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Research Article

Frequency of Peripheral Retinal Lesions in Patients Evaluated for Corneal Refractive Surgery

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Abstract: This prospective, non-interventional, experimental cohort study investigates the distribution, characteristics, and anatomical location of peripheral retinal lesions in myopic candidates undergoing thorough preoperative assessment for corneal refractive procedures, aiming to refine patient safety protocols and lower the incidence of postoperative complications.

This clinical investigation evaluates the frequency and regional distribution of peripheral retinal lesions in individuals undergoing screening for corneal refractive surgery. Out of five hundred consecutive patients (one thousand eyes), complete dilated fundus evaluations utilizing indirect ophthalmoscopy and three-mirror contact lens biomicroscopy were performed. The cohort was stratified into three distinct clinical groups based on the severity of spherical equivalent refraction: low myopia, moderate myopia, and high myopia. The objective of this study was to establish the precise institutional prevalence of peripheral retinal pathologies and determine if a statistically significant association exists between the severity of myopic refractive error, increased axial length, and the presence of predisposing vitreoretinal lesions. The results demonstrated a high overall prevalence of peripheral retinal lesions, with lattice degeneration, atrophic retinal holes, and snail-track degeneration identified as the most common pathomorphological entities. Quantitative statistical analysis confirmed a highly significant, positive correlation between increasing axial length, high myopic spherical equivalent, and the complexity of peripheral vitreoretinal degenerations. In conclusion, the findings emphasize that comprehensive, mandatory dilated peripheral retinal screening remains indispensable for all candidates undergoing refractive surgery, irrespective of their initial degree of myopia. This investigation provides crucial baseline epidemiological evidence that fills a key diagnostic gap, underscoring the vital role of proactive prophylactic laser photocoagulation in reducing the long-term risk of rhegmatogenous retinal detachment.

Keywords: Myopia, Lattice Degeneration, Refractive Surgery.

The rapid global rise in the prevalence of myopia has positioned refractive error correction as a major priority in modern clinical ophthalmology. To achieve visual independence from spectacles and contact lenses, an increasing number of patients seek elective corneal refractive procedures, including laser-assisted in situ keratomileusis, photorefractive keratectomy, and small-incision lenticule extraction [1-3]. While these surgical interventions are highly precise and target the anterior segment by reshaping the corneal stroma, the underlying anatomical and pathophysiological changes associated with myopia in the posterior segment remain completely unaltered. Myopic eyes are characterized by progressive axial elongation, which induces mechanical stretching, thinning, and structural instability of both the scleral shell and the peripheral retinochoroidal tissue [4-6]. Consequently, these structural alterations predispose myopic individuals to a wide spectrum of vitreoretinal degenerations, which can compromise the integrity of the peripheral neurosensory retina.

Vitreoretinal degenerations of the peripheral retina encompass a diverse range of lesions, traditionally classified into those that predispose to rhegmatogenous retinal detachment and those that run a benign clinical course. High-risk lesions of clinical significance include lattice degeneration, snail-track degeneration, atrophic retinal holes, and tractional retinal tears, all of which exhibit localized vitreous liquefaction and abnormally strong vitreoretinal adhesion at their margins [7-9]. Conversely, benign lesions, such as paving-stone degeneration, snowflake degeneration, and oral pigmentary changes, carry a minimal risk of retinal tear formation but must still be accurately identified and differentiated from dangerous pathologies. The biomechanical stress induced by the creation of a corneal flap, pressure fluctuations during microkeratome or femtosecond laser suction ring application, and post-surgical vitreous dynamics can accelerate posterior vitreous detachment [10]. This accelerated separation of the vitreous can exert significant traction on pre-existing areas of strong vitreoretinal adhesion, potentially leading to new retinal tears or transforming pre-existing asymptomatic lesions into a devastating rhegmatogenous retinal detachment.

Despite the clinical importance of identifying these pre-existing pathologies, substantial variations remain in preoperative screening practices and indications for prophylactic intervention. While some surgical centers rely heavily on ultra-widefield digital imaging, others maintain that manual dilated indirect ophthalmoscopy with scleral indentation remains the gold standard for detecting subtle peripheral breaks and degenerations [1-3]. Furthermore, there is no universal consensus regarding the exact threshold of myopic refractive error or axial length at which the risk of carrying a predisposing peripheral lesion increases exponentially. This lack of uniformity in the clinical literature often leaves refractive surgeons without clear, evidence-based guidelines on whether low to moderate myopes require the same intensive peripheral retinal screening as high myopes prior to corneal laser ablation.

The present prospective, experimental cohort study was designed to systematically assess the frequency, clinical patterns, and anatomical locations of peripheral retinal lesions in a large cohort of patients presenting for corneal refractive surgery. By classifying candidates into distinct, well-defined groups based on their spherical equivalent refraction and measuring their axial lengths, this investigation aims to establish clear statistical associations between anterior segment refractive parameters and posterior segment pathology. This research addresses an important gap in the literature by evaluating how minor increments in axial length and refractive status affect the relative risk of carrying silent, sight-threatening retinal lesions. The insights gained from this investigation provide refractive surgeons with robust data to refine preoperative screening protocols, standardize the use of prophylactic laser photocoagulation, and enhance long-term visual safety outcomes for patients.

Methodology: To achieve a high level of clinical validity, this study utilized a prospective, non-interventional, experimental cohort design to evaluate consecutive patients who presented to the refractive surgery screening at Lahore General Hospital between January 2024 and December 2025. The minimum required sample size was calculated prior to data collection using Epi Info software version 7.2. Based on an estimated prevalence of peripheral retinal lesions of fifteen percent in the myopic population seeking refractive surgery, a confidence level of ninety-five percent, a margin of error of three percent, and a design effect of one, the minimum sample size required was determined to be five hundred patients (one thousand eyes). Written informed consent was obtained from all participating candidates after a detailed verbal and written explanation of the nature, scope, and potential clinical utility of the dilated retinal examination. The protocol of this clinical investigation adhered strictly to the ethical tenets of the Declaration of Helsinki and was formally approved by the Institutional Review Board and Bioethics Committee.

The study population was divided into three distinct clinical groups based on the pre-treatment spherical equivalent refraction of the eyes: Group A comprised eyes with low myopia, defined as a spherical equivalent of less than or equal to negative three diopters; Group B consisted of eyes with moderate myopia, defined as a spherical equivalent between negative three diopters and negative six diopters; and Group C included eyes with high myopia, defined as a spherical equivalent of greater than or equal to negative six diopters. The inclusion criteria required patients to be between eighteen and forty-five years of age, possess stable refractive errors for at least one year, and be suitable candidates for corneal refractive surgery on corneal tomographic evaluation. The exclusion criteria consisted of a history of prior intraocular or corneal surgery, previous retinal laser photocoagulation, coexisting ocular pathologies such as glaucoma, uveitis, or macular degeneration, systemic diseases with known ocular manifestations such as diabetes mellitus, and media opacities that precluded high-quality visualization of the peripheral retina.

A standardized, comprehensive ophthalmic examination protocol was executed systematically for each participant. Initial assessments included autorefraction, manifest refraction, non-contact tonometry, and corneal topography. Axial length measurements were obtained using a non-contact optical biometer to ensure high-precision data. Following the initial screening, pharmacological pupillary dilation was achieved in all subjects using a sequential instillation of tropicamide one percent and phenylephrine two point five percent eye drops, repeated twice at ten-minute intervals. A minimum pupillary diameter of seven millimeters was confirmed prior to the fundus evaluation. The peripheral retina was examined systematically out to the ora serrata in all thirty-six clock hours. This comprehensive evaluation was performed by a single senior retinal specialist who was masked to the patient's refractive group, utilizing indirect ophthalmoscopy with a twenty-diopter lens combined with scleral indentation, followed by three-mirror Goldmann contact lens biomicroscopy for detailed structural characterization of any detected lesions.

All identified peripheral retinal lesions were documented on a standardized fundus chart, noting their precise clock-hour location, distance from the equator, and morphologic characteristics. Lesions were categorized as lattice degeneration, snail-track degeneration, atrophic retinal holes, tractional retinal tears, and benign degenerations, including paving-stone or snowflake changes. Statistical analysis was performed using SPSS software version 26.0. Continuous variables, such as age, spherical equivalent, and axial length, were expressed as mean plus or minus standard deviation, while categorical variables, such as the presence and type of retinal lesions, were expressed as frequencies and percentages. The chi-square test was employed to compare the prevalence of retinal lesions among the three myopic groups. An independent t-test and one-way analysis of variance were used to analyze the relationship between axial length and the presence of peripheral pathology. A p-value of less than zero point zero five was considered statistically significant for all analyses.

Results

Table 1 presents the demographic and clinical characteristics of the study cohort. The five hundred enrolled patients had a mean age of twenty-eight point four plus or minus five point two years, with a balanced gender distribution of two hundred and forty males and two hundred and sixty females. The mean axial length of the entire cohort was twenty-five point twelve plus or minus one point thirty-five millimeters, ranging from twenty-two point forty to twenty-nine point eighty millimeters. The mean spherical equivalent was negative four point forty-five plus or minus two diopters.

Parameter	Total Cohort (n = 500 patients)	Group A: Low Myopia (n = 280 eyes)	Group B: Moderate Myopia (n = 410 eyes)	Group C: High Myopia (n = 310 eyes)	p-value
Age (Years; Mean ± SD)	28.4 ± 5.2	27.9 ± 4.8	28.6 ± 5.5	28.8 ± 5.1	0.245
Gender (Male / Female)	240 / 260	132 / 148	195 / 215	151 / 159	0.812
Spherical Equivalent (D)	-4.45 ± 2.15	-1.85 ± 0.65	-4.32 ± 0.88	-7.82 ± 1.14	<0.001
Axial Length (mm; Mean ± SD)	25.12 ± 1.35	23.85 ± 0.62	25.02 ± 0.74	26.88 ± 1.05	<0.001
Intraocular Pressure (mmHg)	14.2 ± 2.1	14.1 ± 1.9	14.3 ± 2.2	14.2 ± 2.0	0.654

Table 1 highlights that while age, gender, and intraocular pressure remained highly uniform and statistically comparable across the three study groups, the spherical equivalent and axial length showed highly significant variations, reflecting the successful and clear stratification of the study groups.

Table 2 details the overall and group-specific frequency of different peripheral retinal lesions identified across the one thousand examined eyes. Peripheral retinal lesions of some type were detected in two hundred and twenty-eight eyes, representing an overall eye prevalence of twenty-two point eight percent.

Lesion Type	Overall Frequency (n = 1000 eyes)	Group A: Low Myopia (n = 280 eyes)	Group B: Moderate Myopia (n = 410 eyes)	Group C: High Myopia (n = 310 eyes)	p-value
Lattice Degeneration	85 (8.5%)	8 (2.9%)	29 (7.1%)	48 (15.5%)	<0.001
Snail-Track Degeneration	38 (3.8%)	2 (0.7%)	14 (3.4%)	22 (7.1%)	<0.001
Atrophic Retinal Holes	42 (4.2%)	4 (1.4%)	15 (3.7%)	23 (7.4%)	0.001
Tractional Retinal Tears	15 (1.5%)	0 (0.0%)	4 (1.0%)	11 (3.5%)	0.002
Benign Degenerations	48 (4.8%)	10 (3.6%)	18 (4.4%)	20 (6.5%)	0.214
Total Affected Eyes	228 (22.8%)	24 (8.6%)	80 (19.5%)	124 (40.0%)	<0.001

Table 2 demonstrates that the prevalence of high-risk lesions, such as lattice degeneration, snail-track degeneration, and atrophic holes, increases significantly as the severity of myopia worsens, with Group C exhibiting a statistically superior rate of peripheral pathology compared to Groups A and B.

Table 3 analyzes the quantitative association between measured ocular axial length and the presence of predisposing peripheral retinal lesions (including lattice, snail-track, holes, and tears) versus eyes with normal peripheral retinas or purely benign changes.

Axial Length Category (mm)	Total Eyes (n = 1000)	Eyes with Predisposing Lesions	Eyes without Predisposing Lesions	Odd Ratio (95% CI)	p-value
< 24.00 mm	312	12 (3.8%)	300 (96.2%)	Reference	Reference
24.00 to 25.99 mm	438	54 (12.3%)	384 (87.7%)	3.52 (1.85 - 6.68)	<0.001
≥ 26.00 mm	250	114 (45.6%)	136 (54.4%)	20.95 (11.12 - 39.48)	<0.001

Table 3 illustrates a highly significant, direct relationship between axial elongation and the presence of predisposing lesions, with eyes possessing an axial length of twenty-six millimeters or greater showing a twenty-fold increase in the odds of harboring high-risk pathologies compared to those with shorter axial lengths.

The primary objective of this prospective clinical investigation was to establish the frequency and distribution of peripheral retinal lesions in myopic candidates presenting for corneal refractive surgery, and to analyze their relationship with refractive status and axial length. The observed overall prevalence of peripheral retinal abnormalities in twenty-two point eight percent of the examined eyes underscores the substantial burden of subclinical posterior segment pathology in patients seeking elective anterior segment procedures. This rate of detection is consistent with contemporary global literature, which highlights that myopic eye expansion is not merely an optical inconvenience but a progressive anatomical process that alters the structural integrity of the peripheral retina [11-12]. The high frequency of silent, asymptomatic lesions discovered during routine screening demonstrates that a normal central visual acuity of twenty-twenty and a lack of visual symptoms do not rule out the presence of predisposing vitreoretinal pathologies.

Lattice degeneration was identified as the most common clinically significant lesion in this study, affecting eight point five percent of the overall cohort and fifteen point five percent of the high myopia group. This progressive vitreoretinal pathology is characterized by localized retinal thinning, overlying vitreous liquefaction, and hyperpigmented margins with strong vitreoretinal adhesion [13-14]. The clinical significance of lattice degeneration in corneal refractive candidates is magnified by the surgical mechanics of the procedures. The temporary application of high-vacuum suction rings during the creation of a corneal flap in laser-assisted in situ keratomileusis induces rapid intraocular pressure changes and transient mechanical deformation of the globe. These mechanical forces can transmit vitreoretinal traction to the margins of pre-existing lattice lesions, leading to new retinal tears and subsequent rhegmatogenous retinal detachment in the postoperative period [11-12].

Snail-track degeneration and atrophic retinal holes were also detected in significant proportions, particularly among individuals with moderate and high myopia. Snail-track lesions share a similar histopathological profile with lattice degeneration, representing areas of lipid-like degeneration within the inner retinal layers that exhibit high vitreoretinal traction at their boundaries [15-17]. Atrophic retinal holes, which develop from progressive, localized retinal thinning rather than active vitreous traction, also pose a substantial clinical risk. Although atrophic holes are generally considered less unstable than tractional tears, they can serve as conduits for liquefied vitreous to enter the subretinal space, especially when subjected to the physical stresses of refractive surgery or the natural progression of myopic vitreous syneresis. The detection of fifteen active tractional retinal tears in this asymptomatic cohort further emphasizes the critical necessity of thorough, preoperative indirect ophthalmoscopy.

A major finding of this study is the strong, statistically significant association between increasing axial length and the prevalence of predisposing peripheral retinal lesions. The data reveal a clear, step-wise increase in the rate of retinal pathology as axial length elongates, with the odds of harboring high-risk lesions increasing more than twenty-fold in eyes with an axial length of twenty-six millimeters or greater. This quantitative association supports the biomechanical model of myopic scleral stretching, where the progressive expansion of the vitreous cavity stretches the peripheral retina, leading to localized thinning, ischemia, and vitreoretinal interface disruption [18-20]. Refractive surgeons must remain aware that while a patient's manifest spherical equivalent can sometimes underestimate the structural risk due to corneal curvature variations, the direct measurement of axial length provides a highly reliable, objective indicator of peripheral retinal fragility.

The clinical findings of this study have direct implications for pre-operative screening and management protocols in refractive surgery clinics. The high prevalence of peripheral pathology in moderate and high myopes supports the implementation of mandatory, dilated fundus examinations with scleral indentation for all refractive candidates, regardless of their presenting visual acuity. Relying solely on non-dilated imaging or visual symptom histories is insufficient and can lead to missed peripheral lesions located near the ora serrata. Early detection of high-risk lesions allows for timely prophylactic argon laser photocoagulation, which creates a strong chorioretinal adhesion around the pathology, neutralizing the risk of tear formation and subsequent retinal detachment prior to the refractive procedure [11-12].

Furthermore, this study highlights the importance of standardized follow-up intervals for patients undergoing prophylactic laser treatment before their refractive surgeries. Current consensus recommendations suggest waiting at least two to three weeks after laser photocoagulation to allow the chorioretinal scar to achieve maximum tensile strength before subjecting the eye to the vacuum pressures of corneal refractive surgery [15-17]. This cautious approach minimizes the risk of mechanical failure at the lesion margins. By establishing a clear correlation between axial elongation and retinal pathology, this study provides clinical evidence to help risk-stratify refractive candidates and optimize the allocation of retinal screening resources.

Conclusion: In conclusion, this prospective clinical study demonstrates that peripheral retinal lesions are highly prevalent among myopic candidates presenting for corneal refractive surgery, with the frequency and severity of these lesions closely linked to increasing axial length and spherical equivalent refraction. Comprehensive dilated fundus screening utilizing indirect ophthalmoscopy and scleral indentation remains an essential component of the preoperative workup, helping to identify predisposing lesions and implement timely prophylactic laser therapy. By characterizing these structural risk factors, this investigation contributes to improved patient safety and helps prevent vision-threatening retinal complications in the growing population of refractive surgery patients.

Dilated peripheral retinal screening is essential for myopic refractive surgery candidates due to a high prevalence of predisposing lesions. The risk of carrying high-risk pathologies increases significantly with greater axial length and spherical equivalent refraction. Routine prophylactic laser photocoagulation of unstable lesions is vital to minimize the risk of postoperative rhegmatogenous retinal detachment.

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