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# Study of central macular and nerve fiber layer/ganglionic cell layer (NFL/GCL) thickness in normal and amblyopic eyes of pediatric patients with uniocular amblyopia

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**Abstract**
**Purpose:** To examine central macular and peripapillary retinal nerve fibre layer (RNFL)/ganglion cell layer (GCL) thickness in uniocular amblyopic patients.
**Methods:** This cross sectional observational prospective study conducted on 20 patients (8-18 years) diagnosed with uniocular amblyopia. Central Macular Thickness (CMT) and NFL/GCL thickness was measured by OCT (NIDAC RS 3000 ADVANCE) and data was compared with normal fellow eye.
**Results:** In a study group of 20 children (males=14, females= 6), the mean values of CMT observed in amblyopic eyes is (354 mm) and those of healthy fellow eyes is (253.55 mm). Also, RNFL/GCL thickness was determined in these children where mean value in amblyopic eyes is (121.89 mm) and those of healthy fellow eyes is (119 mm). Amblyopic eyes had slightly greater central macular thickness (macular map) as compared to the healthy fellow eye (p-value of (<0.05). The values of RNFL/GCL thickness showed no change (p- value (>0.05).
**Conclusions:** In children aged predominantly 8 and 18 years, central macular thickness may be increased in eyes with amblyopia, although it is uncertain if this precedes or follows the development of amblyopia. No differences in peripapillary RNFL thickness were found when compared with normal eyes.

**Keywords:** Central macular, layer/ganglionic, NFL/GCL, uniocular amblyopia

## Introduction

Amblyopia is defined as a decrease of visual acuity for which no causes can be detected by the physical examination of the eye, caused by vision deprivation or abnormal binocular interaction [1].

Amblyopia is a decrease of visual acuity in one or both eyes caused by abnormal visual experience during visual maturation and which in appropriate cases is reversible by therapeutic measures. It is usually found in patients with strabismus, anisometropia, or pattern vision deprivation. It occurs usually during the development of a neuronal network between the retina and the cerebral cortex. The first 2–3 years of the life are the most common age for development, but it may develop up to the age of 8–9 years [2].

Amblyopia is the one of the most common cause of visual loss in children affecting 0.2% to 1.1% of school going children. The causes of amblyopia in decreasing order of prevalence are strabismic, anisometropic, mixed, ametropic, meridional and sensory deprivation amblyopia [2]. The literature and experimental studies have described the pathophysiology of structural changes in amblyopia at different levels of the visual information processing pathway. The anatomical changes have been described at the cortical, lateral geniculate body and retinal levels [3].

Amblyopia is classified as deprivation amblyopia, anisometropic amblyopia, strabismic amblyopia, mixed amblyopia. The structures involved in amblyopia are under investigation. Some studies have suggested that the site responsible for the visual deficit may be located in the lateral geniculate nucleus (LGN) [4].

The American Academy of Ophthalmology considers amblyopia an interocular difference of 2 lines or more in a visual acuity table (without specifying any), or visual acuity worse than or equal to 20/30 with the best optical correction [5].

In this study we are using the above criteria for diagnosis of amblyopia in our patients.

Optical coherence tomography (OCT) was introduced in 1991 and since then it has become an invaluable tool in the diagnosis and management of different retinal disorders. OCT is a non- invasive imaging test. Optical coherence tomography (OCT) provides high resolution images of the retina and its layers. OCT has high repeatability and is not influenced by high refractive errors, age and sex of the subjects [6].

Optical coherence tomography (OCT) is a used for quantification of the retinal structures. Time domain OCT have been used to study RNFL and macular thickness in amblyopic eyes. More recently, spectral-domain OCT (SD-OCT) has been used as it scans more data points (7). Keeping this in mind the present study was undertaken to assess the mean central macular thickness and mean RNFL /GCL thickness in amblyopic eyes of children using OCT in cases of unilateral amblyopia and comparison was made with the fellow normal eyes.

**Methodology**

This is a hospital based cross sectional observational study.

After taking permission from scientific and institutional ethics committee.All patients in age group 8-18 years of either gender presenting to eye OPD of NIMS Medical College with complaints of diminution of vision will undergo detailed history and examination.

After complete history and examination including best corrected visual acuity (BCVA) using Snellen's chart, refraction, slit lamp bio microscopy, indirect ophthalmoscopy, intra ocular pressure (IOP) measurement, those patients diagnosed as uniocular amblyopia according to the diagnostic criteria mentioned, will be selected. Inclusion and exclusion criteria will be applied on these patients. Those fulfilling criteria will be enrolled in study. Written informed consent will be taken. Detailed history on preformed proforma including basic demographic data, presenting complaints, past history and family history will be noted for all enrolled patients. Detailed examination including BCVA using Snellen's chart, refraction, slit lamp bio microscopy, indirect ophthalmoscopy, and intra ocular pressure (IOP) measurement by applanation tonometer. Macular thickness, NFL/GCL thickness of each patient will be measured by OCT [NIDEK RS-3000 ADVANCE]. and horizontal scans will be taken for each patient. All the scans will be taken by the same examiner under the same conditions. Collected data will be presented in appropriate charts and tables as preformed in proforma. Data will be compared within each eye of the patient. Patient's other normal eye is taken as control.

**Inclusion Criteria**

1. Patients of age group 8-18 years, of either gender, coming to Ophthalmology OPD in NIMS hospital diagnosed with uniocular amblyopia.
2. Patients who give assent for the study.
3. Patients whose legal guardians are willing to give voluntary written informed consent.

**Exclusion Criteria**

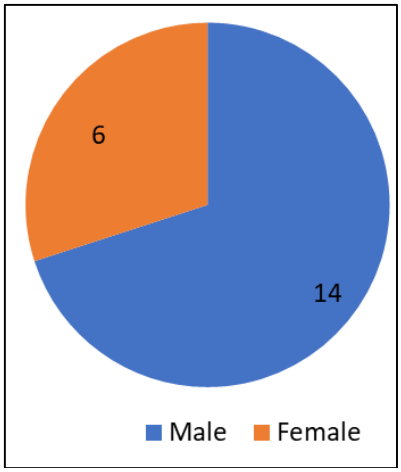
1. Patients with other ocular abnormality or ocular trauma.
2. Patient with history of intraocular surgery or refractive surgery.
3. Patients with neck deformity who cannot participate for OCT evaluation.
4. Uncooperative patients.

**Results and observations**

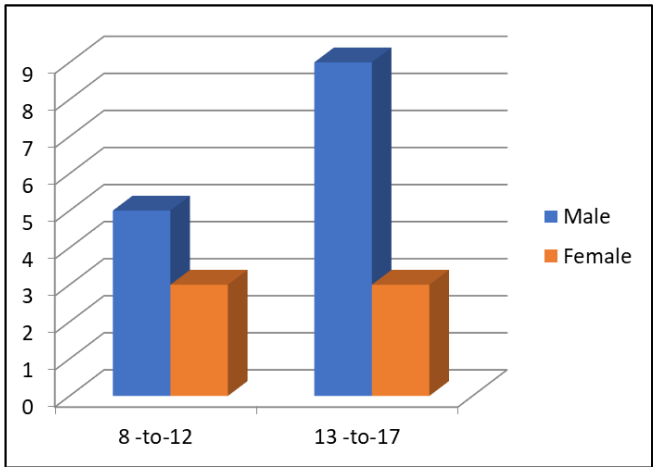
**Demography**

**Gender distribution**

| Gender | Cases |
|---|---|
| Male | 14 |
| Female | 6 |
| Total | 20 |




**Age Distribution**




| Age | Male | Female |
|---|---|---|
| 8 to 12 | 5 | 3 |
| 13 to 17 | 9 | 3 |
| TOTAL | 14 | 6 |

| | Amblyopic eye | Fellow eye | P value |
|---|---|---|---|
| CMT | 354 ± 25.77 micron | 253 ± 26.56 micron | <0.05 |
| RNFL thickness | 121 ± 16.95 micron | 119 ± 18.61 micron | >0.05 |

**Average CMT and Rnfl Thickness**

Average CMT value in amblyopic eye was found to be 354±25.77 micron and in fellow eye was found to be 253±26.56 micron (P value <0.05).

P value <0.05 indicates statistically significant difference between amblyopic and fellow eye. So Positive association was found between amblyopia and CMT.

Average RNFL thickness value in amblyopic eye was found to be 121±16.95 micron and in normal fellow eye was found to be 119±18.61 micron (P value >0.05).

P value >0.05 indicates statistically insignificant difference between amblyopic and fellow eye. So no Positive association was found between amblyopia and RNFL thickness.

## Discussion

In present study, the mean age was 13.2 ± 2.82 years which is comparable with study done by V Kavitha *et al* [8] where the mean age was 9.77 ± 2.674 were in the age group of 5 – 18 years.

In our study it is found that central macular thickness may be increased in eyes with amblyopia, although it is uncertain if this precedes or follows the development of amblyopia. No differences in peripapillary RNFL thickness were found when compared with normal eyes. Shivam Sood, Amit Maitreya [2], Renu Dhasmana [3] (2019) [9] *et al*. in their study, Foveal thickness was found significantly more in the amblyopic eye than fellow normal eye whereas the RNFL thickness showed no statistically significant difference between the two groups.

Son C Huynh(2009) [10] *et al*. demonstrated in their study that In children aged predominantly 6 and 12 years, central macular thickness may be increased in eyes with amblyopia, although it is uncertain if this precedes or follows the development of amblyopia. No differences in peripapillary RNFL thickness were found when compared with normal eyes.

Dima Andalib (2013) [11] *et al*. in their study showed that thicker macula was found in anisometropic amblyopic eyes, but the increase of macular thickness in strabismic amblyopic eyes was not significant. Retinal involvement was not observed in the peripapillary nerve fiber layer of amblyopic eyes.

V Kavitha, Mallikarjun M Heralgi (2019) [8] *et al*. studied MT and FT, which were more in amblyopic eyes as compared to normal fellow eyes and group 2, decreased with improvement in BCVA after occlusion therapy. However, there was no difference in RNFLT between amblyopic eyes and normal fellow eyes and group 2 before and after occlusion therapy.

May-Yung Yen (2004) [12] *et al*. in their study showed that RNFLT may be affected by refractive amblyopia, but further histopathologic confirmation is needed.

## Conclusion

- In children aged predominantly 8 to 18 years, central macular thickness may be increased in eyes with amblyopia, although it is uncertain if this precedes or follows the development of amblyopia.
- No differences in peripapillary RNFL thickness were found when compared with normal eyes.

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