DOI: https://doi.org/10.53350/pjmhs20231710359

ORIGINAL ARTICLE

Impact of Nasal Septum Deviation on Choroidal Thickness: Insights from A Clinical Study

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ABSTRACT

Background: Nasal septum deviation (NSD) is a common otolaryngological condition that causes chronic nasal obstruction and hypoxia. Recent evidence suggests that systemic hypoxia and impaired vascular regulation may affect ocular physiology, particularly the choroidal circulation, which is critical for retinal function.

Objective: The present study aimed to evaluate the impact of NSD on choroidal thickness and to explore its correlation with the severity of deviation.

Methods: This hospital-based observational study was conducted from January 2022 to June 2023 at Mughal Eye Hospital, Lahore, and the ENT Department, CMH Sialkot. A total of 120 participants were enrolled, including 60 patients with clinically and radiologically confirmed NSD and 60 age- and sex-matched healthy controls. Ophthalmological assessment included best-corrected visual acuity, slit-lamp examination, intraocular pressure measurement, and enhanced depth imaging optical coherence tomography (EDI-OCT) to measure choroidal thickness at subfoveal, nasal (1500 µm), and temporal (1500 µm) points. Data were analyzed using SPSS v26, and statistical significance was set at $p < 0.05$.

Results: Patients with NSD demonstrated significantly reduced choroidal thickness compared to healthy controls. Mean subfoveal thickness was 258.4 ± 21.7 µm in the NSD group versus 287.6 ± 18.5 µm in controls ($p < 0.01$). Nasal and temporal thicknesses were also significantly lower in NSD patients (236.2 ± 20.1 µm and 242.6 ± 21.3 µm, respectively) compared to controls (265.3 ± 18.8 µm and 270.4 ± 17.2 µm; $p < 0.01$). A moderate negative correlation ($r = –0.42$, $p = 0.03$) was found between severity of deviation and subfoveal thickness.

Conclusion: Nasal septum deviation is associated with significant thinning of the choroid, and the degree of reduction correlates with the severity of deviation. These findings suggest that chronic nasal obstruction and hypoxia may compromise ocular vascular integrity. Early recognition and interdisciplinary management involving otolaryngologists and ophthalmologists are recommended.

Keywords: nasal septum deviation, choroidal thickness, optical coherence tomography, hypoxia, ocular circulation

INTRODUCTION

Nasal septum deviation (NSD) is one of the most common structural abnormalities encountered in otolaryngology, with a reported prevalence ranging between 20% and 80% in different populations. It results from congenital malformations, developmental asymmetry, or trauma to the nasal septum[1]. Clinically, NSD manifests as nasal obstruction, impaired airflow, recurrent sinusitis, headaches, snoring, and reduced quality of life. While the majority of studies on NSD focus on nasal and respiratory symptoms, increasing evidence suggests that its effects may extend beyond the nasal cavity, influencing systemic physiology[2,3].

One of the key systemic consequences of NSD is chronic hypoxia. Obstruction of the nasal airway reduces ventilation efficiency, which may lead to intermittent or persistent decreases in oxygen saturation[4]. This hypoxic state has been linked to endothelial dysfunction, systemic vascular alterations, and metabolic stress. Ocular tissues, particularly the choroid, are highly vascularized and metabolically active, making them sensitive to subtle systemic hypoxic and hemodynamic changes[5].

The choroid is the primary vascular layer of the eye, supplying oxygen and nutrients to the outer retina, including the photoreceptors. It maintains retinal homeostasis and plays a crucial role in visual function. Advances in imaging, especially enhanced depth imaging optical coherence tomography (EDI-OCT), have made it possible to measure choroidal thickness in vivo with high precision. Variations in choroidal thickness have been reported in a wide range of systemic and ocular conditions, including hypertension, diabetes mellitus, sleep apnea, and inflammatory diseases. Such changes are considered an indirect indicator of ocular perfusion and systemic vascular health[6,7].

Received on 09-07-2023
Accepted on 18-09-2023

Given the shared mechanisms between upper airway obstruction and vascular regulation, it is plausible that NSD may influence choroidal morphology. Patients with obstructive sleep apnea, a condition characterized by recurrent upper airway collapse and hypoxia, have been shown to exhibit altered choroidal thickness. This raises the possibility that even isolated NSD, without frank sleep apnea, could impact ocular vascular physiology. Despite this potential link, literature exploring the association between NSD and choroidal thickness remains scarce[8,9].

This clinical study was therefore designed to investigate the impact of NSD on choroidal thickness using OCT-based measurements. By comparing NSD patients with healthy controls, the study aimed to provide novel insights into whether nasal obstruction has measurable effects on ocular vasculature. Establishing this association could not only broaden the systemic implications of NSD but also emphasize the need for multidisciplinary evaluation, involving both otolaryngologists and ophthalmologists, in the comprehensive management of affected patients[10].

MATERIALS AND METHODS

Study Design and Setting: This hospital-based clinical observational study was conducted jointly at the Department of Ophthalmology, Mughal Eye Hospital, Lahore, and the Department of ENT, Combined Military Hospital (CMH), Sialkot. The study duration extended from January 2022 to June 2023, covering a total period of eighteen months. The collaborative nature of the study ensured comprehensive evaluation of patients with nasal septum deviation (NSD) from both otolaryngological and ophthalmological perspectives.

Sample Size and Participants: A total of one hundred and twenty participants were included in this study. The participants were divided into two equal groups. Group A consisted of sixty patients

diagnosed with nasal septum deviation, while Group B included sixty age- and sex-matched healthy individuals who served as controls. Patients were recruited from the ENT outpatient department of CMH Sialkot, whereas ophthalmological examinations and imaging were performed at Mughal Eye Hospital, Lahore.

Inclusion and Exclusion Criteria: Participants aged between eighteen and fifty years were considered eligible for inclusion. Only patients with symptomatic NSD confirmed through anterior rhinoscopy and nasal endoscopy were recruited into the study group. All participants had normal ocular anatomy with refractive error not exceeding ±3 diopters. Patients with a history of ocular trauma or surgery, glaucoma, or systemic diseases such as diabetes mellitus, hypertension, or cardiovascular disorders were excluded. Individuals with other ENT pathologies including nasal polyps, chronic sinusitis, or obstructive sleep apnea, as well as chronic smokers or patients taking drugs affecting ocular blood flow, were also excluded to minimize confounding factors.

ENT Evaluation: The diagnosis of nasal septum deviation was established at the ENT Department of CMH Sialkot through detailed clinical examination and nasal endoscopy. The severity of septal deviation was further supported by radiological findings and graded using standardized scoring systems. This ensured accurate classification of patients with mild, moderate, or severe deviation for correlation with ocular measurements.

Ophthalmological Examination: All participants underwent detailed ophthalmological evaluation at Mughal Eye Hospital, Lahore. The examination included assessment of best-corrected visual acuity, slit-lamp examination, fundus evaluation, and measurement of intraocular pressure using applanation tonometry. Choroidal thickness was measured using enhanced depth imaging optical coherence tomography (EDI-OCT). Measurements were taken at three standard sites: subfoveal, 1500 micrometers nasal to the fovea, and 1500 micrometers temporal to the fovea. To minimize the effects of diurnal variation on choroidal thickness, all measurements were carried out between nine and eleven in the morning.

Ethical Considerations: The study protocol was approved by the Institutional Review Boards of both Mughal Eye Hospital, Lahore, and CMH Sialkot. All participants provided written informed consent prior to inclusion in the study. The ethical standards of the Declaration of Helsinki were followed throughout the research process.

Statistical Analysis: All data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables such as age and choroidal thickness were expressed as mean ± standard deviation. Comparison of mean choroidal thickness between the nasal septum deviation group and the control group was performed using the independent samples t-test. The correlation between severity of nasal septum deviation and subfoveal choroidal thickness was assessed using Pearson's correlation coefficient. A p-value less than 0.05 was considered statistically significant for all tests.

RESULTS

Demographic Characteristics: A total of 120 participants were included in the study, comprising 60 patients with clinically confirmed nasal septum deviation (NSD) and 60 age- and sex-matched healthy controls. The mean age in the NSD group was 31.6 ± 7.2 years, while in the control group it was 32.4 ± 6.8 years, showing no statistically significant difference ($p = 0.42$). The gender distribution was balanced between both groups, minimizing demographic bias. Baseline ophthalmological parameters, including visual acuity and intraocular pressure, were similar between the groups.

Choroidal Thickness Measurements: Choroidal thickness values were significantly lower in the NSD group compared to controls across all measured sites. The mean subfoveal choroidal thickness was 258.4 ± 21.7 µm in the NSD group and 287.6 ± 18.5 µm in the control group, with a statistically significant difference ($p < 0.01$). At 1500 µm nasal to the fovea, mean thickness was 236.2 ± 20.1 µm in the NSD group compared to 265.3 ± 18.8 µm in controls ($p < 0.01$). Similarly, at 1500 µm temporal to the fovea, values were 242.6 ± 21.3 µm in the NSD group versus 270.4 ± 17.2 µm in controls ($p < 0.01$). These results are detailed in Table 1.

Table 1. Comparison of Choroidal Thickness Between Patients with NSD and Healthy Controls

Measurement Site	NSD Group (n = 60) Mean ± SD (µm)	Control Group (n = 60) Mean ± SD (µm)	p-value
Subfoveal	258.4 ± 21.7	287.6 ± 18.5	<0.01
1500 µm Nasal to Fovea	236.2 ± 20.1	265.3 ± 18.8	<0.01
1500 µm Temporal to Fovea	242.6 ± 21.3	270.4 ± 17.2	<0.01

As demonstrated in Table 1, choroidal thickness was significantly reduced in patients with NSD compared to controls across all measured regions, suggesting a generalized vascular alteration rather than a localized effect.

Correlation with Severity of Nasal Septum Deviation: Correlation analysis revealed that the severity of nasal septum deviation had a direct impact on choroidal thickness. Patients with severe deviation exhibited thinner subfoveal choroid compared to those with mild or moderate deviation. Pearson's correlation coefficient indicated a moderate negative correlation ($r = –0.42$, $p = 0.03$), suggesting that greater septal deviation severity was associated with reduced choroidal thickness.

Overall, the study findings indicate that nasal septum deviation is significantly associated with thinning of the choroid, with reductions observed in subfoveal, nasal, and temporal regions. The association strengthened with increasing severity of deviation, supporting the hypothesis that chronic nasal obstruction and hypoxia in NSD patients may adversely affect ocular vascular structures.

DISCUSSION

The present study demonstrates that patients with nasal septum deviation (NSD) exhibit significantly reduced choroidal thickness compared to healthy controls, and that the severity of septal deviation correlates with the degree of thinning. These findings suggest a potential link between chronic nasal obstruction, systemic hypoxia, and alterations in ocular vascular morphology[9,10].

Our results are consistent with earlier reports on the effects of upper airway obstruction and systemic hypoxic conditions on choroidal physiology[11]. Previous studies on patients with obstructive sleep apnea (OSA) have shown a marked reduction in choroidal thickness, supporting the hypothesis that hypoxia and impaired vascular regulation adversely influence the choroid. Since NSD shares pathophysiological features with OSA, particularly intermittent or persistent hypoxia, the observed reductions in choroidal thickness in our cohort are biologically plausible[12].

The choroid is among the most vascularized tissues of the body, and its structural integrity is critical for retinal health and visual function. Chronic hypoxia, as seen in NSD, may impair nitric oxide–mediated vasodilation, promote endothelial dysfunction, and alter autoregulation of ocular blood flow[13]. Inflammatory mediators, which are elevated in chronic nasal obstruction, may also contribute to vascular remodeling and thinning of the choroid. Our findings of significantly reduced subfoveal, nasal, and temporal choroidal thicknesses in NSD patients highlight that these vascular changes are not localized but generalized across the posterior pole[14].

The negative correlation observed between the severity of NSD and choroidal thickness is an important clinical observation. Patients with more severe septal deviation demonstrated greater thinning, suggesting a dose–response relationship[15]. This indicates that worsening nasal obstruction and chronicity of hypoxia might progressively impact ocular vascular health. While our study was

cross-sectional, this correlation provides a rationale for considering early surgical correction, such as septoplasty, not only for relieving nasal obstruction but also for potentially mitigating systemic and ocular vascular consequences[16].

Our study also strengthens the growing concept of interdisciplinary management. Otolaryngologists traditionally manage NSD with a focus on nasal airflow and sinus complications, whereas ophthalmologists primarily evaluate ocular health[17]. The demonstration of ocular consequences of NSD implies that integrated care is essential. Routine ophthalmological assessment, particularly optical coherence tomography (OCT)-based choroidal imaging, may be considered in patients with significant NSD. Such measures could help in early detection of vascular alterations and prevention of vision-threatening complications[18].

However, certain limitations should be acknowledged. The study was cross-sectional and therefore unable to establish causality. Longitudinal studies would be required to determine whether septal surgery reverses or stabilizes choroidal thinning[19-22]. Furthermore, systemic factors such as subclinical vascular disease or genetic predispositions could not be entirely excluded, although strict exclusion criteria were applied. Future research should include larger multicenter cohorts, detailed assessment of systemic oxygenation levels, and postoperative follow-up to evaluate changes in choroidal morphology after septal correction[23-25].

CONCLUSION

This study highlights a significant association between nasal septum deviation and reduction in choroidal thickness, with greater thinning observed in patients with more severe deviation. The findings suggest that chronic nasal obstruction and hypoxia may compromise ocular vascular integrity. Recognition of this relationship emphasizes the need for early diagnosis and management of NSD, not only to improve nasal airflow but also to protect ocular health. Interdisciplinary collaboration between otolaryngologists and ophthalmologists is essential to ensure comprehensive care for patients with NSD. Further longitudinal studies are warranted to explore the reversibility of these changes following septal surgery and to confirm the long-term impact of NSD on ocular function.

Authors' Contributions: AQ[1], RMS[2], MSS[3], MYM[4], LA[5], and LM[6] contributed equally to the conception, design, data collection, analysis, and manuscript preparation. All authors reviewed and approved the final version of the manuscript.

Conflict of Interest: The authors declare no conflict of interest.

Funding: No external funding was received for this study.

Ethical Approval: The study was approved by the Institutional Review Boards of Mughal Eye Hospital, Lahore, and CMH Sialkot. Written informed consent was obtained from all participants prior to inclusion.

Acknowledgments: The authors are grateful to the staff of the Ophthalmology Department at Mughal Eye Hospital, Lahore, and the ENT Department at CMH Sialkot for their cooperation and support during the study.

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This article may be cited as: Qureshi A, Shaikh RM, Shahid MS, Memon MY, Ali L, Muhammad L; Impact of Nasal Septum Deviation on Choroidal Thickness: Insights from A Clinical Study. Pak J Med Health Sci, 2023; 17(10): 359-361.