# Effect of Myopia and Axial Length on Peripapillary Retinal Nerve Fiber Layer Thickness Using Spectral Domain Optical Coherent Tomography

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**Abstract:** ***Background**: Myopia is a refraction error in which parallel rays of light coming from infinity are focused in front of retina with a accommodation at rest. It results in many pathological changes like thinning of RNFL. RNFL thickness measurement is sensitive for detection of glaucoma and it correlates with severity of functional deficit in the visual field. RNFL thickness can be measured with OCT which is high resolution cross-sectional imaging technology used for retinal imaging. **Aim**: To evaluate the effect of myopia and axial length on peripapillary RNFL thickness using spectral domains OCT **Material & Methods**: Randomly selected 100 myopic patients between age 15-40yrs excluding patients with history of any type of glaucoma, severe ocular trauma ,refractive surgery, strabismus, retinal diseases, uveitis, refractive errors other than myopia, amblyopia, corneal abnormalities, media opacities, ocular hypertension, any neurological diseases that could affect optic nerve head underwent detailed ocular examination including visual acuity, refraction, IOP measurements, visual field testing, fundus examination, axial length measurement, RNFL thickness measurement using SD-OCT. **Results**: A significant, strong association found between axial length and RNFL thickness. RNFL thickness decreases as axial length increases in all four quadrants. Average 360 degree RNFL thickness (mean±SD) in all 200 eyes was 92.30±10µm. The 'p' value was <0.0001, which was significant. **Conclusion**: It was found from our results that RNFL thickness decreases with increase in axial length and increase in myopic refractive error. Thus axial length affected the average RNFL thickness and myopia affected the RNFL thickness distribution. Prevalence of glaucoma is higher in myopic eyes thus myopia may be a confounded in addition to being a risk factor*

**Keywords:** Myopia, axial length, glaucoma, RNFL thickness, SD-OCT.

## 1. Introduction

Myopia is the most common clinical condition seen in clinical practice. Myopia, or nearsightedness, is the most common refractive error in children and young adults.Myopia has increasingly become a concern due to the unawareness and stigma among parents. Furthermore, the COVID-19 pandemic has added to the previous woes. The prolonged use of digital screens among children has increased the incidence of myopia and accelerated its progression.Indeed, the incidence and prevalence of myopia have increased considerably. The prevalence of myopia varies according to ethnicity and geography. The prevalence of myopia is highest in regions of East Asia (47%) and Southeast Asia (39%) as compared to Central Europe (27%) and Central Africa (7%). Myopia is attributable to a complex interaction between genetics and the environment. Familial clustering in myopia is evident in twin studies and high sibling risk ratios.Children predisposed to myopia have a large axial length at birth, which supersedes the emmetropization process, resulting in rapid progression to myopia during childhood. However, the progression slows during young adulthood and plateaus by the age of 18 years.However, the progression of myopia continues until the age of 25 years in a few individuals. After 25 years of age, any progression can be attributed to lens thickening, resulting in a myopic shift.Myopia is considered to be a risk factor for open-angle glaucoma based on the findings of many studies.Nevertheless, this relationship remains obscure.It may be a confounding factor in the diagnosis of glaucoma. Disc changes in myopes may make it difficult to distinguish glaucomatous optic neuropathy from the myopia-related optic nerve and retinal abnormalities that may complicate both the diagnosis and treatment of glaucomatous disease. The presence of optic disc tilt and torsion along with peripapillary atrophy in myopic eyes makes detection of glaucomatous optic disc changes difficult. Glaucoma diagnosis relies upon determining progressive optic nerve damage with corresponding visual field deterioration and peripapillary nerve fiber layer thinning.Diagnosing glaucoma in the presence of optic nerve and retinal characteristics of moderate or high myopia is a unique challenge. Thus, it is imperative to understand the effects of high myopia on the RNFL thickness. RNFL thinning associated with myopia may mimic the RNFL thinning associated with glaucoma, possibly leading to overdiagnosis. Optical coherence tomography (OCT) is an objective and accurate method for RNFL thickness measurement. Compared with other RNFL analyzers, such as scanning laser polarimetry and Heidelberg retinal tomography, OCT provides high-resolution images with a quantitative analysis of the retinal features.The new generation of spectral domain (SD) OCT with high speed image acquisition, superior axial resolution (1-5 µm) and generation of 3-dimensional images provides detailed measurements of RNFL and the macula. Moreover, SD OCT permits segmentation and measurement of individual retinal layers using computer-assisted programs.RNFL, as measured by SD OCT, varies with age, gender, ethnicity, axial length, refractive status and optic disc area. Association of myopia with primary open angle glaucoma is well recognized with 2-3 times higher risk of developing glaucoma in myopes.Various studies have measured the effect of axial length or refractive status on peripapillary RNFL thickness using high resolution SD OCT and recommended that axial length must be taken into account while evaluating patients for diagnosis and follow-up of glaucoma on the basis of OCT findings.However, to our best knowledge, although RNFL thinning is indicative of glaucomatous damage, it remains uncertain whether RNFL thickness would vary with the refractive status of the eye. It is therefore important to investigate whether any correlation exists between RNFL measurements and axial length/ refractive error in myopia, with regard to the observation that the risk of development of glaucoma is increased with an increasing degree of myopia. Therefore, we focused on determining the relationship between RNFL axial length andmyopia using SD OCT.

## 2. Aim

To evaluate the effect of myopia and axial length on peripapillary RNFL thickness using spectral domains OCT.

## 3. Material & Methods

Total 200 eyes of 100 patients between the age of 15-40 years with myopic refractive error were included in this study. After initial screening, the data regarding age, gender, diagnosis was recorded in the case record form. Examination of visual acuity with Snellen's chart and correction of refractive error was done by retinoscopy and subjective refraction. All patients were divided into three groups depending upon refractive status as low myopia with spherical equivalent of (SE < -3.00 D), moderate myopia (SE between -3.00 D to -6.00 D), high myopia with spherical equivalent of (SE > -6.00 D) . Also depending upon axial length of the myopic eyes divided into three groups as 1st group having axial length <24 mm, 2nd group having axial length 24 – 26 mm, 3rd group having axial length >26 mm.

Detailed ocular examination such as visual acuity both for distance and near was determined by Snellen's chart & Jagger's chart, refraction was done with streak retinoscope at 2/3rd meter distance, refractive correction was done by retinoscopy and subjective refraction, anterior segment examination, IOP measurement was recorded with Goldmann'sapplanation tonometer, visual field testing, fundus examination using- Direct ophthalmoscope, Indirect ophthalmoscope, Slit lamp bio microscopy with 90D lens, axial length measurement , RNFL measurement was done by Cirrus HD SD-OCT.

## 4. Result

This study included 200 eyes of 100 patients with myopia ranging from −1D to −6D. Average age of patients was 25.64 with standard deviation 6.38 years . The study group had 45 males (45%) and 55 females (55%). Both, age and gender of the patient did not influence the RNFL thickness.Mean refractive error of right eye was -3.85 with standard deviation 261 similarly the mean refractive error of left eye was -3.49 with standard deviation 2.37. The low myopia group (<−3D) had 107 eyes, moderate myopia (−3D to −6D) had 55 eyes, and high myopia (>−6D) had 38 eyes. Mean axial length of right eyes were 24.63 with standard deviation was 1.49 mm and mean axial length of left eyes were 24.48 with standard deviation was 1.45. Group 1 (<24 mm) included 93 eyes, group 2 (24-26 mm) included 69 eyes and group 3 (>26mm) includes 38 eyes.

There was a statistically significant difference in the average peripapillary RNFL thickness between the three groups based on the axial length of the eye, with a mean (±SD) RNFL of group 1 being 99.88 ± 6.76, for the group 2 being 89.14 ± 4.76 and for group 3 being 77.64 ± 7.45 and *P* =0.000001 for right eye and 100.23 ± 5.08, 89.83 ± 4.44 and 78.82 ± 6.1 for left eye respectively. There was an inverse correlation between axial length and the RNFL thickness.There was a statistically significant difference in the average RNFL thickness between the three degrees of myopia groups, with least myopia having higher RNFL thickness and high myopia with least RNFL thickness (*P* = 0.001); low myopia group mean RNFL being 97.85 ± 7.82, moderate myopia group 89.1 ± 6.69 and high myopia group78.75 ± 8.53 in right eyes and 98.56 ± 6.38, 90.47 ± 5.35, 79.53 ± 6.39 in left eye respectively. There was also a correlation between the degree of refractive error and the mean RNFL thickness along with superior, inferior,nasal and temporal quadrants RNFL thickness.

**Table 1:** Gender distribution of patient

| Gender | n = 100 | In % |
|---|---|---|
| Male | 45 | 45% |
| Female | 55 | 55% |

**Table 2:** Severity of myopia in right and left eye of patients (n=100)

| Degree of Myopia | Right Eye | Left Eye |
|---|---|---|
| Low | 52 | 55 |
| Moderate | 29 | 26 |
| High | 19 | 19 |
| Refractive error (Mean ± SD) | -3.85 ± 2.61 | -3.49 ± 2.37 |

**Table 3:** Mean RNFL thickness distribution of average 360 degree and quadrant wise in axial length of right eye (n=100)

| RNFL Thickness | ≤ 24 | 24 - 26 | > 26 |
|---|---|---|---|
| Average 360 degree | 99.88 ± 6.76 | 89.14 ± 4.76 | 77.64 ± 7.45 |
| Superior quadrant | 125.7 ± 9.64 | 107.97 ± 8.61 | 94.75 ± 10.3 |
| Inferior quadrant | 133.18 ± 7.84 | 116 ± 11.01 | 101.2 ± 13.03 |
| Nasal quadrant | 70.58 ± 6.3 | 60.83 ± 6.82 | 50.2 ± 4.98 |
| Temporal quadrant | 73.27 ± 6.1 | 68.4 ± 3.70 | 64.45 ± 6.93 |

**Table 4:** Mean RNFL thickness distribution of average 360 degree and quadrant wise in axial length of left eye (n=100)

| RNFL Thickness | ≤ 24 | 24 - 26 | > 26 |
|---|---|---|---|
| Average 360 degree | 100.23 ± 5.08 | 89.83 ± 4.44 | 78.82 ± 6.1 |
| Superior quadrant | 126.17 ± 10.87 | 112.18 ± 8.23 | 97.06 ± 11.16 |
| Inferior quadrant | 130.13 ± 9.41 | 117.8 ± 8.02 | 100.1 ± 8.23 |
| Nasal quadrant | 71.21 ± 5.04 | 59.56 ± 5.76 | 52.7 ± 4.7 |
| Temporal quadrant | 73.1 ± 4.18 | 70.35 ± 4.07 | 65.7 ± 5.45 |

**Table 5:** Mean RNFL thickness distribution of average 360 degree and quadrant wise in severity of myopia of right eye (n=100)

| RNFL Thickness | Low | Moderate | High |
|---|---|---|---|
| Average 360 degree | 97.85 ± 7.82 | 89.1 ± 6.69 | 78.75 ± 8.53 |
| Superior quadrant | 122.73 ± 11.28 | 108.5 ± 9.87 | 94.84 ± 11.66 |
| Inferior quadrant | 130.25 ± 9.87 | 115.35 ± 14.1 | 103.11 ± 13.87 |
| Nasal quadrant | 68.73 ± 8.36 | 60.28 ± 7.27 | 51.95 ± 5.46 |
| Temporal quadrant | 72.52 ± 5.76 | 69.14 ± 4.66 | 63.37 ± 6.29 |

**Table 6:** Mean RNFL thickness distribution of average 360 degree and quadrant wise in severity of myopia of left eye (n=100)

| RNFL Thickness | Low | Moderate | High |
|---|---|---|---|
| Average 360 degree | 98.56 ± 6.38 | 90.47 ± 5.35 | 79.53 ± 6.39 |
| Superior quadrant | 124.6 ± 11.03 | 112.27 ± 8.86 | 97.11 ± 10.77 |
| Inferior quadrant | 128.2 ± 10.41 | 118.04 ± 9.2 | 101.74 ± 9.26 |
| Nasal quadrant | 69.1 ± 7.49 | 60.5 ± 5.68 | 53.63 ± 5.25 |
| Temporal quadrant | 72.4 ± 4.34 | 71.1 ± 4.36 | 69.95 ± 5.35 |

## 5. Conclusion

The conclusion of the present study entitled **'Effect of myopia and axial length on peripapillary retinal nerve fiber layer thickness using spectral domain optical coherent tomography'** can be drawn as follows:

1) The mean age of patients was 25.64 ± 6.38, majority of patients 26 % belonged to age group 20 – 25 with the female preponderance.
2) The mean axial length of right eye was 24.63 ± 1.49 and left eye was 24.48 ± 1.45 and, the mean refractive error of right eye was -3.85 ± 2.61 and left eye -3.49 ± 2.37.
3) There was a significant association between thinning of RNFL in each quadrant with increasing degree of myopia ($p < 0.0001$).
4) There was a significant association between thinning of RNFL in each quadrant with increase in axial length ($p < 0.0001$).

It was found from our results that RNFL thickness decreases with increase in axial length and increase in myopic refractive error. Thus axial length affected the average RNFL thickness and myopia affected the RNFL thickness distribution. Prevalence of glaucoma is higher in myopic eyes thus myopia may be a confounded in addition to being a risk factor.

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**Conflicts of interest**

There are no conflicts of interest

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