

# **PROTOCOL**

MACULAR MEASUREMENTS USING OPTICAL  
COHERENCE TOMOGRAPHY IN HEALTHY EGYPTIAN  
CHILDREN

قياسات الماقولة باستخدام جهاز التناسق الطبقي المقطعي البصري في الأطفال  
المصريين الاصحاء

Protocol of a thesis submitted  
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**Master of Ophthalmology**

خطة بحث مقدمة  
لكلية الطب  
جامعة الإسكندرية  
إيفاء جزئياً  
لشروط الحصول على درجة  
الماجستير في طب وجراحة العين

By

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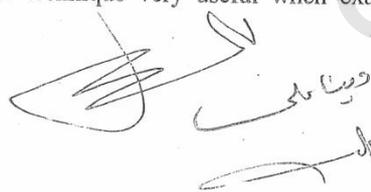
## INTRODUCTION

The posterior pole (anatomic macular or area centralis) is about 4.5-6 mm in diameters, centered on the fovea, and located between the superior and inferior temporal arcades. The macula (anatomic fovea centralis) is located approximately 3 mm temporal to optic disc and is about 1.5 mm, or one disc size in diameter. The presence of xanthophyll, a yellow carotenoid pigment gives the region its name –the macula lutea. The most central part of the macula, the fovea (anatomic foveola) is formed by a central, circa 0.35 mm wide depression and represents the retinal region of greatest visual acuity.<sup>(1)</sup>

Because macular thickness has been found to significantly correlate with visual acuity.<sup>(2)</sup> High resolution and reproducible measurement of macular thickness are needed for both medical and surgical management of macular diseases.<sup>(3)</sup>

Optical coherence tomography (OCT) is nowadays an important diagnostic tool for retinal diseases in clinical practice. It provides cross-sectional or three-dimensional image by measuring echo time delay (time-domain OCT) and magnitude of back scattered or back-reflected light. The OCT gives a kind of optical biopsy with quantitative and reproducible measurements of macular and retinal nerve fiber layer RNFL thickness parameter using near infrared light.<sup>(4,5)</sup> OCT was first developed as a research tool in 1991 to visualize the retina.<sup>(6)</sup>

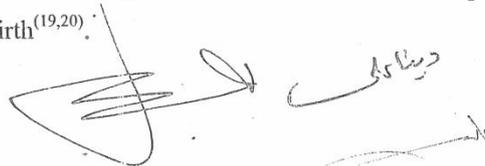
Image capture is non invasive fast painless and non contact. The “non-contact” feature makes the technique very useful when examining children.<sup>(7)</sup>

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OCT helps ophthalmologist diagnose retinal diseases by detecting small changes in retinal and macular morphology, such as thickness and volume. Therefore data documenting normal macular measurements and variations associated with demographic and ocular variables in healthy subjects will help clinical identify and characterize pathologic changes.<sup>(8-10)</sup>

Normative data are provided automatically by OCT, but the data base only includes individuals 18 years and older, limiting its use in children. The normal range of macular thickness in adults has been measured by several investigators using OCT, but much less is known about normative macular thickness values in children. In general OCT provides reliable, accurate and repeatable measures in children.<sup>(11-13)</sup> It is imperative that measures be documented in children, Since ocular development occurs continually, and macular parameters in children differ from those in adults.<sup>(14-16)</sup>

The central retina develops over a prolonged period.<sup>(17)</sup> In the early stage of development, the macular region is a central elevation due to accumulation of ganglion cells. By the sixth month of gestation, this region starts thinning as the cells of the inner retina are displaced centrifugally and develop elongated processes.<sup>(18)</sup> This displacement results in the fovea, the central depression of the macula. The fovea thins progressively towards its centre, the foveola, which is the thinnest part of the macula and consists of cone cells only. Before birth, the fovea has a diameter that is considerably larger than the adult fovea,<sup>(19)</sup> and at birth the cone density is only 20 percent of that of the adult fovea. Cones then elongate, migrate centrally, and increase their packing density. This process is completed five to eight years after birth<sup>(19,20)</sup>.

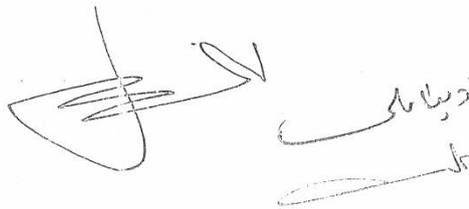


One third to one half of the neurons in the central nervous system are estimated to be lost during a lifetime.<sup>(21)</sup> It therefore appears reasonable that the number of retinal neurons also decreases with age. Histological studies of the human retina and optic nerve have shown a decreased density with age of photoreceptors,<sup>(22)</sup> ganglion cells, pigment epithelial cells<sup>(23)</sup> and optic nerve fibres.<sup>(24)</sup>

Several studies concluded that age had an influence on retinal thickness, and that thickness decreased with 2.6-4.6  $\mu\text{m}$  each decade, depending on which macular area was examined.<sup>(25,26)</sup>

Recent technological improvement leads to the introduction of spectral-domain OCT (SD-OCT) that offers higher scanning speeds, higher scan densities and better resolution than earlier generations of this technology. The ability to visualize areas of interest with a high acquisition rate SD-OCT imager along with the ability to quantify structures expands the utility of OCT to new clinical territories, such as children and other poorly compliant populations.<sup>(27)</sup>

Spectral domain OCT is being used increasingly as a diagnostic and monitoring tool in children with visual loss. Because of short exposure durations and eye-tracking systems in devices such as the Heidelberg Spectralis. However, for the scans to be the most useful for detecting diseases in children, quantitative measures from children should be compared to age matched normal controls. Normal values from children are not currently available from manufacturers.<sup>(27)</sup>

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### AIM OF THE WORK

The aim of the work is to evaluate normal macular thickness and volume in the Egyptian children using optical coherence tomography (OCT).

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## SUBJECTS AND METHODS

### I. Subjects

The study will be conducted on 100 eyes of children aged from 6-16 years, attending or referred to the Ophthalmology Out Patient Clinic in Alexandria University Hospital.

#### Inclusion criteria

To be enrolled, subject had to have no ocular problems other than refractive error (not more than spherical equivalent of  $\pm 4$  diopters).

#### Exclusion criteria

- Children who had congenital ocular abnormality.
- Low OCT signals (less than 6/10)
- Alignment problems.
- Intraocular pressure more than 21mm/Hg were excluded.

### II. Methods

All subject received a full ophthalmic examination including:

- Detailed assessment of far and near visual acuity
- Slit lamp biomicroscopy evaluation
- Dilated fundus examination with direct ophthalmoscope
- Cycloplegic refraction
- Assessment of intraocular pressure (IOP).
- Pupils will be dilated with tropicamide 1% and cyclopentolate 1% or 2% drops, depending on age and iris pigmentation of the subjects.



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- Macular thickness measurement by spectral-domain OCT (Spectralis OCT, Heidelberg Engineering, Heidelberg, Germany).

#### **OCT scanning**

An internal fixation light was used to center the scans on the fovea of the subject. The images in this study were generated by the fast volume scan; 20°×20° (6×6 mm) raster scans consisting of 25 horizontal lines (B-scan sections) that were spaced 240 microns apart with 512 A-scans per B-scan. For each horizontal line, 9 B-scans were averaged with the automatic real-time (ART) mode to reduce speckle noise. The fast scan was chosen as it is less time consuming and more comfortable for the patient as compared to the dense scan.

Macular thickness values were calculated automatically by the software 5.3.2.0) included in the machine.

#### **F. Ethical considerations:**

Written informed consent to participate in this study will be obtained from the legal guardians and verbal consent was obtained from children at the time of examination.



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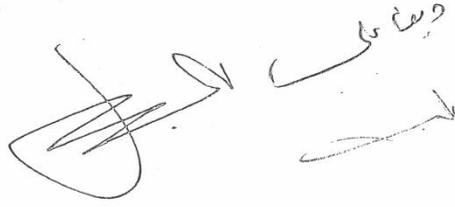
## RESULTS

The findings will be recorded, analyzed, and tabulated with statistical analysis of data to show significance of any relevant results.

   
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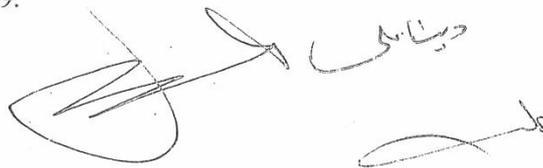
## DISCUSSION

The findings of the study will be discussed in the view of achievement of the aim. The significance of the findings and their comparison with other works in the same field of research in the literature.

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# **ARABIC SUMMARY**

## الملخص العربي

التصوير المقطعي المتجانس الضوئي بالمجال الطبيعي هو تقنية مقطعية غير ضارة لقياس سمك الشبكية.

لقد ساهم التصوير المقطعي المتجانس الضوئي بالمجال الطبيعي في تشخيص ومتابعة تطور أمراض الشبكية، سمك الماقولة يتأثر بالعديد من الأمراض التي تصيب العين والجسم ولذلك يجب التمييز بين قياس سمك الماقولة الطبيعي والغير طبيعي.

قياس سمك الماقولة باستخدام جهاز التصوير المقطعي المتجانس الضوئي درس كثيراً في الماضي. ولكن البيانات عن سمك الماقولة الطبيعي للأطفال غير متاح في العديد من الأجهزة.

ولذا فقد أجرى هذا البحث على خمسين طفل مصري سليم حيث أجرى لهم فحص شامل للعين بما في ذلك التصوير المقطعي المتجانس الضوئي بالمجال الطبيعي باستخدام جهاز سبكترايس في المستشفى الرئيسي لجامعة الإسكندرية وقد تم الحصول على صورة الماقولة باستخدام بروتوكول المسح الحجمي السريع حيث تم حساب سمك الماقولة في النقطة المركزية وثمان مناطق محيطة لتكوين خريطة لسمك الماقولة باستخدام البرنامج المصاحب لجهاز سبكترايس وفي هذه الدراسة تم تحليل العلاقة بين سمك الماقولة والجنس والعمر وقياس مدى الاختلاف بين العين اليمنى والعين اليسرى.

وقد اشتملت الدراسة على ٥٠ عين اليمنى و ٥٠ عين يسرى حيث شارك ٢٤ (٤٨%) من الذكور و ٢٦ (٥٢%) من الإناث في الدراسة وكان متوسط عمر المشاركين ١٠.٢ ± ٢.٧ سنة.

وقد وجد أن متوسط السمك المركزي للماقولة هو ٢٢٠.٩ ± ٢٢.٨ ميكرون كما وجد أن متوسط الماقولة في الاطفال المصريين اقل من تلك التي ظهرت في الدراسات التي نشرت سابقاً على الأطفال الأمريكيين والألمان ولكنها مقاربه للدراسة التي نشرت سابقاً على الأطفال الأتراك باستخدام جهاز سبكترايس.

كما لوحظ أن سمك الماقولة الداخلي كانت أكبر في الذكور عنه في الإناث وكان الفارق ذو دلالة إحصائية ولم يكن هناك فارق ذو دلالة إحصائية في السمك المركزي وسمك الماقولة الخارجي بين الذكور والإناث كما لوحظ أنه ليس هناك فرق بين العين اليمنى واليسرى.

وأن العمر له تأثير على سمك الماقولة الداخلي فقط ولم يكن له تأثير على السمك المركزي وسمك الماقولة الخارجي.

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قياسات المقولة باستخدام جهاز التناسق الطبقي المقطعى البصرى فى الأطفال المصريين  
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للحصول على درجة

الماجستير

فى

طب و جراحة العين

موافقون

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# قياسات المقوله باستخدام جهاز التناسق الطبقي المقطعى البصرى فى الأطفال المصريين الأصحاء

رسالة علمية

مقدمة إلى كلية الطب- جامعة الإسكندرية  
إستيفاء للدراسات المقررة للحصول على درجة

الماجستير

فى

قسم طب وجراحة العين

مقدمة من

نهى عمران المبروك

بكالوريوس الطب والجراحة - بنغازى - ليبيا، ٢٠٠٩