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Frequency of Vitreo-Macular Traction in Patients with Diabetic Macular Edema Using Spectral-Domain Optical Coherence Tomography

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CONFLICT OF INTEREST
None declared.

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None Declared.

ABSTRACT

Objective: To determine the frequency of vitreo-macular traction (VMT) in patients with diabetic macular edema (DME) using spectral-domain optical coherence tomography (SD-OCT).

Study Design: Descriptive, cross-sectional study.

Place and Duration: Department of Ophthalmology, Allama Iqbal Medical College/Jinnah Hospital, Lahore, from 21 December 2020 to 20 June 2021.

Methods: One hundred and ten patients with DME, aged 20–70 years, of either gender, were enrolled by non-probability consecutive sampling. Patients with a history of vitreoretinal surgery, another retinal vascular disease, pan-retinal photocoagulation or grid laser within the preceding three months, or known glaucoma (intraocular pressure >21 mmHg) were excluded. Following pupillary dilatation, SD-OCT (Topcon 3D OCT-1000) was performed with a 6×6 mm macular scan protocol comprising 64 B-scans. For this study, DME was operationally defined as central macular thickness (CMT) >250 µm. VMT was identified as persistent vitreomacular attachment associated with tractional distortion, tissue elevation, or deformation of the macular contour. Continuous variables were summarized as mean ± standard deviation and categorical variables as frequency and percentage. Pearson chi-square testing was used for prespecified subgroup comparisons; $p<0.05$ was considered statistically significant.

Results: The mean age was 51.26 ± 9.44 years; 56 (50.91%) participants were male and 54 (49.09%) were female. Mean duration of diabetes was 13.37 ± 5.21 years and mean CMT was 383.17 ± 77.57 µm. VMT was identified in 38 of 110 patients (34.55%; 95% CI 26.3%–43.8%). No statistically significant association was detected between VMT and age (p=0.862), gender (p=0.062), duration of diabetes (p=0.861), or CMT (p=0.824).

Conclusion: VMT was identified in approximately one-third of patients with DME in this cohort. The vitreomacular interface should therefore be assessed carefully on SD-OCT in patients with DME, particularly because tractional abnormalities may influence treatment planning and response.

Keywords	Diabetic macular edema; vitreo-macular traction; optical coherence tomography; vitreoretinal interface.
Acknowledgement	The authors acknowledge the Department of Ophthalmology, Allama Iqbal Medical College/Jinnah Hospital, Lahore, for facilitating the conduct of this study and the SD-OCT assessments.
Aftab MH et al. Short Title	Vitreo-Macular Traction in Diabetic Macular Edema

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INTRODUCTION

Diabetic macular edema (DME) is a major cause of visual impairment in people with diabetic retinopathy and results from breakdown of the blood–retinal barrier, increased vascular permeability, and accumulation of intraretinal and/or subretinal fluid at the macula. Modern management depends heavily on optical coherence tomography (OCT) for objective assessment of retinal thickness, fluid morphology, and other structural biomarkers that may influence prognosis and treatment response (1,2,10,17). The burden of diabetes and diabetic retinal disease is substantial. In Pakistan, the second National Diabetes Survey reported an age-adjusted weighted diabetes prevalence of 26.3% among adults, highlighting the size of the population at risk for microvascular complications (11). Globally, a 2021 systematic review estimated diabetic retinopathy in 22.27% of people with diabetes and clinically significant macular edema in 4.07% (3).

Vitreo-macular traction (VMT) is an OCT-defined disorder of the vitreomacular interface in which anomalous or incomplete posterior vitreous separation leaves persistent macular attachment that produces anatomic distortion of the fovea; associated findings may include surface deformation, intraretinal cystic change, or localized retinal elevation (4,20). In DME, this tractional component is clinically relevant because vitreomacular interface abnormalities can modify retinal anatomy and may be associated with a less favorable response to anti-vascular endothelial growth factor (anti-VEGF) therapy in some patients (5,7,8,13). Reported VMT frequencies in DME vary across populations and OCT definitions. Kulikov et al. identified VMT in 9.5% of eyes with DME, whereas a Pakistani study by Fatima et al. reported VMT in 23.9% (8,9). Differences in patient selection, OCT platform, definitions of vitreomacular interface disease, previous ocular treatment, and demographic characteristics may contribute to this variation (6,7). The present study was therefore undertaken to determine the frequency of VMT among patients with DME evaluated by SD-OCT in a tertiary ophthalmology setting in Lahore.

MATERIALS AND METHODS

Study design and setting

This descriptive, cross-sectional study was conducted in the Department of Ophthalmology, Allama Iqbal Medical College/Jinnah Hospital, Lahore, from 21 December 2020 to 20 June 2021. The study focused on the frequency of OCT-detected VMT among patients with DME.

Sample size and sampling

The sample size was calculated for estimation of a single proportion using a 95% confidence level, an 8% absolute margin of error, and an expected VMT frequency of 23.9% based on the Pakistani study by Fatima et al (9). This yielded a required sample of approximately 110 participants. Patients were enrolled using non-probability consecutive sampling.

Participants

Patients of either gender, aged 20–70 years, with DME confirmed on SD-OCT were eligible. For this study, DME was operationally defined as CMT >250 µm. Patients with a history of vitreoretinal surgery, another retinal vascular disease such as retinal vein occlusion, pan-retinal photocoagulation or grid laser within the preceding three months, or a known diagnosis of glaucoma with recorded intraocular pressure >21 mmHg were excluded.

Clinical assessment and SD-OCT procedure

Relevant history and best-corrected visual acuity were recorded. Pupils were dilated with 1% tropicamide, supplemented with 2.5% phenylephrine for poorly dilating pupils. SD-OCT was performed by a consultant ophthalmologist using the Topcon 3D OCT-1000 (Topcon Corporation). A standard 6×6 mm macular scan comprising 64 B-scan slices was acquired, with an axial resolution of 6 µm and transverse resolution of 20 µm. The instrument image-quality index was used to confirm scan adequacy, and a fundus photograph was captured concurrently.

VMT was identified on OCT when persistent vitreomacular attachment was associated with tractional alteration of macular anatomy, including tissue elevation, distortion, or deformation at the traction site, consistent with established OCT concepts of VMT (4,20). Age, gender, duration of diabetes, CMT, and presence or absence of VMT were recorded on a structured proforma.

Statistical analysis

Data were analysed using SPSS version 25.0. Continuous variables (age, duration of diabetes, and CMT) were summarized as mean ± standard deviation, while categorical variables were reported as frequency and percentage. The primary VMT proportion was accompanied by a 95% confidence interval calculated using the Wilson method. Prespecified stratified comparisons were performed for age, gender, duration of diabetes, and CMT using the Pearson chi-square test. Crude odds ratios (ORs) with 95% confidence intervals were calculated from the reported 2×2 tables as effect-size estimates. A two-sided p-value <0.05 was considered statistically significant.

Ethical considerations

The study was conducted after approval from the hospital's ethical review committee. Informed consent was obtained from participants before study procedures.

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RESULTS

A total of 110 patients with DME were included. The mean age was 51.26 ± 9.44 years; 85 (77.27%) were aged 46–70 years. There were 56 (50.91%) males and 54 (49.09%) females. Mean duration of diabetes was 13.37 ± 5.21 years, and 77 (70.0%) patients had diabetes for more than 10 years. Mean CMT was 383.17 ± 77.57 µm; 45 (40.91%) patients had CMT >400 µm (Table I).

Table I. Baseline characteristics of the study participants (n=110)

Characteristic	Category / statistic	Value
Age (years)	Mean ± SD	51.26 ± 9.44
Age (years)	20–45	25 (22.73%)
Age (years)	46–70	85 (77.27%)
Gender	Male	56 (50.91%)
Gender	Female	54 (49.09%)
Duration of diabetes (years)	Mean ± SD	13.37 ± 5.21
Duration of diabetes (years)	≤10	33 (30.00%)
Duration of diabetes (years)	>10	77 (70.00%)
Central macular thickness (µm)	Mean ± SD	383.17 ± 77.57
Central macular thickness (µm)	≤400	65 (59.09%)
Central macular thickness (µm)	>400	45 (40.91%)

VMT was identified in 38 of 110 patients, corresponding to a frequency of 34.55% (95% CI 26.3%–43.8%); 72 patients (65.45%) had no VMT (Table II and Figure 1).

Table II. Frequency of vitreo-macular traction (n=110)

VMT status	No. of patients	Percentage
Present	38	34.55%
Absent	72	65.45%
Total	110	100.00%

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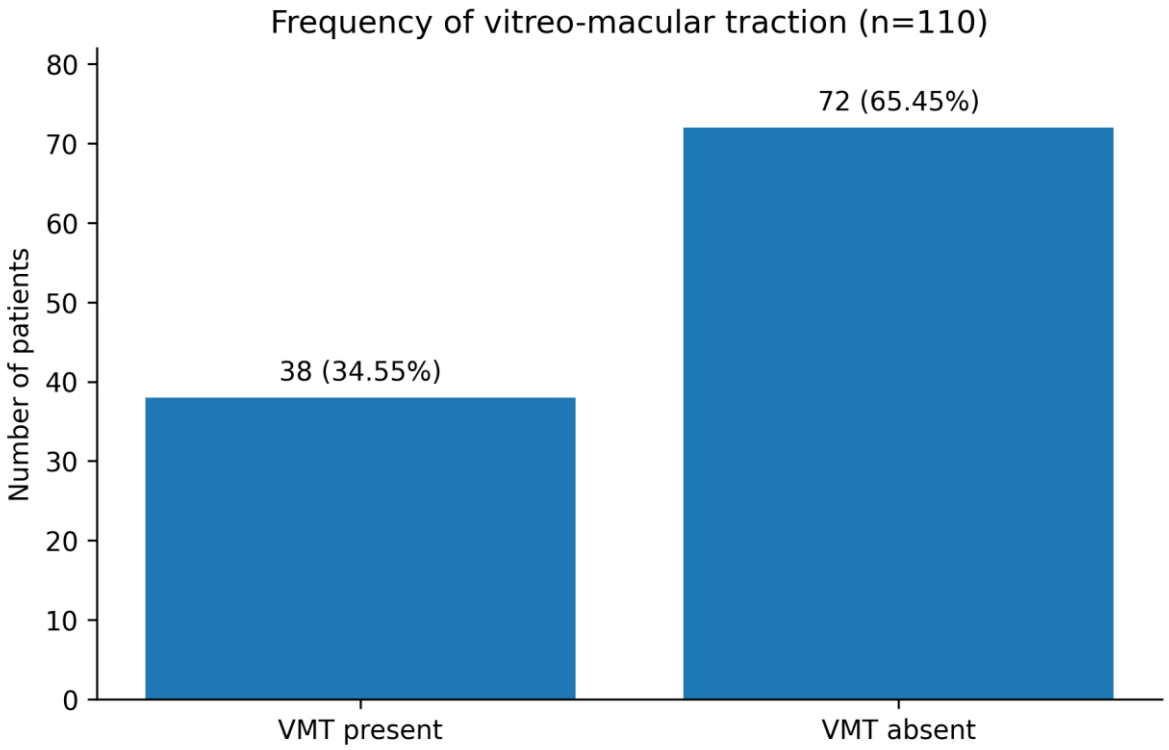

Figure 1. Frequency of vitreo-macular traction among the 110 study participants.

In stratified analyses, VMT prevalence was 36.0% in patients aged 20–45 years and 34.1% in those aged 46–70 years (p=0.862). VMT occurred in 42.9% of males and 25.9% of females (p=0.062). Prevalence was 33.3% in patients with diabetes duration ≤10 years and 35.1% in those with duration >10 years (p=0.861), and 35.4% in patients with CMT ≤400 µm versus 33.3% in those with CMT >400 µm (p=0.824). None of the prespecified subgroup comparisons reached statistical significance (Table III; Figure 2).

Table III. Stratified association of patient characteristics with VMT

Factor	Category	VMT present / total (%)	Crude OR (95% CI)	p-value
Age (years)	20–45	9/25 (36.0%)	Reference	
	46–70	29/85 (34.1%)	0.92 (0.36–2.34)	0.862
Gender	Female	14/54 (25.9%)	Reference	
	Male	24/56 (42.9%)	2.14 (0.96–4.80)	0.062
Duration of diabetes	≤10 years	11/33 (33.3%)	Reference	
	>10 years	27/77 (35.1%)	1.08 (0.46–2.56)	0.861
CMT	≤400 µm	23/65 (35.4%)	Reference	
	>400 µm	15/45 (33.3%)	0.91 (0.41–2.04)	0.824

OR, odds ratio; CI, confidence interval; CMT, central macular thickness. p-values are from Pearson chi-square tests.

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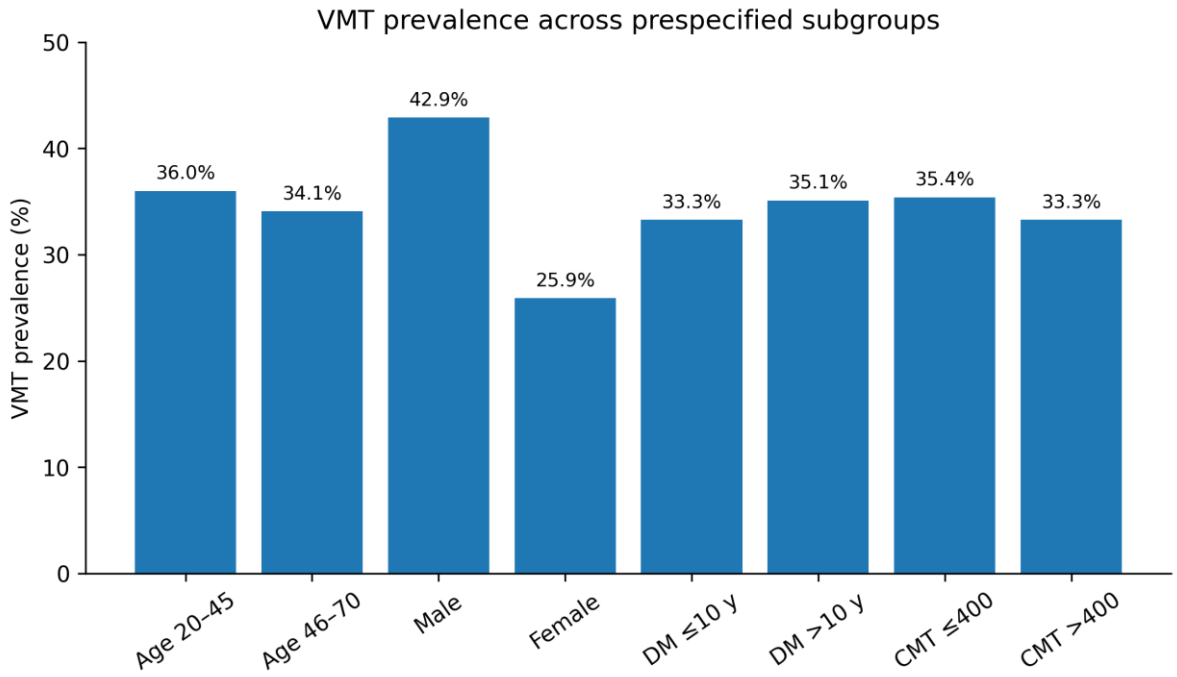

Figure 2. VMT prevalence across the prespecified age, gender, diabetes-duration, and CMT subgroups.

DISCUSSION

The principal finding of this study was an SD-OCT-detected VMT frequency of 34.55% (95% CI 26.3%–43.8%) among patients with DME. The confidence interval indicates that the true proportion in a comparable clinical population may plausibly vary around this point estimate, reinforcing the need to interpret a single-centre frequency estimate with appropriate precision. Published frequencies of vitreomacular interface abnormalities in DME are heterogeneous because studies differ in case selection, OCT acquisition, definitions, and whether epiretinal membrane, vitreomacular adhesion, and VMT are analysed separately or together. Kulikov et al. reported VMT in 9.5% of DME eyes, while Mikhail et al. reported vitreomacular interface abnormalities in 18.5% of eyes in a ranibizumab-treated DME cohort (7,8). In Pakistan, Fatima et al. detected VMT in 23.9% of DME eyes using the Topcon 3D OCT-1000, a platform similar to that used in the present study (9). The higher frequency in the current cohort may reflect differences in referral patterns, patient characteristics, disease chronicity, or the operational interpretation of traction on OCT.

No statistically significant association was detected between VMT and age, gender, duration of diabetes, or CMT. Age-related posterior vitreous separation is central to the biology of the vitreomacular interface, and population-based data have associated VMT with older age and female sex (6). In contrast, the present DME cohort had a restricted age range and relatively small subgroup counts. Although males showed a numerically higher VMT prevalence than females (42.9% vs 25.9%), the crude OR of 2.14 had a 95% CI of 0.96–4.80 and the p-value was 0.062; therefore, this finding should be interpreted as imprecise rather than evidence of a sex-specific association. The absence of a significant relationship between VMT and CMT or diabetes duration suggests that traction cannot be inferred reliably from retinal thickness or chronicity alone. VMT reflects a mechanical disorder of the vitreomacular interface superimposed on the vascular, inflammatory, and structural changes of DME, and advanced OCT assessment is therefore important for direct characterization of both edema morphology and tractional anatomy (10,14,17,18).

Recognition of VMT has potential therapeutic relevance. Anti-VEGF therapy remains a principal treatment for center-involving DME, but vitreomacular interface abnormalities may modify anatomical or functional response (1,2,19). A 2023 systematic review and meta-analysis found that epiretinal membrane/VMT was associated with less CMT reduction at one month and poorer visual gain at three months, although heterogeneity across studies limits certainty (5). Similarly, Hsieh et al. identified VMT as a predictor of poorer response in a real-world anti-VEGF-treated DME cohort (13). Treatment decisions should therefore integrate OCT morphology, visual function, prior response, and the degree of traction rather than rely on CMT alone. For patients with clinically significant traction, surgical release may be considered in selected cases, although the evidence base in DME remains heterogeneous. A comparative study of DME with vitreomacular interface abnormalities showed anatomical improvement after both ranibizumab and pars plana vitrectomy, underscoring the importance of individualized management (12). More broadly, VMT may remain stable, release spontaneously, or progress; systematic-review and observational data indicate that spontaneous release occurs in a proportion of eyes and is influenced by features such as the extent of attachment and associated epiretinal membrane (15,16). Contemporary practice guidance emphasizes OCT-based characterization and careful selection of observation, surgery, or other vitreolysis approaches, with recognition of procedure-specific risks (20,21).

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LIMITATIONS

This study has several limitations. Its single-centre, cross-sectional design limits generalisability and does not permit assessment of the temporal course of VMT or its effect on subsequent treatment response. Consecutive non-probability sampling may introduce selection bias, and the sample size was modest for subgroup comparisons. The analysis used broad categories for age, duration of diabetes, and CMT, which can reduce statistical information compared with modelling these variables continuously. Finally, all OCT assessments were performed on a single device platform, which may limit direct comparison with studies using other segmentation algorithms or higher-density volumetric protocols.

CONCLUSION

Vitreo-macular traction was identified on SD-OCT in 34.55% of patients with diabetic macular edema in this cohort. No statistically significant association was detected with age, gender, duration of diabetes, or central macular thickness. Careful assessment of the vitreomacular interface should form part of OCT interpretation in DME because tractional abnormalities may influence clinical assessment and treatment planning.

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