central foveal thickness is 230.30 ± 18.26 μm, and the average thickness is 270.1 ± 9.4 μm. It also revealed that males have a thicker macula than females, which indicates that gender must be considered while interpreting macular retinal thickness data.

Authors' contributions
This study was carried out by all the named authors. They have developed their assigned parts of the manuscript and reviewed the other parts. All authors reviewed and agreed the final version of the manuscript.

Conflicts of interest
There are no conflicts of interest.

Compliance with ethical principles
The study was approved by the Research Ethical Committee of the Martyr Sohail Al-Atrash Eye Hospital, and all participants provided informed consent before enrollment in the study.

References

1. Song WK, Lee SC, Lee ES, Kim CY, Kim SS. Macular thickness variations with sex, age, and axial length in healthy subjects: A spectral domain-optical coherence tomography study. Invest Ophthalmol Vis Sci 2010;51:3913-8.
2. Nussenblatt RB, Kaufman SC, Palestine AG, Davis MD, Ferris FL 3rd. Macular thickening and visual acuity. Measurement in patients with cystoid macular edema. Ophthalmology 1987;94:1134-9.
3. Massin P, Vicaut E, Haouchine B, Erginay A, Paques M, Gaudric A. Reproducibility of retinal mapping using optical coherence tomography. Arch Ophthalmol 2001;119:1135-42.
4. Paunescu LA, Schuman JS, Price LL, Stark PC, Beaton S, Ishikawa H, *et al*. Reproducibility of nerve fiber thickness, macular thickness, and optic nerve head measurements using StratusOCT. Invest Ophthalmol Vis Sci 2004;45:1716-24.
5. Muscat S, Parks S, Kemp E, Keating D. Repeatability and reproducibility of macular thickness measurements with the Humphrey OCT system. Invest Ophthalmol Vis Sci 2002;43:490-5.
6. Asrani S, Zou S, d'Anna S, Vitale S, Zeimer R. Noninvasive mapping of the normal retinal thickness at the posterior pole. Ophthalmology 1999;106:269-73.
7. Wong AC, Chan CW, Hui SP. Relationship of gender, body mass index, and axial length with central retinal thickness using optical coherence tomography. Eye (Lond) 2005;19:292-7.
8. Kashani AH, Zimmer-Galler IE, Shah SM, Dustin L, Do DV, Eliott D, *et al*. Retinal thickness analysis by race, gender, and age using Stratus OCT. Am J Ophthalmol 2010;149:496-5020.
9. Alamouti B, Funk J. Retinal thickness decreases with age: An OCT study. Br J Ophthalmol 2003;87:899-901.
10. Grading diabetic retinopathy from stereoscopic color fundus photographs-an extension of the modified Airlie house classification. ETDRS report number 10. Early Treatment Diabetic Retinopathy Study Research group. Ophthalmology 1991;98:786-806.
11. Srinivasan VJ, Wojtkowski M, Fujimoto JG, Duker JS. *In vivo* measurement of retinal physiology with high-speed ultrahigh-resolution optical coherence tomography. Opt Lett 2006;31:2308-10.
12. Duan XR, Liang YB, Friedman DS, Sun LP, Wong TY, Tao QS, *et al*. Normal macular thickness measurements using optical coherence tomography in healthy eyes of adult Chinese persons: The Handan Eye Study. Ophthalmology 2010;117:1585-94.
13. Grover S, Murthy RK, Brar VS, Chalam KV. Normative data for macular thickness by high-definition spectral-domain optical coherence tomography (Spectralis). Am J Ophthalmol 2009;148:266-71.
14. Manassakorn A, Chaidaroon W, Ausayakhun S, Aupapong S, Wattananikorn S. Normative database of retinal nerve fiber layer and macular retinal thickness in a Thai population. Jpn J Ophthalmol

2008;52:450-6.

15. Oshitari T, Hanawa K, Adachi-Usami E. Changes of macular and RNFL thicknesses measured by Stratus OCT in patients with early stage diabetes. Eye (Lond) 2009;23:884-9.

16. Pokharel A, Shrestha GS, Shrestha JB. Macular thickness and macular volume measurements using spectral domain optical coherence tomography in normal Nepalese eyes. Clin Ophthalmol 2016;10:511-9.

17. El-Hifnawy MA, Gomaa AR, Abd El-Hady AM, Elkayal HE. Spectralis optical coherence tomography normal macular thickness in Egyptians. Delta J Ophthalmol 2016;17:143-50. Available from: http://www.djo.eg.net/text.asp?2016/17/3/143/195269. [Last accessed on 2019 Jul 15].

18. Al-Zamil WM, Al-Zwaidi FM, Yassin SA. Macular thickness in healthy Saudi adults. A spectral-domain optical coherence tomography study. Saudi Med J 2017;38:63-9.

19. Adhi M, Aziz S, Muhammad K, Adhi MI. Macular thickness by age and gender in healthy eyes using spectral domain optical coherence tomography. PLoS One 2012;7:e37638.

20. Solé González L, Abreu González R, Alonso Plasencia M, Abreu Reyes P. Normal macular thickness and volume using spectral domain optical coherence tomography in a reference population. Arch Soc Esp Oftalmol 2013;88:352-8.

21. Darwish T, Jalloil K, Sulaiman H. The normal values of optic nerve fiber thickness and macular thickness in adults using optical coherence tomography (OCT). Tishreen Univ J Res Sci Stud 2017;39:103-20. available from: http://journal.tishreen.edu.sy/index.php/hlthscnc/article/view/4138. [Last accessed 2019 Sept 20].

22. Ooto S, Hangai M, Sakamoto A, Tomidokoro A, Araie M, Otani T, *et al*. Three-dimensional profile of macular retinal thickness in normal Japanese eyes. Invest Ophthalmol Vis Sci 2010;51:465-73.

23. Evans JR, Schwartz SD, McHugh JD, Thamby-Rajah Y, Hodgson SA, Wormald RP, *et al*. Systemic risk factors for idiopathic macular holes: A case-control study. Eye (Lond) 1998;12(Pt 2):256-9.

24. Risk factors for idiopathic macular holes. The eye disease case-control study group. Am J Ophthalmol 1994;118:754-61.