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OCT BASED COMPARISON OF RNFL THICKNESS AND MACULAR THICKNESS IN AMBLYOPIC AND FELLOW EYE IN KASHMIRI POPULATION

Ophthalmology

Dr Nusrat Shaheen Associate Professor, Department Of Ophthalmology, SKIMS MCH Bemina
Dr Sehrish Rauof Senior Resident, Department Of Ophthalmology, SKIMS MCH Bemina.

ABSTRACT

Background: Amblyopia can be defined as reduced best-corrected visual acuity (BCVA) in one or both eyes caused by abnormal visual experience during visual development. Recently, subtle pathological variations in the macular area which are not noticeable in routine examination have been suggested as the cause of the reduced vision in amblyopic cases who are not responsive to treatment. Several experiments have demonstrated that retinal ganglionic cells can suffer modifications with visual stimulus deprivation from birth, including cell loss, mean nucleolar volume distribution in ganglion cell cytoplasm, and reduction in the optic nerve size area. **Aim & Objectives:** To compare the retinal nerve fibre layer thickness and macular thickness between amblyopic and fellow eyes using spectral domain Cirrus HD optical coherence tomography (OCT). **Materials and Methods:** It was a prospective observational study over a period of 18 months on patients aged 18-40 years. **Inclusion Criteria:** Amblyopia was diagnosed if there were: 2 or more lines of difference in visual acuity of two eyes, < 6/12 BCVA in bilateral cases having anisometropia, or strabismus or ptosis. **Exclusion Criteria:** Any evidence of ocular pathology. **Results:** The mean age of study patients was 28.1+6.74 years. Female were predominant with 57% against 43% males. 68% patients were from rural areas while 32% belonged to urban areas. Mean best visual acuity (logMAR) in amblyopic eye was 0.59+0.412 while as mean BCVA (logMAR) in fellow eye was 0.04+0.175. The difference was statistically significant with a pvalue of < 0.001. The mean central macular thickness (CMT) in the amblyopic eyes was 239.14+20.87 mm) was significantly greater than that of the fellow eyes (237.83+18.49 mm), p = 0.642. The average central macular thickness (CMT) in the amblyopic eyes was 271.31+14.73m) was significantly greater than that of the fellow eyes (269.85+13.81m), p = 0.459. When RNFL individual quadrants were explored, the difference between amblyopic and fellow eyes reached statistical significance in none of the quadrants. The average RNFL thickness (m) in the amblyopic eyes was 97.64+12.53 m) was lower than that of the fellow eyes(98.31+13.18m), p = 0.713. **Conclusion and Implication:** The conclusion of our study was that the mean central macular thickness (CMT) in the amblyopic eyes was significantly greater than that of the fellow eyes and that there is no statistically significant difference in NFLT between the amblyopic eye compared to the normal eyes. Also NFLT seems not to be affected by the type of amblyopia, age of patients and also the severity of amblyopia.

KEYWORDS

Visual Acuity, OCT, Nerve Fibre Layer, Optic nerve

INTRODUCTION

Amblyopia can be defined as reduced best-corrected visual acuity (BCVA) in one or both eyes caused by abnormal visual experience during visual development. It may be caused by sensory deprivation, image blur from refractive errors, strabismus, or a combination of these factors[2]. Amblyopia is a neuroanatomical and neuro-physiological disorder with no associated pathology of the optical axis or macula that could cause low vision, it cannot be eliminated with refractive correction and may be treated if diagnosed at an early stage. Amblyopia may be classified as strabismic, refractive (anisometropic and isometropic), deprivational, idiopathic, and mixed types. Amblyopia is usually associated with changes in the distribution of ocular dominance patterns in the visual cortex, cell shrinkage in the lateral geniculate body, and optic nerve hypoplasia[3].

Amblyopia can be classified as either being unilateral or bilateral. Unilateral amblyopia occurs when the visual image in one eye is compromised or blurred so that, that eye is selectively disadvantaged. In contrast, bilateral amblyopia can occur when there are similar levels of obstruction/blur in both eyes. Normal thickness of the foveola (centre), fovea (1mm) and macula in Chinese children 7-14 years of age has been reported to be 130+ 17.4, 153.8 + 17.6 and 176.7 + 14.8 microns respectively using OCT. The superior and inferior regions of the macula were thicker than the nasal and temporal regions (157-159 microns vs.102-109 microns)[4]. Increased macular thickness and decreased foveal depression have been reported in amblyopic patients using OCT previously. The reason can be related to lack of ganglionic cell apoptosis which normally occurs shortly after birth in healthy infants. Different therapeutic approaches including prescribing appropriate glasses or contact lenses and patching and penalization of the dominant eye have been applied. The success rate of amblyopic therapy depends on the severity of reduced vision, type of refractive errors, ocular alignment, age of the treatment, and the compliance of the child and his or her family. Recently, subtle pathological variations in the macular area which are not noticeable in routine examination have been suggested as the cause of the reduced vision in amblyopic cases who are not responsive to treatment[4].

Several experiments have demonstrated that retinal ganglionic cells can suffer modifications with visual stimulus deprivation from birth, including cell loss, mean nucleolar volume distribution in ganglion cell cytoplasm, and reduction in the optic nerve size area in mice Yen et. al18 reported that the circum papillary retinal nerve fibre layer of refractive amblyopic eyes was thicker than that observed in the normal fellow eye when using time-domain OCT. Retinal nerve fibre layer is considered a very sensitive indicator of early glaucoma, preceding other structural and functional changes of glaucomatous change[11].

Owing to its excellent ability to assess the RNFL thickness and macular thickness, optical coherence tomography (OCT) is the ideal instrument for assessing the RNFL thickness and CMT in amblyope patients.[12] The OCT findings reported by Li-et al19 suggested that the foveal thickness in amblyopic eyes was greater than that in visually normal control eyes.

Aims and Objective:

- To compare the retinal nerve between amblyopic and fellow eyes using spectral domain Cirrus HD optical coherence tomography (OCT).
- To compare the macular thickness between amblyopic and fellow eyes using spectral domain Cirrus HD optical coherence tomography (OCT).

MATERIALS AND METHODS

Study Design: Cross-sectional Observational study.
Study Population: Patients attending the Postgraduate Department of Ophthalmology, Sher-i-Kashmir Institute of Medical Sciences (SKIMS) Medical College Bemina were taken for study according to the inclusion and exclusion criteria over a period of 18 months on patients aged 18-40 years.

Inclusion Criteria: Amblyopia was diagnosed if there were: 2 or more lines of difference in visual acuity of two eyes, < 6/12 BCVA in bilateral cases having anisometropia, or strabismus or ptosis.

Exclusion Criteria: Any evidence of ocular pathology such as Poor clarity of refracting media including corneal opacity, cataract, and vitreous haemorrhage. Posterior segment diseases, retinal and optic disc diseases including glaucoma and intraocular tumours. Medical systemic disorders such as diabetes mellitus, hypertension, and vascular disorders affecting the retina. Very high degrees of refractive errors. Active external eye diseases including corneal disorders. History of trauma or previous ophthalmic surgery. The patients were registered on a pre-structured proforma which included patient's

demographic profile, chief complaints, duration, and any previous treatment. Complete systemic and ocular examination was performed.

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by bar and pie diagrams. Student's independent t-test was employed for comparison of various parameters between amblyopic and fellow eyes. A P-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 100 patients were enrolled in this study who were aged between 18 to 40 years with a mean age of 28.1± 6.74 years Majority of patients i.e. 36% in our study were aged between 26-30 years. There was a little female predominance in our study with 57% females versus 43% males. [Fig 1] In this study, majority of the patients were from rural areas i.e. 68% against 32% rural population. Mean uncorrected visual acuity (logMAR) in amblyopic eye was 0.94 ± 0.497 while as mean UCVA (logMAR) in fellow eye was 0.37±0.384. The difference was statistically significant with a p value of < 0.001. Mean best corrected visual acuity(logMAR) in amblyopic eye was 0.59±0.412 while as mean BCVA (logMAR) in fellow eye was 0.04±0.175. The difference was statistically significant with a p value of < 0.001. The mean central macular thickness (mCMT) in the amblyopic eyes (239.14+20.87) µm was significantly greater than that of the fellow eyes (237.83+18.49) µm, p = 0.642. The average central macular thickness (aCMT) in the amblyopic eyes (271.31+14.73) µm was significantly greater than that of the fellow eyes (269.85+13.81) µm, p = 0.459. [Table 1] The mean RNFL thickness in the amblyopic eyes was 114.72+16.87) µm was not significantly different from that of the fellow eyes (117.09+14.92) µm, p = 0.121. When RNFL individual quadrants were explored, the difference between amblyopic and fellow eyes reached statistical significance in none of the quadrants. The mean RNFL thickness (µm) in the amblyopic eyes was (97.64+12.53) µm was lower than that of the fellow eyes (98.31+13.18) µm, p = 0.713.

DISCUSSION

The amblyopic process may have an effect on various levels of the visual pathway. Atrophy involving the cells in the lateral geniculate nucleus that receive input from the amblyopic eye has been reported[8]. However, retinal involvement in the amblyopic eye is controversial[9]. A total of 100 patients were enrolled in this study who were aged between 18 to 40 years with a mean age of 28.1+6.74 years. There was a little female predominance in our study with 57% females versus 43% males which corresponds with the study of Abdulghaffar AT et al.[1], Yakar K et al.[5], Laylani NAR and Alasady S.[7]

In the present study, mean uncorrected visual acuity (logMAR) in amblyopic eye was 0.94+0.497 while as mean UCVA (logMAR) in fellow eye was 0.37+0.384. The difference was statistically significant with a p value of < 0.001. Mean best corrected visual acuity (logMAR) in amblyopic eye was 0.94+0.497 while as mean UCVA (logMAR) in fellow eye was 0.37+0.384. The difference was statistically significant with a p value of < 0.001 which also correlates with the study of Abdulghaffar AT et al. in which uncorrected visual acuity (logMAR) was 0.98±0.30 and 0.43±0.33 in the amblyopic and fellow eyes, while the mean BCVA by logMAR was 0.68±0.43 and 0.08±0.13 in the amblyopic and fellow eyes, respectively. Comparison of UCVA and BCVA on the basis of logMAR revealed a significant difference between the two subgroups. Fellow eyes showed significantly better UCVA and BCVA values, when compared with the amblyopic eyes. Araki S et al.[6] compared the macular retinal thickness and characteristics of optic nerve head (ONH) parameters in amblyopic and fellow eyes in patients with unilateral amblyopia. The mean central macular thickness (mCMT) in the amblyopic eyes was (239.14+20.87) µm was significantly greater than that of the fellow eyes (237.83+18.49) µm, p=0.642. The average central macular thickness(aCMT) in the amblyopic eyes was (271.31+14.73) µm was significantly greater than that of the fellow eyes (269.85+13.81) µm, p=0.459, all these findings conform with the findings in our study. Al-Haddad CE et al., (2011)33 did a study in which the mean CMT was 244.65±18.13µm in the amblyopic eyes versus 243.89 ±21.58µm in the fellow eyes, and the mean average macular thickness was 268.89±12.62 µm in the amblyopic eyes versus 268.15±13.70 µm in the fellow eyes which also correlates with our study.

In the present study, the mean RNFL thickness in the amblyopic eyes was (114.72+16.87m) which was not significantly different from that of the fellow eyes (117.09+14.92m), p = 0.121. When RNFL individual quadrants were explored, the difference between amblyopic and fellow eyes reached statistical significance in none of the quadrants. The average RNFL thickness (m) in the amblyopic eyes was (97.64+12.53m) was lower than that of the fellow eyes (98.31+13.18m), p = 0.713) but the difference was not statistically significant.

In the study by Abdulghaffar AT et al In myopic amblyopia group, the mean RNFLT in the amblyopic eyes was significantly lower than the fellow eyes with RNFLT in the amblyopic and the fellow eyes of 103.4±12.0 and 103.4±17.2 µm, respectively which corresponds with our study as well. Another example is the study of Yakar K et al., (2015)30 which reported RNFLT being 111.9±12.9 and 109.7± 9.42µm in the amblyopic and fellow eyes, respectively.

Yen MY et al., (2004)[10] Yoon SW et al., (2005)[8] Both stated that that the RNFL was thicker in amblyopic eyes compared to the fellow eyes which contradicts with our study as we found no statistically significant difference in RNFLT of amblyopic eye and the fellow eye. Yoon SW et al., also stated that there is no difference in the macular thickness between the amblyopic eye and the fellow eye which also contradicts with our study as we found thicker CMT in amblyopic eyes than fellow normal eyes.

Table 1: Mean And Average Central Macular Thickness (µm) Of Amblyopic And Fellow Eyes

		Mean	SD	95% CI	P-value
mCMT (µm)	Amblyopic eye	239.14	20.87	228.73-253.48	0.642
	Fellow eye	237.83	18.49	225.36-250.13	
aCMT (µm)	Amblyopic eye	271.31	14.73	259.75-285.48	0.459
	Fellow eye	269.85	13.91	254.32-281.54	

Table 2: RNFL Thickness (µm) In Various Quadrants Of Amblyopic And Fellow Eyes

Quadrant	Amblyopic eye		Fellow eye		P- value
	Mean	SD	Mean	SD	
Superior quadrant	114.72	16.87	118.34	15.91	0.121
Inferior quadrant	117.09	14.92	115.83	15.38	0.557
Temporal quadrant	71.63	11.75	72.15	12.71	0.764
Nasal quadrant	87.41	14.81	85.78	11.36	0.384

Table 3: Average RNFL Thickness (µm) Of Amblyopic And Fellow Eyes

Mean RNFL thickness (µm)	Mean	SD	95% CI	P-value
Amblyopic eye	97.64	12.53	84.72-109.51	0.713
Fellow eye	98.31	13.18	86.17-112.85	

CONCLUSION

The conclusion of our study was that the mean central macular thickness (CMT) in the amblyopic eyes was significantly greater than that of the fellow eyes and that there is no statistically significant difference in NFLT between the amblyopic eye compared to the normal eyes. Also NFLT seems not to be affected by the : type of amblyopia, age of patients and also the severity of amblyopia.

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