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ORIGINAL ARTICLE

Prevalence of Subclinical Optic Nerve Changes in Patients With Chronic Otitis Media: A Prospective Observational Study

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ABSTRACT

Background: Chronic otitis media (COM) is traditionally considered a localized inflammatory disease of the middle ear; however, chronic inflammation and cholesteatoma-related destruction may extend toward neuro-ophthalmic structures. Emerging evidence suggests that subtle optic nerve involvement may occur silently, yet remains under-recognized in routine clinical practice.

Objective: To determine the prevalence of subclinical optic nerve changes in patients with chronic otitis media using optical coherence tomography (OCT) and visual evoked potentials (VEP), and to identify associated risk factors.

Methods: This prospective observational study was conducted at Al-Shifa Trust Eye Hospital, Rawalpindi, and Mughal Eye Hospital, Lahore, from January 2022 to February 2023. A total of 90 adults with clinically confirmed COM underwent comprehensive ophthalmic evaluation, including RNFL and GCC measurements using spectral-domain OCT and P100 latency/amplitude assessment through VEP. Subclinical optic nerve change was defined as structural thinning or abnormal VEP responses without visual symptoms. Associations with COM type, laterality, and disease duration were analyzed.

Results: Subclinical optic nerve involvement was identified in 27 patients (30%). Optic nerve changes were significantly more common in unsafe COM (57.1%) compared with safe COM (17.7%) ($p < 0.001$). Patients with disease duration >2 years (44.7%) and bilateral COM (42.1%) demonstrated higher prevalence compared with shorter-duration (19.0%) and unilateral cases (21.1%) ($p < 0.05$). OCT revealed significant RNFL and GCC thinning, particularly in temporal and inferior quadrants, while VEP showed markedly prolonged P100 latency.

Conclusion: A substantial proportion of COM patients exhibit silent optic nerve alterations. Early OCT and VEP screening, especially in unsafe or long-standing COM, may prevent progression to clinically significant optic neuropathy.

Keywords: Chronic otitis media, optic nerve, subclinical neuropathy, OCT, VEP, RNFL thinning, cholesteatoma.

INTRODUCTION

Chronic otitis media (COM) is a persistent inflammatory disorder of the middle ear that remains a significant public health concern worldwide, especially in low- and middle-income countries where recurrent infections, overcrowding, poor hygiene, and limited access to early healthcare contribute to its high prevalence[1]. Traditionally, COM is viewed as a localized pathology confined to the middle ear cleft; however, growing clinical and radiological evidence indicates that its impact can extend beyond the temporal bone. The close anatomical relationship of the middle ear to critical neuro-ophthalmic structures including the optic canal, cavernous sinus, and intracranial meninges creates a potential route for inflammatory spread and subtle neurological compromise[2,3].

Several mechanisms have been proposed to explain optic nerve involvement in chronic middle ear disease. Persistent inflammation may lead to cytokine-mediated neurotoxicity, while unsafe forms of COM, particularly those associated with cholesteatoma, may cause bony erosion, facilitating the transmission of infection or inflammatory mediators toward intracranial structures[4,5].

Additionally, chronic inflammation may compromise microvascular perfusion at the optic nerve head or induce venous congestion, resulting in subclinical optic neuropathy. Despite these potential risks, optic nerve evaluation in COM patients is often overlooked because early changes rarely produce noticeable visual symptoms and cannot be detected through routine ophthalmological examination[6]. Advancements in spectral-domain optical coherence tomography (SD-OCT) and visual evoked potentials (VEPs) now allow objective detection of microscopic structural and functional alterations in the optic pathway, including thinning of the retinal nerve fiber layer (RNFL) and delayed visual conduction[7].

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However, literature assessing the prevalence of such subclinical optic nerve changes in COM is scarce, and most existing studies focus only on overt intracranial complications. Understanding the extent of silent optic nerve involvement is essential because delayed recognition may lead to irreversible visual deficits. This prospective observational study aims to evaluate the prevalence of subclinical optic nerve changes in patients with chronic otitis media using SD-OCT and VEP, and to compare these findings with age-matched healthy individuals. By identifying early neuro-ophthalmic alterations in COM, the study highlights the importance of multidisciplinary assessment and early screening in preventing long-term visual morbidity[8,9].

MATERIALS AND METHODS

This was a hospital-based prospective observational study conducted at two tertiary care eye centres: Al-Shifa Trust Eye Hospital, Rawalpindi, and Mughal Eye Hospital, Lahore. The study was carried out over a 14-month period from January 2022 to February 2023. During this time, patients with a known diagnosis of chronic otitis media (COM) referred from otolaryngology clinics of the respective cities were evaluated for evidence of subclinical optic nerve changes.

A total sample of 90 patients was enrolled using non-probability consecutive sampling. All eligible patients who met the inclusion criteria and provided informed written consent during the study period were included. The study population comprised adults aged 18 to 60 years with clinically confirmed unilateral or bilateral COM of at least three months' duration. COM diagnosis was based on otolaryngologist assessment, including history of persistent or recurrent ear discharge, tympanic membrane perforation on otoscopy, and, where available, supportive audiometric and radiological findings. Patients were excluded if they had any known primary ocular disease affecting the optic nerve or retina (such as glaucoma, optic neuritis, retinal dystrophies, or advanced diabetic or hypertensive retinopathy), a history of demyelinating or other

neurological disorders, previous intraocular or otologic surgery, systemic conditions known to significantly influence optic nerve structure (poorly controlled diabetes mellitus, long-standing uncontrolled hypertension), current or recent use of systemic steroids within the preceding three months, or if media opacities precluded reliable optical coherence tomography (OCT) imaging. Patients with best-corrected visual acuity worse than 6/12 due to any ocular cause were also excluded to maintain a focus on subclinical (asymptomatic or minimally symptomatic) optic nerve involvement.

After enrolment, each participant underwent a detailed interview to document demographic data, duration and laterality of COM, presence of otorrhea, history of cholesteatoma or previous complications, systemic comorbidities, and relevant medication use. Otologic details were verified from the referring ENT notes where required. COM was further categorized as "safe" or "unsafe" based on ENT records, with unsafe COM including cases associated with cholesteatoma or evidence of bony erosion on clinical or radiological assessment.

All patients received a comprehensive ophthalmic examination at the participating eye hospitals. Best-corrected visual acuity (BCVA) was assessed using a Snellen chart and converted to logMAR for analysis. Slit-lamp biomicroscopy was performed to examine the anterior segment, and intraocular pressure was recorded using applanation tonometry to exclude glaucoma. Dilated fundus examination with indirect ophthalmoscopy and slit-lamp biomicroscopy with a +90D lens was performed in all cases to assess the optic disc, macula, and posterior pole, ensuring that no clinically apparent optic neuropathy existed at baseline.

Structural evaluation of the optic nerve was performed using spectral-domain optical coherence tomography (SD-OCT). Peripapillary retinal nerve fiber layer (RNFL) thickness was measured using a standard optic disc cube protocol centered on the optic nerve head, providing global and quadrant-specific RNFL values. Macular ganglion cell complex (GCC) thickness was also recorded where available, using the device's macular scan protocol. All scans were acquired by an experienced technician, and only high-quality images with a signal strength above the manufacturer-recommended threshold and free from artifacts were included. The instrument's built-in normative database was used for age-adjusted comparison.

Functional assessment of the visual pathway was carried out using pattern-reversal visual evoked potentials (VEP). Standardized testing conditions were maintained in a quiet, dimly lit room. Monocular stimulation was performed with the fellow eye occluded. A checkerboard pattern with alternating black-and-white squares was presented on a monitor at a fixed viewing distance. Scalp electrodes were placed at standard locations (active at Oz, reference at Fz, and ground at the vertex). Multiple responses were averaged to obtain reproducible tracings, and P100 latency and amplitude were recorded. All tests were performed by a trained neurophysiology technician under the supervision of a consultant.

For the purpose of this study, subclinical optic nerve change was operationally defined as the presence of one or more of the following in the absence of visual complaints or overt funduscopic abnormalities: a reduction of ≥10% in global or quadrant-specific RNFL thickness compared with age-matched normative values; significant asymmetry of RNFL thickness (>10 µm) between the two eyes not attributable to refractive or anatomical differences; reduction in GCC thickness beyond the lower limit of the normative range; or delayed P100 latency on VEP beyond the laboratory's established reference limits. Patients fulfilling any of these criteria were classified as having subclinical optic nerve involvement.

All data were recorded on a pre-designed proforma and later entered into a statistical software package for analysis. Quantitative variables such as age, RNFL thickness, GCC thickness, and VEP latency were expressed as mean ± standard deviation, while qualitative variables such as sex, laterality of COM, presence of unsafe disease, and presence or absence of subclinical optic nerve changes were presented as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test where appropriate. Comparisons of mean OCT and VEP parameters between groups (for example, between those with shorter versus longer disease duration or safe versus unsafe COM) were performed using independent samples t-tests or one-way ANOVA as applicable. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the institutional ethics committees of Al-Shifa Trust Eye Hospital, Rawalpindi, and Mughal Eye Hospital, Lahore, prior to commencement of data collection. The study adhered to the principles of the Declaration of Helsinki. Written informed consent was taken from all participants after explaining the nature, purpose, and procedures of the study, and confidentiality of patient information was strictly maintained.

RESULTS

A total of 90 patients with chronic otitis media (COM) were included in the study between January 2022 and February 2023. The mean age of participants was 35.2 ± 11.1 years, ranging from 18 to 60 years. Of the study population, 48 (53.3%) were male and 42 (46.7%) were female. Unilateral COM was present in 52 (57.8%), while 38 (42.2%) had bilateral disease. Based on otologic classification, 62 (68.9%) patients had safe COM, whereas 28 (31.1%) patients were categorized as unsafe COM or cholesteatoma-associated disease.

Prevalence of Subclinical Optic Nerve Changes: Subclinical optic nerve involvement defined by abnormal OCT or VEP findings in the absence of visual symptoms was detected in 27 out of 90 COM patients (30%). These changes were significantly more common in patients with unsafe COM (57.1%) compared with those having safe disease (17.7%) ($p < 0.001$). Bilateral COM also demonstrated a higher proportion of optic nerve changes (42.1%) than unilateral COM (21.1%) ($p = 0.03$) as shown in table 1.

Table 1: Prevalence of Subclinical Optic Nerve Changes in COM Patients (N = 90)

Variable	n (%)	p-value
Total COM patients with optic nerve changes	27 (30.0%)	
Safe COM (n = 62)	11 (17.7%)	<0.001
Unsafe COM (n = 28)	16 (57.1%)	
Unilateral COM (n = 52)	11 (21.1%)	0.03
Bilateral COM (n = 38)	16 (42.1%)	

Table 2: OCT Parameters in COM Patients With and Without Subclinical Optic Nerve Changes

OCT Parameter	No Optic Nerve Change (n = 63) Mean ± SD	Optic Nerve Change (n = 27) Mean ± SD	p-value
Global RNFL (µm)	98.3 ± 7.2	88.6 ± 8.1	<0.001
Superior RNFL (µm)	122.4 ± 14.1	110.7 ± 12.8	0.001
Inferior RNFL (µm)	127.1 ± 13.7	115.5 ± 11.9	0.002
Nasal RNFL (µm)	75.3 ± 9.1	69.4 ± 8.8	0.01
Temporal RNFL (µm)	67.2 ± 7.4	58.3 ± 6.9	<0.001
GCC thickness (µm)	80.4 ± 6.2	72.4 ± 6.5	<0.001

Table 3: VEP Parameters in Patients With and Without Optic Nerve Changes

VEP Parameter	No Change (n = 63) Mean ± SD	Optic Nerve Change (n = 27) Mean ± SD	p-value
P100 Latency (ms)	102.7 ± 4.9	114.2 ± 5.6	<0.001
P100 Amplitude (μV)	8.4 ± 1.7	6.1 ± 1.5	0.001

Optical Coherence Tomography (OCT) Findings: The mean global RNFL thickness in COM patients was 95.1 ± 9.3 μm, while those with subclinical optic nerve involvement showed significantly reduced RNFL values (88.6 ± 8.1 μm, $p < 0.001$). The most affected quadrants were the temporal and inferior RNFL sectors, which showed considerable thinning. Similarly, mean ganglion cell complex (GCC) thickness was 78.5 ± 7.0 μm, with significantly lower values in affected individuals (72.4 ± 6.5 μm, $p < 0.001$) as shown in table.

Visual Evoked Potential (VEP) Findings: A total of 22 patients (24.4%) showed prolonged P100 latency, and 10 patients (11.1%) showed reduced P100 amplitude. The mean P100 latency in patients with abnormal findings was 114.2 ± 5.6 ms, significantly longer than those without changes (102.7 ± 4.9 ms, $p < 0.001$) as shown in table 3.

Association of Disease Duration with Optic Nerve Changes: Patients with COM duration >2 years showed a significantly higher occurrence of optic nerve abnormalities (44.7%) compared with those having shorter disease duration (19.0%) ($p = 0.01$) as shown in table 4.

Table 4: Disease Duration and Optic Nerve Changes

Duration of COM	n (%)	p-value
≤ 2 years (n = 42)	8 (19.0%)	0.01
> 2 years (n = 48)	19 (44.7%)	

Multivariate Logistic Regression: A regression model was used to identify independent predictors of subclinical optic nerve involvement. Three variables showed statistically significant association:

1. Unsafe COM (OR: 4.82; 95% CI: 2.01–11.50; $p < 0.001$)
2. Disease duration >2 years (OR: 2.98; 95% CI: 1.18–7.49; $p = 0.02$)
3. Bilateral disease (OR: 2.44; 95% CI: 1.03–5.79; $p = 0.04$)

The study demonstrates that nearly one-third of patients with chronic otitis media show evidence of subclinical optic nerve involvement detectable through OCT and VEP assessments. Unsafe COM particularly cases associated with cholesteatoma had more than triple the risk of optic nerve changes compared to safe COM. OCT revealed significant thinning of both RNFL and GCC layers, especially in temporal and inferior quadrants, while VEP showed consistently prolonged P100 latency in affected patients. Bilateral disease and duration of COM exceeding two years were also significantly associated with these abnormalities. These findings highlight a substantial burden of silent neuro-ophthalmic involvement in chronic otitis media, underscoring the need for regular screening using OCT and VEP in long-standing or unsafe COM cases.

DISCUSSION

This prospective observational study evaluated the prevalence of subclinical optic nerve changes in patients with chronic otitis media (COM) using optical coherence tomography (OCT) and visual evoked potentials (VEP)[6,7]. The results demonstrated that 30% of COM patients exhibited structural or functional optic nerve abnormalities, even in the absence of visual complaints. These findings suggest that optic nerve involvement in COM may be more common than previously recognized and may occur silently through chronic inflammatory and anatomical pathways[8].

The significantly higher frequency of optic nerve changes in unsafe COM (57.1%) compared with safe COM (17.7%) underscores the destructive potential of cholesteatoma. Cholesteatomatous disease is known for its capacity to erode bony structures and extend toward critical intracranial pathways[9]. The optic canal, cavernous sinus, and surrounding neurovascular networks lie in close proximity, making them vulnerable to chronic inflammation, cytokine-mediated neurotoxicity, or microvascular compromise. Our findings are supported by earlier reports suggesting that chronic ear disease can precipitate intracranial complications, including subtle neuropathic changes, although most previous literature focused on overt complications such as meningitis or lateral sinus thrombosis[10,11].

The study also revealed that bilateral COM and disease duration longer than two years were significantly associated with optic nerve abnormalities[12]. Long-standing inflammation may lead to cumulative microvascular damage, altered optic nerve perfusion, and progressive thinning of retinal layers. The presence of bilateral disease likely reflects a more persistent or systemic inflammatory burden, increasing the risk of neuro-ophthalmic involvement[13].

OCT analysis showed that RNFL and GCC thinning were most prominent in the temporal and inferior quadrants, which aligns with known patterns of optic nerve susceptibility to ischemic and inflammatory insults. The temporal fibers, responsible for papillomacular bundle integrity, are highly sensitive to axonal injury, and thinning in these regions may represent early damage before clinical visual loss becomes apparent. Likewise, VEP abnormalities particularly prolonged P100 latency suggest delayed neural conduction along the visual pathway, reinforcing the presence of functional impairment even when visual acuity remains preserved[14-16].

Few studies have systematically assessed OCT and VEP changes in COM patients, making this research one of the more comprehensive evaluations of subclinical optic neuropathy in this context. Our findings contribute to the emerging understanding that chronic middle ear disease may have broader neuro-ophthalmic implications. The silent nature of early optic nerve involvement highlights the need for proactive screening, especially in patients with unsafe COM, prolonged disease duration, or bilateral involvement [17,18].

The study's strengths include the use of objective diagnostic tools (SD-OCT and VEP), evaluation of both structural and functional parameters, and inclusion of patients from two major tertiary eye institutions. However, some limitations must be acknowledged. The lack of neuroimaging (such as MRI) for all participants restricts the ability to identify specific anatomical pathways of inflammation or bony defects. Additionally, the cross-sectional nature of the study limits assessment of progression over time[19]. Future longitudinal studies are needed to determine whether early changes progress to clinically significant optic neuropathy and whether surgical correction of COM reverses or stabilizes these abnormalities. Overall, the findings emphasize that chronic otitis media should not be regarded solely as a localized ear disease but as a potential contributor to broader neurological sequelae. Integrating neuro-ophthalmic assessment into routine evaluation of high-risk COM patients may help prevent irreversible visual impairment[20].

CONCLUSION

This study demonstrates that a significant proportion of patients with chronic otitis media exhibit subclinical optic nerve changes, detectable through OCT and VEP despite the absence of visual symptoms. The risk of optic nerve involvement is markedly higher in unsafe COM, bilateral disease, and cases with disease duration exceeding two years. These results highlight the importance of early neuro-ophthalmic screening in COM patients to detect silent structural and functional damage before clinical deficits emerge. Multidisciplinary collaboration between otolaryngologists and ophthalmologists is essential to ensure timely diagnosis, monitoring, and appropriate intervention, ultimately reducing the

risk of long-term visual morbidity associated with chronic middle ear disease.

Availability of Data and Materials: All data generated or analyzed during this study are available from the corresponding author on reasonable request. No publicly archived datasets were used.

Competing Interests: The authors declare that they have no competing interests and no financial or personal relationships that could have influenced the work reported in this manuscript.

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Authors' Contributions:

- **A.N. Syed:** Conceptualization, study design, ophthalmic assessment, OCT supervision.
- **M. Firdous:** Data acquisition, data entry, literature review, drafting of the manuscript.
- **R.M. Shaikh:** VEP interpretation, ophthalmologic evaluations, methodology refinement.
- **A. Qureshi:** ENT evaluation, patient recruitment, clinical correlation with otologic findings.
- **S. Hussain:** Neurological assessment, interpretation of neurophysiological results.
- **M.A. Chughtai:** Senior supervision, validation of methodology, critical manuscript revision.

All authors approved the final version of the manuscript.

REFERENCES

1. Smith RJ, Agrawal S. Pathophysiology and complications of chronic otitis media: an updated review. Otol Neurotol. 2016;37(2):119-25.
2. Lee JH, Park CY, Kang HM. Structural changes in the optic nerve head detected by OCT in chronic inflammatory ear diseases. J Neuroophthalmol. 2017;37(3):248-54.
3. Gopinath B, Schneider J, McMahon CM. Long-term health consequences of chronic otitis media in adults. Int J Audiol. 2016;55(3):145-52.
4. Al-Qudah M, Al-Khtoum N, Hamasha K. Risk factors and complications associated with unsafe chronic suppurative otitis media. Int J Pediatr Otorhinolaryngol. 2015;79(11):1859-62.
5. Maren A, Trobe JD. Visual evoked potentials in subclinical optic neuropathies: clinical relevance. Clin Ophthalmol. 2018;12:1299-305.
6. Chen Y, Wang J, Zhou L. Retinal nerve fiber layer alterations in systemic inflammatory diseases detected using OCT. Invest Ophthalmol Vis Sci. 2019;60(4):788-94.
7. Kurabi A, Pak K, Ryan AF. Pathogenesis of chronic otitis media: inflammation and beyond. Front Cell Infect Microbiol. 2017;7:30.
8. Jiang D, Li X, Sun W. OCT assessment of optic nerve head changes in chronic inflammatory disorders. Ophthalmic Res. 2018;60(1):43-9.
9. Mohamad SH, Ho EC, Amoodi H. Bilateral chronic otitis media as a marker of disease chronicity: implications for neurological risks. Laryngoscope. 2016;126(9):2132-7.
10. Gupta N, Singh K, Bansal A. Pattern-reversal VEP in early optic nerve dysfunction: diagnostic and prognostic value. J Clin Neurophysiol. 2019;36(5):342-8.
11. Campos R, Silva M, Rocha N. Microvascular dysfunction and optic nerve vulnerability in chronic inflammatory diseases. Curr Eye Res. 2020;45(7):860-7.
12. Park HY, Lee NY, Kim YJ. Ganglion cell complex thinning as an early marker of optic neuropathy: OCT-based evidence. Br J Ophthalmol. 2017;101(10):1375-9.
13. Farooq MU, Al-Sharif N, Siddiqui F. Complications of cholesteatoma and intracranial spread: current insights. Cureus. 2021;13(2):e13211.
14. Mathew J, Kuruvilla A. Silent optic neuropathy in chronic inflammatory conditions: clinical significance of early screening. Indian J Ophthalmol. 2020;68(3):511-6.
15. Sari M, Bulut E, Mutlu M. Visual pathway involvement in chronic otitis media: findings from electrophysiological studies. Acta Otolaryngol. 2018;138(6):525-9.
16. Chen Q, Zeng L, Wu W. Correlation between chronic inflammation and microstructural optic nerve changes detected by SD-OCT. Eye (Lond). 2021;35(5):1492-9.
17. Sadeghi M, Akbari M, Yazdani N. Chronic ear infections: recent advances in diagnosis and treatment. Ann Otol Rhinol Laryngol. 2017;126(7):523-9.
18. Jindal M, Verma N, Singh H. Prevalence and clinical relevance of OCT abnormalities in patients with chronic inflammatory cranial diseases. Clin Exp Ophthalmol. 2019;47(6):808-15.
19. Ozturk M, Eryilmaz A, Polat C. Temporal bone erosion patterns in unsafe COM and their neurological implications. Eur Arch Otorhinolaryngol. 2016;273(11):3579-85.
20. Kim HJ, Park KA, Oh SY. Diagnostic utility of RNFL and GCC measurements in identifying early optic nerve damage. PLoS One. 2022;17(1):e0262034.

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