

# CHANGES IN MACULAR THICKNESS AFTER PART TIME OCCLUSION IN CHILDREN WITH AMBLYOPIA USING OPTICAL COHERENCE TOMOGRAPHY (OCT)

By

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## ABSTRACT

**Background:** Amblyopia is the commonest childhood vision disorder, most children with amblyopia require refractive correction as well as patching; Evidences for direct retinal changes in amblyopic eyes are still inconclusive and controversial.

**Objectives:** To detect changes in the macula by macular Optical Coherence Tomography (OCT) after part time occlusion in children with amblyopia.

**Patients and Methods:** Arandomised non controlled study included forty child suffering amblyopia in this study. Best corrected visual acuity (BCVA: 0.1- 0.5) were recruited and treated with refractive correction, and part time occlusion (6 hours/day) for one week per year. BCVA and macular thickness were measured by OCT before and after treatment. Factorial repeated-measures analysis of variance was performed to determine the macular thickness in amblyopic eyes changed after amblyopia treatment.

**Results:** The mean age of children was  $8.57 \pm 2.52$  years. There was a statistically significant difference in the central macular thickness pre & post amblyopia treatment. There was no statistically significant difference for the other macular thickness parameters except for superior quadrant of parapovea where the difference was significantly significant.

**Conclusion:** The mean of central macular thickness and superior quadrant of parapovea increased after part time occlusion treatment compared to pretreatment. No significant difference in average macular thickness, (nasal, temporal, inferior) parapovea, perifovea, retinal nerve fiber layer (RNFL) thickness and ganglion cell layer (GCL) before and after treatment.

**Keywords:** Amblyopia, occlusion therapy, macular changes.

## INTRODUCTION

Strabismic amblyopia results from abnormal binocular interaction where there is continued monocular suppression of the deviating eye. Bilateral ametropic amblyopia results from high symmetrical refractive errors, usually herpermetropia.

Meridional amblyopia results from image blur in one meridian, e.g. uncorrected astigmatism. In absence of organic lesion, a difference in best corrected visual acuity of two snellen lines or more (or  $< 1$  log unit) is indicative of amblyopia (Bowling , 2016).

The part-time occlusion treatment in school-aged amblyopes, which had been carried out after school hours, was successful and the effect was sustained in most cases (*Hwang et al., 2010*).

Optical coherence tomography (OCT) uses a continuously emitting optically coherent laser diode centered at 850 nm and focused at the retina. The super-luminescence low-coherence diode emits light with a 20 to 25 nm band width. For thickness measurements, the time delay of reflected or backscattered light is determined using coherence interferometry (*Liu et al., 2010*).

Evidences for direct retinal changes in amblyopic eyes are still inconclusive and controversial, although electroretinograms elicited by patterned stimuli in humans with various types of amblyopia were found to be significantly reduced. Studies using optical coherence tomography (OCT) imaging of the retina have not produced definite results (*Sapkota et al., 2014*).

The purpose of this study was to determine macular changes by OCT after part time occlusion treatment in children with amblyopia.

## PATIENTS AND METHODS

A randomised non controlled study included forty child aged 5–12 years at the outpatient clinic, El Mattarya Teaching Hospital and Al-Hussein University Hospital, Cairo, Egypt. The study protocol was adhered to the tents of declaration of Heliniski and was approved by the ethical committee of the Faculty of Medicine, Al-Azhar University.

### Inclusion criteria:

We included in the study children with BCVA in the amblyopic eye was 0.1 to 0.5 by decimal system after conversion from snellen chart; Intereye acuity difference was 2 Snellen lines. No amblyopia treatment (other than spectacles) in the past month and no more than 1 month of amblyopia treatment in the past 6 months.

### Exclusion criteria:

In the study we excluded children with history of seizures, prematurity (birth weight < 1500 g or gestational age <34 weeks), mental retardation, ocular anomalies or pathologies, fundus lesions, nystagmus, glaucoma, organic lesions and history of intraocular surgery.

The patient hos undergon complete eye examination ,BCVA testing with Snellen chart including crowding phenomenon and neutral denisty filter before and after part time occlusion treatment with patching (6 hours/day) for one week per year, evaluation of ocular duction and versions, alternate prism cover test for diagnosis and measurement of eye deviation, cycloplegic refraction (automated) 45 min after installing cyclopentolate 1%, one drop 10 min apart, anterior segment examination by slit lamp, IOP measurement with air puff tonometer, funduscopy to rule out optic nerve and macular lesions . 3D retinal topography of amblyopic eye of each participante was done before and after patching using topcon 3d oct 2000 fa plus machine (made in Japan).

The mean of these values, as calculated by preloaded software was used to calculate the average macular thickness,

central macular thickness, total volume, parafoveal quadrants, perifoveal quadrants, RNFL thickness and GCL.

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Paired sample

t-test of significance was used when comparing between related samples. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the Probability (p-value) was considered significant as the following: P-value <0.05 was considered significant, P-value <0.001 was considered as highly significant and P-value >0.05 was considered insignificant.

### RESULTS

The present study included 19 (47.5%) females and 21 (52.5%) males. The mean age was 8.57±2.52. The main complain in the study group was diminution of vision in 32 patient (80%), and eye deviation in 8

patients (20%). Considering refraction of the study group, myopic patients were 26(65%) with a mean -7.07±4.55, While hyperopic patients was 14(35%) with a mean 3.93±1.96 (Table 1).

**Table (1): Refraction distribution of the study group**

Refraction	No.	%	Range	Mean±SD
Myopia	26	65.0%	-16.75 to -1	-7.07±4.55
Hypermetropia	14	35.0%	1 to 8	3.93±1.96
Total	40	100.0%	-16.75 to 8	-3.22±6.51

In the study group, the right eye was amblyopic in 21(52.5%) patients, while the left eye was the affected in 19 (47.5%) patients. Considering BCVA, we found a

statistically significant difference when compared pre - and post - amblyopia treatment (Table 2).

**Table (2): Comparison between BCVA before and after treatment**

BCVA	Range	Mean±SD	Mean Diff.	Mann-Whitney test	
					p-value
Before	0.1-0.5	0.27±0.12	0.22		<0.001
After	0.1-1	0.49±0.20			

Fundus examination was normal in 32 (80%), tigroid in 4 (10%), tigroid with tilted disc in 3 (7.5%) and tigroid with mylenated nerve fibers in 1 (2.5%). Two of our patients suffered alternating exotropia (5%) and 8 patients suffered esotropia (fully accommodative) (20%). There was a statistically significant difference in the central thickness when compared pre - and post - amblyopia

treatment, while the difference was statistically non-significant in average macular thickness and total volume There was a statistically significant difference in the superior quadrant of parafovea when compared pre - and post - amblyopia treatment, while the difference was statistically non-significant in other quadrants of parafovea There were statistically non-significant differences in

all quadrants when compared pre - and post - amblyopia treatment (Table 3). Considering RNFL thickness, GCL+ and GCL++, we found statistically non-

significant differences when compared pre - and post - amblyopia treatment (Table 3).

**Table (3): Pre-treatment VS. post-treatment OCT macula**

Treatment parameters	Before Treatment	After Treatment	Paired Sample t-test	
			Mean Diff.	p-value
Average Thickness	267.65±20.60	268.40±21.28	0.750	0.525
Central Thickness	188.30±28.33	195.08±33.88	6.780	0.038*
Total Volume	7.49±0.81	7.61±0.62	0.120	0.118
<b>Parafovea Macula</b>				
Nasal	294.20±24.95	297.63±23.45	3.430	0.064
Superior	292.25±26.72	297.45±23.23	5.200	0.049*
Temporal	281.20±21.55	285.13±27.16	3.930	0.216
Inferior	291.65±25.15	292.53±24.83	0.880	0.666
<b>Perifovea Macula</b>				
Nasal	277.20±30.65	277.28±32.45	0.080	0.938
Superior	264.83±20.44	264.70±22.81	-0.130	0.942
Temporal	250.00±23.52	251.60±23.74	1.600	0.237
Inferior	258.70±28.17	261.33±25.93	2.630	0.479
RNFL Thickness	31.65±2.18	32.00±2.31	0.350	0.264
GCL+	71.00±3.49	71.18±3.57	0.180	0.138
GCL++	102.03±4.25	102.78±4.21	0.750	0.235

## DISCUSSION

The mainstay treatment for amblyopia is occlusion of the better eye by an opaque patch (“patching”), to promote visual function. Part-time occlusion, defined as occlusion for 2-6 hours per day, has been shown to achieve results similar to those of prescribed full-time occlusion. The relative duration of patch-on and patch-off intervals should reflect the degree of amblyopia, maintenance patching of 1- 2 hours per day is often prescribed to prevent recurrence of amblyopia after successful patching.

By examination of forty amblyopogenic patients, we performed pretreatment OCT macula, part time occlusion treatment (6 hours/day) for one

week per year and post treatment OCT macula.

In our study, there was a significant increase in the mean of central macular thickness and superior quadrant of parafovea after part time occlusion treatment compared to pretreatment. No significant difference in average macular thickness, (nasal, temporal, inferior) parafovea, perifovea, RNFL thickness, GCL+ and GCL++ before and after treatment.

*Tugcu et al.*, (2014) studied macular thickness in the amblyopic eyes and reported no difference in macular thickness. *Chen et al.*, (2013) reported no significant thickness difference in any region of the macula. *Chun-Hsiu* (2018)

reported no difference was found in the macular and choroidal thicknesses between the persistent and recovered amblyopic eyes. *Huynh et al., (2009)* found that both foveal minimum thickness and average foveal thickness were greater in the amblyopic eyes with high myopia than in the normal fellow eyes. In contrast, both inner and outer macular thickness were thinner in the amblyopic eyes compared with that of the fellow eyes. *Pang et al., (2015)* reported that amblyopic eyes in children with myopic anisometropia had thicker foveae and thinner peripheral maculae compared to the fellow eyes before amblyopia treatment. Central maculae tended to be thinner following amblyopia treatment with no changes in peripheral macula. *Kavitha et al., (2019)* reported that macular thickness and foveal thickness which were more in amblyopic eyes as compared to normal fellow eyes and normal eyes of normal children, decreased with improvement in BCVA after occlusion therapy. However, there was no difference in RNFL thickness between amblyopic eyes and normal fellow eyes and normal eyes of normal children before and after occlusion therapy.

The variations in results of these reports are probably due to different study populations, defining criteria, type of amblyopia, different instruments used in measuring and co-existent factors like refractive errors.

## CONCLUSION

The mean of central macular thickness and superior quadrant of parapovea increased after part time occlusion treatment compared to pretreatment. No significant difference in average macular

thickness, (nasal, temporal, inferior) parapovea, perifovea, RNFL thickness and GCL before and after treatment.

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## تغيرات في سمك الماقولة بعد التغطية الجزئية للعين في حالات الكسل الوظيفي باستخدام التصوير المقطعي الضوئي المترابط

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**خلفية البحث:** الكسل الوظيفي للعين هو أكثر عيوب الأبصار انتشارا في مرحلة الطفولة، معظم الأطفال الذين يعانون من كسل وظيفي يحتاجون لاصلاح خلل الانكسار بالاضافة الي تغطية العين، الدلائل علي وجود تغيرات شبكية العين في العين التي بها كسل وظيفي مازالت غير حاسمة و محل جدل.

**الهدف من البحث:** قياس سمك أجزاء الماقولة باستخدام التصوير المقطعي الضوئي في العين التي بها كسل وظيفي قبل وبعد العلاج بتغطية العين لجزء من الوقت.

**المرضى وطرق البحث:** دراسة عشوائية غير محكومة تضمنت أربعين طفل يعانون من الكسل الوظيفي للعين ( أفضل تصحيح لحدة الابصار 0.1 – 0.5 ) تم علاجهم باصلاح خلل الانكسار والتغطية الجزئية للعين (6 ساعات/اليوم) لمدة اسبوع عن كل عام من عمر الطفل، افضل تصحيح لحدة الابصار وسمك أجزاء الماقولة (بجهاز التصوير المقطعي الضوئي) تم قياسهم قبل وبعد العلاج. تم اجراء تحليل متكرر للفرق في للقياسات لتحديد اذا كان هناك تغيير في سمك مركز الابصار بعد العلاج.

**نتائج البحث:** متوسط اعمار الاطفال يتراوح بين 5-12 سنة. هناك تغيير ذات دلالة احصائية في متوسط سمك النقرة بمركز الابصار قبل وبعد العلاج، ولا يوجد تغيير ذو دلالة إحصائية في باقي أجزاء ماقولة العين ماعدا الجزء العلوي

**الاستنتاج:** هناك زيادة في متوسط سمك النقرة والجزء العلوي من مجاور الماقولة بعد العلاج بالتغطية الجزئية للعين ولكن لا يوجد إختلاف ذو اهمية في باقي

أجزاء الماقولة وسمك طبقة الألياف العصبية بالشبكية و طبقة الخلايا العقدية بعد العلاج.