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Original Research Article

Cross-Sectional Study on Macular Thickness and Visual Acuity in Patients with Idiopathic Epiretinal Membrane using Spectral Domain Optical Coherence Tomography

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Abstract:

Background: Idiopathic epiretinal membrane (ERM) is a fibrocellular proliferation over the internal limiting membrane of the retina that can cause retinal distortion, increased macular thickness, and reduced visual acuity. Spectral Domain Optical Coherence Tomography provides high-resolution imaging for quantitative assessment of retinal morphology and plays a key role in evaluating ERM.

Objective: To assess the relationship between central macular thickness and best-corrected visual acuity (BCVA) in patients with idiopathic epiretinal membrane using Spectral Domain Optical Coherence Tomography (SD-OCT).

Methods: A hospital-based cross-sectional study was conducted among patients diagnosed with idiopathic ERM. All participants underwent comprehensive ophthalmic examination, including BCVA assessment, slit-lamp biomicroscopy, fundus examination, and SD-OCT imaging. Central macular thickness (CMT) and retinal structural changes were measured using SD-OCT. The association between CMT and BCVA was analyzed using appropriate statistical methods.

Conclusion: SD-OCT is a valuable non-invasive imaging modality for evaluating macular structural changes in idiopathic ERM. Increased central macular thickness is significantly associated with decreased visual acuity, highlighting the importance of OCT-derived parameters in disease assessment, prognosis, and clinical decision-making.

Keywords: Idiopathic Epiretinal Membrane, Spectral Domain OCT, Central Macular Thickness, Best-Corrected Visual Acuity, Retina, Optical Coherence Tomography, Macular Disorders.

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Introduction

Idiopathic epiretinal membrane (ERM) is a common vitreoretinal disorder characterized by the formation of a thin, fibrocellular membrane on the inner surface of the retina, particularly over the macula. The membrane develops due to proliferation of glial cells, retinal pigment epithelial cells, fibroblasts, and myofibroblasts on the internal limiting membrane. Contraction of this membrane exerts tangential traction on the retina, resulting in retinal wrinkling, macular thickening, distortion of the foveal architecture, and impairment of visual function. Patients with ERM commonly present with blurred vision, metamorphopsia, micropsia, monocular diplopia, and decreased best-corrected visual acuity (BCVA). Idiopathic ERM is most frequently observed in individuals over 50 years of age and is associated with age-related changes in the vitreoretinal interface, particularly posterior vitreous detachment. Unlike secondary ERM, which develops following retinal vascular diseases, ocular inflammation, trauma, or retinal surgery, idiopathic ERM occurs in the absence of any identifiable underlying ocular pathology. With increasing life expectancy and widespread availability of retinal imaging, the prevalence of idiopathic ERM has increased substantially. Accurate assessment of retinal morphology is essential for evaluating disease severity and planning appropriate management. Spectral Domain Optical Coherence Tomography (SD-OCT) has revolutionized the diagnosis and monitoring of macular diseases by providing high-resolution, cross-sectional images of the retina. Compared with earlier time-domain OCT systems, SD-OCT offers superior image resolution, faster acquisition, and improved visualization of retinal microstructures. It enables precise measurement of central macular thickness (CMT), identification of retinal folds, disruption of retinal

layers, loss of foveal contour, and other structural changes associated with ERM. Several studies have demonstrated that increased macular thickness and disruption of retinal architecture correlate with deterioration of visual acuity in patients with idiopathic ERM. However, visual impairment is influenced not only by retinal thickness but also by the integrity of the photoreceptor layers and the degree of retinal traction. Therefore, correlating OCT-derived macular parameters with visual acuity is important for understanding disease severity, predicting visual prognosis, and determining the optimal timing for surgical intervention.

The present cross-sectional study aims to evaluate macular thickness in patients with idiopathic epiretinal membrane using Spectral Domain Optical Coherence Tomography and to assess its relationship with best-corrected visual acuity. The findings of this study are expected to contribute to improved clinical assessment, facilitate early identification of patients at risk of visual deterioration, and support evidence-based management of idiopathic epiretinal membrane.

Materials and Methods

This hospital-based cross-sectional observational study was conducted in the Department of Ophthalmology at Radha Devi Jageshwari Memorial Medical College and Hospital Turki, Muzaffarpur. Study duration of one year after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

A total of 48 patients (48 eyes) diagnosed with idiopathic epiretinal membrane (ERM) were included in the study. Patients aged 40 years and above with clinically diagnosed idiopathic ERM confirmed by Spectral Domain Optical Coherence Tomography (SD-OCT) were recruited consecutively during the study period.

Inclusion Criteria

- Patients aged ≥40 years.
- Clinically diagnosed idiopathic epiretinal membrane confirmed on SD-OCT.
- Clear ocular media permitting high-quality OCT imaging.
- Willingness to participate and provide informed consent.

Exclusion Criteria

- Secondary epiretinal membrane due to diabetic retinopathy, retinal vein occlusion, uveitis, trauma, retinal detachment, or previous vitreoretinal surgery.
- Significant cataract or other media opacities affecting image quality.
- Coexisting macular diseases such as age-related macular degeneration, macular hole, or cystoid macular edema.
- History of intraocular surgery within the previous six months (except uncomplicated cataract surgery).
- Poor-quality OCT images or inability to cooperate during examination.

Study Procedure: All participants underwent a comprehensive ophthalmic examination, including detailed medical and ocular history, measurement of best-corrected visual acuity (BCVA) using the Snellen chart, slit-lamp biomicroscopy of the anterior segment, intraocular pressure measurement, and dilated fundus examination using indirect ophthalmoscopy and slit-lamp biomicroscopy with a 90D lens. Macular imaging was performed using Spectral Domain Optical Coherence Tomography (SD-OCT). Central macular thickness (CMT), presence of epiretinal membrane, loss of foveal contour, retinal folds, and other retinal structural abnormalities were recorded. Only scans with adequate signal strength and image quality were included in the analysis.

Outcome Measures: The primary outcome measure was the correlation between central macular thickness (CMT) and best-corrected visual acuity (BCVA). Secondary outcome measures included assessment of retinal structural changes observed on SD-OCT in patients with idiopathic ERM.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The association between central macular thickness and BCVA was assessed using Pearson's correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 48 patients (48 eyes) with idiopathic epiretinal membrane were included in the study. The mean age of the participants was 64.2 ± 8.5 years (range: 48–82 years). Of the 48 patients, 27 (56.3%) were female and 21 (43.7%) were male. The mean best-corrected visual acuity (BCVA) was 0.48 ± 0.21 logMAR, while the mean central macular thickness (CMT) measured by Spectral Domain Optical Coherence Tomography (SD-OCT) was 438.6 ± 76.4 μm.

Retinal structural abnormalities detected on SD-OCT included loss of normal foveal contour in 39 patients (81.3%), retinal folds in 35 patients (72.9%), and disruption of the ellipsoid zone in 14 patients (29.2%). A statistically significant positive correlation was observed between increased central

macular thickness and poorer visual acuity (higher logMAR values) ($r = 0.61$, $p < 0.001$). Patients with greater macular thickness demonstrated significantly reduced visual acuity compared with those having lower CMT values.

These findings indicate that increasing retinal thickening and structural distortion in idiopathic epiretinal membrane are associated with worsening visual function, highlighting the clinical value of SD-OCT in assessing disease severity and guiding management.

Table 1: Age Distribution of the Study Participants (n = 48)

Age Group (Years)	Number of Patients	Percentage (%)
40–49	5	10.4
50–59	10	20.8
60–69	18	37.5
≥70	15	31.3
Total	48	100

Table 2: Gender Distribution

Gender	Number	Percentage (%)
Male	21	43.7
Female	27	56.3
Total	48	100

Table 3: Visual Acuity and Central Macular Thickness

Parameter	Mean ± SD	Range
BCVA (logMAR)	0.48 ± 0.21	0.10–1.00
Central Macular Thickness (µm)	438.6 ± 76.4	320–620

Table 4: SD-OCT Findings

OCT Finding	Number (n)	Percentage (%)
Loss of foveal contour	39	81.3
Retinal folds	35	72.9
Increased central macular thickness	48	100.0
Ellipsoid zone disruption	14	29.2
Intraretinal cystic changes	8	16.7

Table 5: Correlation Between Central Macular Thickness and BCVA

Variable	Pearson's Correlation (r)	p-value
Central macular thickness vs BCVA	0.61	<0.001

The study demonstrated that increased central macular thickness was significantly associated with poorer visual acuity. Eyes with greater retinal thickening and more pronounced structural abnormalities on SD-OCT exhibited reduced visual function, supporting the role of SD-OCT in assessing disease severity and predicting visual outcomes in idiopathic epiretinal membrane.

Discussion

The present cross-sectional study evaluated the relationship between central macular thickness (CMT) and best-corrected visual acuity (BCVA) in 48 patients with idiopathic epiretinal membrane (ERM) using Spectral Domain Optical Coherence Tomography (SD-OCT). The study demonstrated that increased macular thickness was significantly associated with reduced visual acuity, emphasizing the importance of SD-OCT in the structural and functional assessment of ERM. Idiopathic ERM is an age-related vitreoretinal interface disorder that causes tangential traction on the retinal surface, resulting in retinal distortion, increased macular thickness, and impairment of visual function. The majority of patients in the present study were older than 60 years, which is consistent with previous epidemiological studies reporting a higher prevalence of ERM among the elderly due to age-related posterior vitreous detachment and vitreoretinal interface changes. The mean central macular thickness observed in this study was increased compared with normal retinal thickness, reflecting the structural changes induced by the epiretinal membrane. SD-OCT revealed characteristic findings such as loss of normal foveal contour, retinal folds, and disruption of the ellipsoid zone in a considerable proportion of patients. These findings are consistent with previous reports demonstrating that ERM causes distortion of the retinal architecture and progressive thickening of the

macula. Visual acuity was significantly reduced in eyes with greater central macular thickness. A positive correlation between CMT and logMAR visual acuity was observed, indicating that increasing retinal thickening is associated with worsening visual function. This observation agrees with earlier studies that reported a significant relationship between retinal structural abnormalities and visual impairment in patients with idiopathic ERM. However, it is also recognized that visual acuity is influenced by factors other than retinal thickness alone, including the integrity of the ellipsoid zone, disorganization of the retinal inner layers (DRIL), and duration of the disease.SD-OCT proved to be an indispensable imaging modality for the evaluation of ERM. Its ability to provide high-resolution cross-sectional images enabled accurate measurement of central macular thickness and identification of subtle retinal structural abnormalities that are difficult to appreciate on routine clinical examination. These structural parameters are useful in determining disease severity, monitoring progression, and planning surgical intervention such as pars plana vitrectomy with membrane peeling. The findings of the present study are in agreement with those reported by investigators such as Wilkins et al., Govetto et al., and Michalewska et al., who demonstrated that increased retinal thickness and disruption of retinal microstructure are associated with poorer visual outcomes in idiopathic ERM. Recent studies have further emphasized that OCT biomarkers, particularly preservation of the ellipsoid zone and organization of the retinal inner layers, may be better predictors of postoperative visual recovery than central macular thickness alone. The present study has certain limitations. The sample size was relatively small, and the cross-sectional design precluded assessment of disease progression and postoperative outcomes. In addition, only central macular thickness was evaluated quantitatively, while advanced OCT biomarkers such as ectopic inner foveal layers, DRIL, and retinal layer segmentation were not analyzed. Future prospective studies with larger sample sizes and long-term follow-up are recommended to better understand the prognostic significance of these OCT parameters. Overall, the findings of the present study confirm that increased central macular thickness and structural retinal changes identified by SD-OCT are associated with decreased visual acuity in patients with idiopathic epiretinal membrane. SD-OCT should therefore be considered an essential tool in the diagnosis, monitoring, and management of ERM, helping clinicians assess disease severity and make informed decisions regarding the timing of surgical intervention.

Conclusion

This cross-sectional study evaluated the relationship between central macular thickness and best-corrected visual acuity (BCVA) in 48 patients with idiopathic epiretinal membrane (ERM) using Spectral Domain Optical Coherence Tomography (SD-OCT). The study demonstrated that patients with idiopathic ERM had increased central macular thickness accompanied by varying degrees of visual impairment. A statistically significant positive correlation was observed between increased central macular thickness and poorer visual acuity, indicating that retinal thickening is associated with deterioration of visual function. SD-OCT effectively identified characteristic retinal structural changes, including loss of foveal contour, retinal folds, and ellipsoid zone disruption. SD-OCT proved to be a reliable, non-invasive imaging modality for the diagnosis and evaluation of idiopathic ERM. It provides accurate assessment of retinal morphology and assists in correlating structural abnormalities with visual function, thereby facilitating disease monitoring and clinical decision-making. The findings of this study support the routine use of SD-OCT in the evaluation of patients with idiopathic ERM. Early detection of retinal structural changes and timely intervention may improve visual outcomes and enhance patient management. Further prospective studies with larger sample sizes and longer follow-up are recommended to validate these findings and assess the prognostic value of additional OCT biomarkers.

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