

The Effect of Unilateral Refractive Amblyopia in Retinal Structure

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Abstract

Aim: the study was aimed to assess the effect of unilateral refractive amblyopia on the thickness of macula (M), nerve fiber layer (NFL) and ganglion cell layer (GCL) structure and to compare it with normal eyes. **Material and Methods:** this is a cross sectional case control and prospective study was done in the period from October 2017 to October 2019 at Alwalidiean charity eye hospital. Vision and visual acuity tested by Snell's (E) chart ,refractive state estimated by Autorefractometer, best correct visual acuity done by Trial frame, Trial ophthalmic lenses set and pinhole test, inter-ocular pressure measured by Air puff tonometer and measurement of macula, optic nerve, and ganglion cell thickness by cirrus OCT5000 **Results:** Total of 100 patients were included in this study divided equally in two groups ,first group was unilateral refractive amblyopic patients and second group normal patients with (42% males and 58% females), (46% males and 54% females) respectively their age range (10-40)years, (12-40)years with mean of (23.4± 7.89) ,(23.9±7) respectively with no significant difference p value(0.673). The refractive unilateral amblyopic group included (74%) hypermetropic patients and (26%) myopic patients. Their visual acuity was ranged (0.05-0.6), (0.02-0.5) with mean of (0.030±0.030), (0.34±0.16) respectively for amblyopic eyes and ranged (1), (1) with mean of (1.00±1.00), (1.00±1.00) respectively for non-amblyopic eyes with significant difference of both (p<0.05). The refractive state for hypermetropic patients was ranged (2-8D) with mean of (3.39±1.49D) for amblyopic eyes and ranged (1-4D) with mean of (1.66±1.00D) for non-amblyopic eyes with significant difference (p<0.05). While for myopic patients was ranged (-2-6) with mean of (-3.31±1.31D) for amblyopic eyes and ranged (-2-5D) with mean of (-3±1.41D) for non-amblyopic eyes with no significant difference (p<0.05). Normal group their refractive state no more than ±0.75D and their vision 1.00. The study reveal that the average macula thickness (AMT) was significantly thicker in hypermetropic amblyopic eyes and opposite in myopic amblyopic eyes (p<0.05) of both, in comparison of macular thickness with normal eyes significant difference was found in myopic amblyopic eyes only (p<0.05). Average nerve fiber layer thickness (ANFLT) was significantly thinner in the myopic amblyopic eyes (p<0.05), in comparison with normal the myopic amblyopic eyes significantly thinner than normal eyes (p<0.05). Average ganglion cell thickness (AGCT) significantly thinner in myopic amblyopic eyes (p<0.05), in comparison with normal the hypermetropic amblyopic eyes significantly thinner than the normal eyes (p<0.05). **Conclusion:** The study showed that unilateral refractive amblyopia caused significant changes in macula, ganglion cell and retinal nerve fiber layer thickness.

Keywords: Amblyopia, macula thickness, nerve fiber layer thickness, ganglion cell layer thickness.

Introduction

The meaning of the word amblyopia is blurring of vision amblyos=blurred, opia= vision (1)
Unilateral = in one eye, Bilateral= in both eyes
Amblyopia is identified by reduce best corrected visual acuity in one or both eyes caused by an abnormal visual experience in the developing visual system without any organic abnormality of the globe (2).

Optical coherence tomography (OCT) is non-invasive technique for high-resolution cross-sectional tomographic imaging of the retina and optic nerve (2).

This study was aimed to assessment the effect of refractive unilateral amblyopia in the thickness of macula, ganglion cell and nerve fiber layer by using HD-OCT it has done before in different races and countries, it reveals controversial

result what motivates researcher to do it as first study in Sudanese people.

Material and methods

The study was cross sectional case control and prospective done at Alwalidian Charity Eye Hospital in period from October 2017 to October 2019.

One hundred patients were included in this study they agree to participated and full fill the criteria, male or female their ages between (10-40) years old free from any systemic or ocular diseases, intra-ocular pressure less than 23 mmHg and have no history of ocular surgery, for amblyopic group must have refractive error more than ± 2 D and for the normal group have refractive error not more than ± 0.75 D their

vision 6/6. Vision and visual acuity were tested by Snell's (E) chart , refraction estimated by Auto-Refractometer (Tomy version 100-24ov Nagoya 451-5001 Japan) Pinhole test to persist amblyopia, fundus examination done by ophthalmologist , inter-ocular pressure examined by non-contact Air-Puff Tonometer (100-24ov451-005 Japan) and measurement macula, optic nerve and ganglion cell thickness by Cirrus OCT 5000.

RESULTS

A total of 100 patients were included in this study they divided equally in tow groups first group unilateral refractive amblyopic and second group normal group

Table (1) the demographic data of both group

Variable	Amblyopic group	Normal group
Age	23.4 $\pm$ 7.89 range (10-40)years	23.9 $\pm$ 7 range (12-40)
Gender	Male 42% Female 58%	Male 46% Female 54%
Visual Acuity		
VA- hyper	amb0.30 $\pm$ 0.30 range(0.05-0.6) non-am1.00 $\pm$ 0.00range(1.00)p(0.001)	
VA- Myopia	amb0.34 $\pm$ 0.16range(0.02-0.5) non-amb1.00 $\pm$ 0.00 range(1.00)p (0.001)	

VA:Visual Acuity

Table (2) distribution of the degree of myopia

	Amblyopic eyes		Non-amblyopic eyes	
Myopia	Freq.	%	Freq.	%
Total	13	26%	13	26%
Range	-6 to -2D		-5 to -2D	
Mean SD	-3.31 $\pm$ 1.31D		-3 $\pm$ 1.41D	

Table(3) distribution of the degree of hypermtropia

	Amblyopic Eyes		Non-amblyopic Eyes	
Hyperopia	Freq.	%	Freq.	%
Total	37	74%	37	74%
Range	2-8 D		1-4 D	
Mean SD	3.39± 1.49D		1.66± 1D	

Table(4) Comparison of AMT between amblyopic eyes and non-amblyopic eyes according to refractive error type.

		Amblyopic eyes		Non-amblyopic eyes		
Variable	N	Mean, SD	Range	Mean, SD	Range	P value
Hyper	37	277.2±21.2 µm	194-307µm	269.9±24.8 µm	185-310 µm	0.019*
Myopia	13	243.6±40.9µm	164-300 µm	271.9±24.6 µm	185-310 µm	0.019*

Paired sample t-test showed a significant difference in the hypermertopic and the myopic amblyopia.

Table (5) Comparison of AMT between amblyopic eyes and normal eyes

		Amblyopic eyes		Normal eyes		
Variable	N	Mean, SD	Range	Mean, SD	Range	P value
Hyper	37	277.2±21.2µ	194-307	277.1±14.6µm	216-305	0.967
Myopia	13	243.6±40.9µ	164-300	277.1±14.6µm	216-305	0.028*

Paired sample t-test showed no significant difference in hypermertopic amblyopia while a significant difference found in the myopic amblyopia .

Table (6) comparison of ANFLT between amblyopic eyes and non-amblyopic eyes according to refractive error type

		Amblyopic eyes		Non-amblyopic eyes		
Variable	N	Mean, SD	Range	Mean, SD	Range	P value
Hyper	37	102.5±15.8µm	70-142	97.4±11.9µm	53-130	0.064
Myopia	13	86.6±17.2µm	45-116	97.4±11.9µm	53-130	0.007*

Paired sample t-test showed no significant difference in hypermertopic amblyopia while a significant difference found in myopic amblyopia .

Table (7) comparison of ANFLT between amblyopic eyes and normal eyes.

		Amblyopic Eyes		Normal Eyes		
Variable	N	Mean, SD	Range	Mean, SD	Range	P value
Hyper	37	102.5±15.8µm	70-142	99.8±10.2µm	82-119	0.431
Myopia	13	86.6±17.2µm	45-116	99.8±10.2µm	82-119	0.014*

Paired sample t-test showed no significant difference in hypermertopic amblyopia while a significant difference found in myopic amblyopia .

Table (8) comparison of AGCLT between amblyopic eyes and non-amblyopic eyes according to refractive error type

Variable	N	Amblyopic eyes		Non-amblyopic eyes		P value
		Mean, SD	Range	Mean, SD	Range	
Hyper	37	82.3±14.1µm	42-101	83±1.93µm	26-110	0.627
Myopia	13	76.3±19.7µm	25-95	83±1.93µm	26-110	0.047*

Paired sample t-test showed no significant difference in hypermetropic amblyopia while a significant difference found in the myopic amblyopia.

Table (9) comparison of AGCLT between amblyopic eyes and normal eyes.

Variable	N	Amblyopic Eyes		Normal Eyes		P value
		Mean, SD	Range	Mean, SD	Range	
Hyper	37	82.3±14.1µm	42-101	86.7±5.80µm	74-97	0.047*
Myopia	13	76.3±19.7µm	25-95	86.7±5.80µm	74-97	0.111

Paired sample t-test showed significant difference in the hypermetropic amblyopia while not significant difference found in the myopic amblyopia.

Discussion

This is the first study done in Sudan it was aimed to compare the thickness of macula, nerve fiber layer, and ganglion cell layer between the amblyopic eyes and the non-amblyopic eyes in amblyopic group and between amblyopic eyes and normal eyes in normal group.

The study included one hundred patients divided equally into two groups refractive unilateral amblyopic group and normal group, their ages ranged between (10-40) years, (12-40) years with mean (23.4±7.89) year, (23.9±7) years, respectively, with no significant difference table 1. The refractive unilateral amblyopic group included (26%) myopic patient and (74%) hypermetropic patients table 3 and 4 respectively, the range of hypermetropia of amblyopic eyes were (2-8D) with mean of (3.39±1.49D) and

of the non-amblyopic eyes were (1-4D) with mean of (1.66±1.00D) with significant difference and the range of myopia of amblyopic eyes were (-6-2D) with mean of (-3.3±1.31D) and of non-amblyopic eyes were (-5-2D) with mean of (-3.00±1.41D) with no significant difference table 2.

Considering to average macula thickness (AMT) our study reveals that the macula thickness of hypermetropic amblyopic eyes was significantly more thicker than the non-amblyopic eyes and opposite (thinner) was found in myopic eyes table 4 these results were disagreed with study of Abdullah G et al Jull 2011(3) who found no significant difference of MT between amblyopic and normal fellow eyes, study of Come et al., 2017 Jan(4) found no significant difference in AMT between amblyopic and non-amblyopic eyes of both myopia and hypermetropia eyes. Our

study agreed with Andalib et al., 2013 (2) in myopic finding but disagreed with his hypermetropic findings. The findings of Araki et al., 2014(5) were similar to our study. While in compare it with normal eyes there is significant thinning in the myopic amblyopic eyes table (5)

Considering to average nerve fiber layer thickness (ANFLT) our study reveal that No significant difference in hypermetropia and should significant difference in myopic amblyopic eyes was thinner than non-amblyopic eyes table (6). These result disagree with, Abdullah et al., 2011(3) was found RNFL significantly ticker in amblyopic eyes, Andalib et al., 2013 (2) found no significant difference, and Come et al., 2017 (4) also found no significant difference wither in hypermetropia or mayopia. While in compare it with normal eyes there is significant thinning in the myopic amblyopic eyes table 7.

Considering average ganglion cell layer thickness (AGCLT) the study reveal that no significant difference between the amblyopic eyes and non-amblyopic eyes in hypermetropia. this result agree with Araki et al., 2014 (5) who found no significant difference between the amblyopic and non- amblyopic eyes, but disagree with him in myopia the amblyopic eyes were significantly thinner than the non-amblyopic eyes, also disagree with study of Park et al., 2011(6) found it thinner in amblyopic eyes in all four location. While in the normal group the hypermetropia amblyopic eyes were thinner than the normal eyes table 9.

Conclusion

The study showed that unilateral refractive amblyopia caused significant changes in the thickness of retinal structure according to the type of refractive error the average macular thickness thicker in hypermetropic amblyopic eyes and thinner in myopic amblyopic eyes than the non-amblyopic eyes. when compare with normal eyes thinner in myopic amblyopic eyes, the average nerve fiber layer thickness thinner in myopic amblyopic eyes than the non-amblyopic eyes and also thinner when compare with normal eyes. The average ganglion cell layer thickness thinner in myopic amblyopic eyes than non-amblyopic eyes and also thinner when compare with normal eyes in hypermetropic eyes

Recommendations

The resercher recommend to treat amblyopia as early as possible and do ocular coherence tomography for every amblyopic patient to see how far it effect and wither the effect depend on the severity of amblyopia or not

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