ISSN Print: 2664-7591
ISSN Online: 2664-7605
Impact Factor: RJIF 5.2
IJPCR 2025; 7(1): 10-13
www.pharmaceuticaljournal.in
Received: 06-01-2025
Accepted: 10-02-2025

Rughani Kalgi Pareshbhai
Final Year Post Graduate, Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Dr. Manjula YM
Professor and Guide, Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Dr. Vaishnavi Kamin
Post Graduate, Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Dr. Simran Padiyar
Post Graduate, Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Dr. Nibedita Acharya
Professor and HOD, Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Dr. Kavya Deshpande
Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Dr. Sushma A
Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Corresponding Author:
Rughani Kalgi Pareshbhai
Final Year Post Graduate, Department of Ophthalmology, BGS Global Institute of Medical Sciences, Bengaluru. Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India

Comparative analysis of retinal nerve fiber layer thickness between myopic and emmetropic eyes: Patterns of thinning and clinical implications

Rughani Kalgi Pareshbhai, Manjula YM, Vaishnavi Kamin, Simran Padiyar, Nibedita Acharya, Kavya Deshpande and Sushma A

DOI: https://doi.org/10.33545/26647591.2025.v7.i1a.116

Abstract
Introduction: Myopia is a significant risk factor for open-angle glaucoma, but diagnosing glaucoma in myopic patients remains challenging due to overlapping structural characteristics. Optical coherence tomography (OCT) is widely used to measure retinal nerve fiber layer (RNFL) thickness for glaucoma diagnosis; however, normative databases typically exclude individuals with high refractive errors. This study aimed to evaluate RNFL thickness in myopic patients compared to emmetropes and analyze quadrant-specific changes across varying degrees of myopia.
Methods: This cross-sectional observational study included 120 subjects (60 myopes, 60 emmetropes) aged 20-35 years attending ophthalmology OPD at BGS Global Institute of Medical Sciences Hospital. Comprehensive ophthalmic examination including refractive error measurement and RNFL thickness assessment using Cirrus HD Spectral Domain OCT was performed. Myopes were categorized as low (<-3D), moderate (-3D to-6D), and high (>-6D). Mean RNFL thickness was recorded globally and by quadrant.
Results: Mean RNFL thickness was significantly lower in myopes (85.78±11.04 µm) compared to emmetropes (100.22±7.17 µm; p<0.001) across all quadrants. Among myopes, significant differences were observed in average RNFL thickness by severity (low: 88.04±10.96 µm; moderate: 77.69±8.29 µm; high: 87.50±0.71 µm; p = 0.009), with significant variations in inferior (p = 0.004) and superior (p = 0.002) quadrants but not in nasal (p = 0.098) and temporal (p = 0.105) quadrants. Notable violation of the ISNT rule was observed particularly in moderate and high myopes. Gender did not significantly influence RNFL thickness in either myopic or emmetropic groups.
Conclusion: Myopia significantly affects peripapillary RNFL thickness measurements, with variations across different quadrants and degrees of myopia. The violation of the ISNT rule in moderate and high myopes highlights the importance of cautious interpretation of OCT measurements in myopic patients when screening for glaucoma and suggests the need for myopia-specific normative databases.

Keywords: Myopia, glaucoma, RNFL thickness, OCT, ISNT rule, normative database

Introduction
Myopia, a common refractive error affecting a significant portion of the global population, has shown an alarming increase in prevalence over recent decades, particularly in East Asian countries [1]. This growing prevalence raises important clinical considerations, as myopia is associated with various ocular complications including glaucoma, choroidal neovascularization, and retinal detachment [2].
The relationship between myopia and glaucoma has been extensively studied, with numerous investigations suggesting that myopia is a potential risk factor for primary open-angle glaucoma (POAG). Several population-based studies have demonstrated a two-to three-fold increased risk of glaucoma among myopic individuals compared to non-myopic controls. However, the diagnosis of glaucoma in myopic patients presents unique challenges for clinicians due to overlapping structural characteristics between the two conditions [3-4].
Glaucoma diagnosis typically relies on the assessment of structural changes in the optic nerve head, peripapillary retinal nerve fiber layer (RNFL) thickness, and corresponding visual field defects. In myopic eyes, the optic disc often presents with morphological alterations such as tilting, torsion, and peripapillary atrophy, which can complicate the

differentiation between physiological myopic changes and glaucomatous optic neuropathy [5]. These overlapping features potentially lead to both overdiagnosis and underdiagnosis of glaucoma in myopic populations.

With the advancement of imaging technology, optical coherence tomography (OCT) has become an essential tool for quantitative assessment of the RNFL thickness in glaucoma diagnosis and monitoring. Spectral-domain OCT, such as Cirrus HD-OCT, provides high-resolution cross-sectional images of the retina and enables precise measurement of the RNFL thickness. However, the normative databases used by OCT devices typically exclude individuals with high refractive errors, raising questions about the applicability of these reference values to myopic populations [6].

Understanding the influence of myopia and axial length on RNFL thickness measurements is crucial for accurate interpretation of OCT results in myopic patients. The potential misinterpretation of physiological myopic RNFL thinning as glaucomatous damage could lead to unnecessary treatment and patient anxiety. Conversely, attributing glaucomatous changes to myopia might result in delayed diagnosis and treatment of glaucoma. In this context, our study aims to study the RNFL thickness in myopic patients compared to emmetropes and to study the changes in RNFL thickness as per quadrant distribution in myopic patients compared to emmetropes. By understanding these relationships, we hope to contribute to the development of more accurate diagnostic protocols for glaucoma assessment in myopic populations.

Methods

This cross-sectional observational study included myopic patients (-1D to-10D) attending the ophthalmology OPD at BGS Global Institute of Medical Sciences Hospital from January 2024 to January 2025. Institutional ethics approval and informed consent were obtained.

Inclusion criteria

Patients aged between 20-35 years with myopia of-1D to-10D

Exclusion criteria

- Those not giving consent
- History of any ocular surgeries
- History of glaucoma
- History of other ocular or systemic diseases

A detailed history and comprehensive ophthalmological examination were conducted. Refractive error was measured using an Auto Refkeratometer RC 5000 and retinoscopy. Patients were categorized into three groups based on myopic refraction: low myopia (<−3D), moderate myopia (−3D to −6D), and high myopia (>−6D).

RNFL thickness was measured by a single operator using Cirrus HD Spectral Domain OCT (4000 1720) version 5.2.1.2 to obtain an Optic Disc Cube 200×200 scan, selecting the three best scans after dilating pupil with Tropicacyl plus. OCT was repeated if scans were suboptimal due to poor focus or centration, and patients were excluded if repeat scans remained unsatisfactory. The final selected scans were analyzed using the average RNFL thickness program, with mean RNFL thickness recorded globally and for the superior, inferior, nasal, and temporal quadrants.

Statistical Analysis

RNFL thickness is summarised with mean and standard deviation. The student t-test was applied when RNFL thickness of two groups was compared and one-way ANOVA was used when with >2 groups (degree of Myopia) was compared.

Results

A total of 120 subjects (60 myopes and 60 emmetropes) were included in this study. The mean average RNFL thickness was significantly lower in myopes (85.78±11.04 µm) compared to emmetropes (100.22±7.17 µm; p<0.001). This significant thinning was consistently observed across all quadrants (Table 1).

In the inferior quadrant, myopes demonstrated a mean thickness of 106.40±19.76 µm compared to 128.33±10.75 µm in emmetropes (p<0.001). Similarly, the superior quadrant showed significant thinning in myopes (108.20±19.09 µm) compared to emmetropes (119.87±10.69 µm; p<0.001). The nasal quadrant thickness was 67.62±12.45 µm in myopes versus 82.57±12.07 µm in emmetropes (p<0.001). The temporal quadrant also showed significant thinning in myopes (61.50±10.33 µm) compared to emmetropes (68.25±7.98 µm; p<0.001).

Table 1: Comparison of Retinal Nerve Fiber Layer Thickness (RNFL) of Myopes and Emmetropes

Group		AVERAGE RNFL (µM)	RNFL-I (µM)	RNFL-S (µM)	RNFL-N (µM)	RNFL-T (µM)
Myope	Mean	85.78	106.40	108.20	67.62	61.50
	Std. Deviation	11.042	19.761	19.089	12.448	10.326
Emmetrope	Mean	100.22	128.33	119.87	82.57	68.25
	Std. Deviation	7.169	10.749	10.687	12.065	7.976
Significance		p<0.001	p<0.001	p<0.001	p<0.001	p<0.001

Variation in RNFL Thickness According to Degree of Myopia

When myopes were stratified by severity (low: <3D; moderate: 3D-6D; high: >6D), significant differences in RNFL thickness were observed (Table 2). The average RNFL was thickest in low myopes (88.04±10.96 µm), compared to moderate myopes (77.69±8.29 µm), and high myopes (87.50±0.71 µm). This variation across myopia severity was statistically significant (p = 0.009).

Significant differences by myopia severity were also observed in the inferior quadrant (p = 0.004) and superior quadrant (p = 0.002). The inferior quadrant showed progressive thinning with increasing myopia severity (low: 110.73±18.58 µm; moderate: 90.85±17.72 µm; high: 110.00±8.49 µm). In the superior quadrant, moderate myopes showed the thinnest RNFL (92.23±13.20 µm) compared to low myopes (112.42±18.54 µm).

No significant differences were found in the nasal (p = 0.098) and temporal (p = 0.105) quadrants across different

degrees of myopia, although a trend toward thinning was observed in the nasal quadrant with increasing myopia severity. Table 2 also demonstrates violation of ISNT rule which is marked particularly in moderate and high Myopes.

Table 2: Comparison of Retinal Nerve Fiber Layer Thickness with regards to different Grades of Myopia

Degree of Myopia		AVERAGE RNFL (µm)	RNFL-I (µm)	RNFL-S (µm)	RNFL-N (µm)	RNFL-T (µm)
Low (<3D)	Mean	88.04	110.73	112.42	69.58	60.09
	Std. Deviation	10.956	18.578	18.543	12.311	8.501
Moderate (3D-6D)	Mean	77.69	90.85	92.23	61.23	66.85
	Std. Deviation	8.290	17.715	13.198	11.234	14.696
High (>6D)	Mean	87.50	110.00	117.00	65.00	58.50
	Std. Deviation	.707	8.485	2.828	15.556	6.364
Significance		P = 0.009	P = 0.004	P = 0.002	P = 0.098	P = 0.105

Gender-Based Comparison of RNFL Thickness

Among emmetropes (Table 3), no significant gender differences were observed in average RNFL thickness (males: 99.54±5.92 µm; females: 100.81±8.16 µm; p = 0.496) or in any of the quadrants (inferior: p = 0.612; superior: p = 0.835; nasal: p = 0.309; temporal: p = 0.974).

Similarly, among myopes (Table 4), no significant gender-based differences were found in average RNFL thickness (males: 86.76±11.60 µm; females: 84.87±10.60 µm; p = 0.513) or in any quadrant (inferior: p = 0.328; superior: p = 0.375; nasal: p = 0.283; temporal: p = 0.102).

Table 3: Comparison of RNFL thickness with regards to Gender amongst Emmetropes

SEX		AVERAGE RNFL	RNFL-I	RNFL-S	RNFL-N	RNFL-T
Male	Mean	99.54	127.57	120.18	80.86	68.29
	Std. Deviation	5.916	9.562	8.697	12.516	7.458
Female	Mean	100.81	129.00	119.59	84.06	68.22
	Std. Deviation	8.157	11.802	12.302	11.648	8.522
Significance		P = 0.496	P = 0.612	P = 0.835	P = 0.309	P = 0.974

Table 4: Comparison of RNFL thickness with regards to Gender amongst Myopes

SEX		AVERAGE RNFL	RNFL-I	RNFL-S	RNFL-N	RNFL-T
Male	Mean	86.76	109.00	110.48	69.41	59.24
	Std. Deviation	11.599	20.779	18.786	10.463	9.395
Female	Mean	84.87	103.97	106.06	65.94	63.61
	Std. Deviation	10.604	18.771	19.430	14.019	10.853
Significance		P = 0.513	P = 0.328	P = 0.375	P = 0.283	P = 0.102

Discussion

Our study demonstrates that peripapillary RNFL thickness is significantly reduced in myopic eyes compared to emmetropic eyes across all quadrants. This finding supports the growing body of evidence suggesting that myopia affects RNFL thickness measurements obtained by OCT [7]. The average RNFL thickness in myopes (85.78±11.04 µm) was significantly lower than in emmetropes (100.22±7.17 µm; $p<0.001$), a difference that remained consistent across all quadrants.

The thinning of RNFL in myopic eyes may be attributed to the elongation and stretching of the ocular globe, which could lead to a mechanical spreading of nerve fibers over a larger surface area [8]. This structural alteration might not necessarily indicate a reduction in the absolute number of nerve fibers but rather their redistribution across an expanded retinal surface. Our findings align with studies by Barboni *et al*., who reported significant RNFL thinning with increasing axial length [9].

Interestingly, our analysis of RNFL thickness variation across different degrees of myopia revealed that moderate myopes (-3D to-6D) exhibited the thinnest average RNFL (77.69±8.29 µm) compared to low myopes (88.04±10.96 µm) and high myopes (87.50±0.71 µm). This non-linear relationship contradicts the expected progressive thinning with increasing myopia severity and warrants further investigation. The small sample size in the high myopia group (evident from the low standard deviation of 0.707) may have influenced this finding.

Of particular clinical significance is our observation regarding the violation of the ISNT rule (Inferior > Superior > Nasal > Temporal) in moderate and high myopes. The ISNT rule, traditionally used as a screening tool for glaucoma, appears to be less reliable in myopic populations. This finding has important implications for glaucoma diagnosis, as deviation from the ISNT rule in myopic patients might falsely suggest glaucomatous damage [10, 11].

The quadrant-specific analysis revealed that while all quadrants showed significant thinning in myopes compared to emmetropes, the pattern of thinning varied across different degrees of myopia. The inferior and superior quadrants demonstrated significant variation with increasing myopia severity (p = 0.004 and p = 0.002, respectively), whereas the nasal and temporal quadrants did not show statistically significant differences across myopia groups (p = 0.098 and p = 0.105, respectively). This selective vulnerability of certain quadrants to myopia-related changes aligns with findings from previous study [12].

Gender did not significantly influence RNFL thickness in either myopic or emmetropic groups, suggesting that sex-based normative databases may not be necessary for RNFL interpretation.

Our study has several clinical implications. First, the significant thinning of RNFL in myopic eyes emphasizes the

need for myopia-specific normative databases in OCT devices. Current OCT algorithms typically use normative data derived from populations with minimal refractive errors, which may lead to false-positive glaucoma diagnoses in myopic patients [13]. Second, the violation of the ISNT rule in moderate and high myopes highlights the importance of cautious interpretation of this clinical sign in myopic populations.

This study has certain limitations. The cross-sectional design prevents us from determining causality or monitoring RNFL changes over time with myopia progression. Additionally, while we measured refractive error, we did not directly measure axial length, which may provide a more direct correlation with RNFL thickness. The small sample size in the high myopia group is another limitation that may have affected our statistical analyses.

Future research should focus on longitudinal assessment of RNFL changes with myopia progression and development of myopia-specific normative databases for OCT devices. Additionally, investigating the relationship between functional visual field parameters and structural RNFL changes in myopic eyes would enhance our understanding of the clinical significance of these findings.

Conclusion

Our study demonstrates that myopia significantly affects peripapillary RNFL thickness measurements obtained by OCT, with variation across different quadrants and degrees of myopia. These findings highlight the importance of cautious interpretation of OCT RNFL measurements in myopic patients, particularly when screening for glaucoma. Clinicians should consider refractive status when evaluating RNFL thickness and not rely solely on standard normative databases for diagnosing glaucomatous damage in myopic eyes.

References

1. Foster PJ, Jiang Y. Epidemiology of myopia. Eye (Lond). 2014 Feb;28(2):202-208. doi:10.1038/eye.2013.280.
2. Haarman AEG, Enthoven CA, Tideman JWL, Tedja MS, Verhoeven VJM, Klaver CCW. The complications of myopia: A review and meta-analysis. Invest Ophthalmol Vis Sci. 2020 Apr 9;61(4):49. doi:10.1167/iovs.61.4.49.
3. Chen SJ, Lu P, Zhang WF, Lu JH. High myopia as a risk factor in primary open angle glaucoma. Int J Ophthalmol. 2012;5(6):750-753. doi:10.3980/j.issn.2222-3959.2012.06.18.
4. Ha A, Kim CY, Shim SR, Chang IB, Kim YK. Degree of myopia and glaucoma risk: A dose-response meta-analysis. Am J Ophthalmol. 2022;236:107-119.
5. Michelessi M, Lucenteforte E, Oddone F, Brazzelli M, Parravano M, Franchi S, *et al*. Optic nerve head and fibre layer imaging for diagnosing glaucoma. Cochrane Database Syst Rev. 2015 Nov 30;2015(11):CD008803. doi:10.1002/14651858.CD008803.pub2.
6. Lommatzsch C, van Oterendorp C. Current status and future perspectives of optic nerve imaging in glaucoma. J Clin Med. 2024;13(7):1966. doi:10.3390/jcm13071966.
7. Tai ELM, Ling JL, Gan EH, Adil H, Wan-Hazabbah WH. Comparison of peripapillary retinal nerve fiber layer thickness between myopia severity groups and controls. Int J Ophthalmol. 2018 Feb 18;11(2):274-278. doi:10.18240/ijo.2018.02.16.
8. Ng D, Cheung C, Luk F, *et al*. Advances of optical coherence tomography in myopia and pathologic myopia. Eye (Lond). 2016;30:901-916. doi:10.1038/eye.2016.47.
9. Barboni P, Parisi V, Carbonelli M. The influence of axial length on retinal nerve fibre layer thickness and optic-disc size measurements by spectral-domain OCT. Br J Ophthalmol. 2012;96(1):57-61. doi:10.1136/bjo.2010.196782.
10. Morgan J, Bourtsoukli I, Rajkumar K, Ansari E, Cunliffe I, North R, *et al*. The accuracy of the Inferior > Superior > Nasal > Temporal neuroretinal rim area rule for diagnosing glaucomatous optic disc damage. Ophthalmology. 2012;119(4):723-730. doi:10.1016/j.ophtha.2011.10.004.
11. Harizman N, Oliveira C, Chiang A, Tello C, Marmor M, Ritch R, *et al*. The ISNT rule and differentiation of normal from glaucomatous eyes. Arch Ophthalmol. 2006;124(11):1579-1583. doi:10.1001/archopht.124.11.1579.
12. Xie R, Zhou XT, Lu F, Chen M, Xue A, Chen SH, *et al*. Correlation between myopia and major biometric parameters of the eye: A retrospective clinical study. Optom Vis Sci. 2009;86(5):E503-508. doi:10.1097/OPX.0b013e31819f9bc5.
13. Kang SH, Hong SW, Im SK, Lee SB, Ahn MD. Effect of myopia on the thickness of the retinal nerve fiber layer measured by Cirrus HD optical coherence tomography. Invest Ophthalmol Vis Sci. 2010;51(8):4075-4083. doi:10.1167/iovs.09-4737.