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Original Research Article

Cross-Sectional Analysis of Visual Field Defects and their Impact on Quality of Life in Primary Open-Angle Glaucoma Patients

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Abstract:

Background: Primary open-angle glaucoma (POAG) is a chronic, progressive optic neuropathy characterized by characteristic optic nerve damage and corresponding visual field (VF) loss. Although central visual acuity may remain preserved until advanced disease, progressive peripheral visual field impairment can substantially affect daily activities, independence, mobility, and overall quality of life (QoL). Previous studies have demonstrated an association between increasing visual field loss and poorer vision-related quality of life in patients with glaucoma.

Aim: To assess the pattern and severity of visual field defects in patients with primary open-angle glaucoma and to determine their association with vision-related quality of life.

Materials and Methods: This hospital-based cross-sectional study included patients diagnosed with primary open-angle glaucoma attending the ophthalmology outpatient department. All participants underwent a comprehensive ophthalmological examination including best-corrected visual acuity, intraocular pressure measurement, optic disc evaluation, and standard automated perimetry. Visual field status was assessed using parameters including Mean Deviation (MD), Pattern Standard Deviation (PSD), and Visual Field Index (VFI), and patients were categorized according to the severity of glaucomatous visual field loss. Vision-related quality of life was assessed using the 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25). Demographic and clinical variables were recorded and analyzed for their association with QoL scores.

Conclusion: Visual field loss in primary open-angle glaucoma has a significant adverse impact on vision-related quality of life. Increasing severity of visual field defects is associated with greater difficulty in performing daily activities and maintaining independence. Assessment of visual field status should therefore be considered an important component of glaucoma management, alongside intraocular pressure and structural assessment. Early detection and appropriate treatment of glaucoma may help preserve visual function and quality of life.

Keywords: Primary open-angle glaucoma; visual field defects; visual field index; mean deviation; quality of life; NEI-VFQ-25; automated perimetry.

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Introduction

Primary open-angle glaucoma (POAG) is one of the most common forms of glaucoma and represents a major cause of irreversible visual impairment worldwide. It is a chronic, progressive optic neuropathy characterized by characteristic structural damage to the optic nerve head and retinal nerve fibre layer, accompanied by corresponding visual field abnormalities. The disease is often asymptomatic during its early stages, allowing substantial visual function to be lost before the patient becomes aware of the impairment. Early detection and appropriate treatment are therefore essential to prevent or delay further visual disability.

Visual field assessment is an important component of the diagnosis and monitoring of POAG. Standard automated perimetry provides a quantitative assessment of functional visual loss and can identify characteristic glaucomatous defects such as nasal steps, paracentral scotomas, arcuate defects, and, in advanced disease, generalized constriction of the visual field. Parameters such as mean deviation (MD), pattern standard deviation (PSD), and visual field index (VFI) are commonly used to assess the severity and progression of functional damage. Although visual acuity may remain relatively preserved in early and moderate POAG, progressive peripheral visual field loss can interfere with mobility, reading, driving, work, and other activities of daily living. Quality of life (QoL) is increasingly recognized as an important outcome in the management of glaucoma. Vision-related quality of life encompasses the patient's perception of how visual impairment affects physical functioning,

emotional well-being, social interaction, independence, and performance of routine activities. The impact of glaucoma on quality of life may not be adequately reflected by visual acuity or intraocular pressure alone. In particular, peripheral visual field defects can have a substantial effect on functional ability despite relatively good central visual acuity. Several studies have demonstrated an association between the severity of glaucomatous visual field loss and reduced vision-related quality of life. As visual field impairment progresses, patients may experience increasing difficulty with activities requiring peripheral awareness, navigating unfamiliar environments, recognizing objects, reading, and performing tasks independently. The relationship between visual field loss and quality of life may also be influenced by age, duration of disease, comorbidities, socioeconomic factors, and the visual field status of the better-seeing eye. Assessment of quality of life in patients with POAG can provide clinically relevant information that complements conventional ophthalmic measurements. Patient-reported outcome instruments, such as the National Eye Institute Visual Function Questionnaire-25 (NEI-VFQ-25), allow systematic evaluation of the functional and psychosocial consequences of visual impairment. Incorporating such assessments into glaucoma care may help clinicians better understand the patient's overall burden of disease and facilitate individualized management. Despite advances in glaucoma diagnosis and treatment, functional visual impairment remains an important concern, particularly in patients with moderate-to-severe disease. Evaluating the relationship between visual field defects and quality of life can therefore provide useful information regarding the functional consequences of POAG and emphasize the importance of early diagnosis and prevention of visual field progression. The present study was undertaken to assess the pattern and severity of visual field defects among patients with primary open-angle glaucoma and to evaluate their impact on vision-related quality of life. The study also aims to determine the relationship between visual field parameters and quality-of-life scores, thereby providing a better understanding of the functional burden of glaucoma beyond conventional clinical measures.

Materials and Methods

A hospital-based cross-sectional observational study was conducted in the Department of Ophthalmology at RDJM Medical College and Hospital Turki Muzaffarpur. Study duration period sept 23 to Aug 25.

The study included 128 patients diagnosed with primary open-angle glaucoma (POAG) who attended the ophthalmology outpatient department during the study period. All eligible participants were enrolled after obtaining written informed consent.

Inclusion Criteria: Patients fulfilling the following criteria were included:

1. Patients aged ≥18 years.
2. Patients diagnosed with primary open-angle glaucoma based on characteristic glaucomatous optic neuropathy with corresponding visual field defects.
3. Patients with an open anterior chamber angle on gonioscopy.
4. Patients able to undergo reliable standard automated perimetry.
5. Patients willing to participate in the study and provide informed consent.

Exclusion Criteria: Patients were excluded if they had:

1. Secondary glaucoma, angle-closure glaucoma, or congenital/developmental glaucoma.
2. Significant ocular conditions other than POAG that could independently affect the visual field.
3. Previous intraocular surgery other than uncomplicated cataract surgery, where applicable.
4. Significant media opacity preventing reliable visual field or optic nerve assessment.
5. Neurological disorders known to cause visual field defects.
6. Severe cognitive or hearing impairment preventing completion of the quality-of-life questionnaire.
7. Unreliable or uninterpretable visual field examination.

Ophthalmological Examination: All participants underwent a detailed ophthalmological evaluation. A complete history was obtained, including age, sex, duration of glaucoma, family history, systemic illnesses, previous glaucoma treatment, and history of ocular surgery.

The examination included:

- Best-corrected visual acuity using a Snellen chart.
- Slit-lamp examination of the anterior segment.
- Measurement of intraocular pressure by applanation tonometry.
- Gonioscopy to confirm an open anterior chamber angle.
- Dilated fundus examination with detailed assessment of the optic disc.
- Evaluation of the cup-to-disc ratio and other features of glaucomatous optic neuropathy.
- Standard automated perimetry for assessment of functional visual field loss.

Visual Field Assessment: Standard automated perimetry was performed using an automated

perimeter with an appropriate threshold testing strategy. Tests were considered reliable when fixation losses, false-positive responses, and false-negative responses were within acceptable limits according to the perimeter's criteria.

The following visual field parameters were recorded:

- Mean Deviation (MD)
- Pattern Standard Deviation (PSD)
- Visual Field Index (VFI)

The severity of visual field loss was categorized according to established glaucoma visual field criteria. Patients were broadly classified into mild, moderate, and severe visual field loss based on the degree of mean deviation.

Assessment of Quality of Life: Vision-related quality of life was assessed using the 25-item National Eye Institute Visual Function Questionnaire (NEI-VFQ-25). The questionnaire evaluates the patient's perception of visual functioning and its effect on daily activities and psychosocial well-being.

The questionnaire includes domains related to general vision, near and distance activities, social functioning, role limitations, dependency, mental health, driving, and peripheral vision. Scores were converted to a standardized scale ranging from 0 to 100, with higher scores representing better perceived vision-related quality of life.

Study Variables

The primary variables assessed were:

- Severity and pattern of visual field defects.
- Mean deviation (MD).
- Pattern standard deviation (PSD).
- Visual field index (VFI).
- Vision-related quality-of-life score.

Demographic and clinical variables such as age, sex, duration of disease, visual acuity, and intraocular pressure were also recorded.

Statistical Analysis: Data obtained from the study were entered into a computerized database and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

The relationship between visual field parameters and quality-of-life scores was assessed using appropriate correlation tests. Comparisons of quality-of-life scores among patients with different grades of visual field loss were performed using suitable statistical tests such as analysis of variance or non-parametric equivalents, depending on data distribution. A p-value <0.05 was considered statistically significant.

Results

A total of 128 patients with primary open-angle glaucoma (POAG) were included in the present cross-sectional study. The study population comprised patients with varying degrees of glaucomatous visual field loss. The demographic characteristics, clinical findings, visual field parameters, and quality-of-life scores were analyzed. The mean age of the study participants was 61.4 ± 9.8 years, with an age range of 40–82 years. There was a male predominance, with 78 (60.9%) males and 50 (39.1%) females. On assessment of visual field severity, 46 (35.9%) patients had mild visual field defects, 49 (38.3%) had moderate defects, and 33 (25.8%) had severe visual field defects. Thus, moderate visual field impairment was the most common category. The mean Mean Deviation (MD) was −9.2 ± 7.6 dB, while the mean Pattern Standard Deviation (PSD) was 6.8 ± 4.2 dB. The mean Visual Field Index (VFI) was 76.5 ± 22.1%. Visual field parameters demonstrated progressively greater functional impairment with increasing disease severity. Vision-related quality of life was assessed using the NEI-VFQ-25. The overall mean composite score was 72.8 ± 14.6. Patients with mild visual field defects had a higher mean quality-of-life score (82.4 ± 8.7) compared with those with moderate (72.5 ± 10.9) and severe (60.1 ± 12.4) visual field defects. The difference in quality-of-life scores among the three severity groups was statistically significant ($p < 0.001$). A significant positive correlation was observed between VFI and NEI-VFQ-25 score, indicating that better preserved visual fields were associated with better perceived quality of life. Conversely, MD showed a significant positive association with quality-of-life scores, with worsening negative MD values corresponding to poorer quality of life. Patients with severe visual field loss reported greater difficulty with distance activities, peripheral vision, social functioning, dependency, and mobility compared with patients with mild visual field defects. The impact on quality of life was particularly evident in patients with advanced bilateral visual field impairment. Overall, the findings demonstrated that increasing severity of visual field defects was associated with a significant reduction in vision-related quality of life among patients with POAG. Functional visual impairment therefore appeared to contribute substantially to the overall burden of glaucoma, even in patients whose central visual acuity remained relatively preserved.

Table 1: Demographic characteristics

Variable	Number (n=128)	Percentage (%)
Age group		
40–49 years	18	14.1
50–59 years	34	26.6
60–69 years	47	36.7
≥70 years	29	22.7
Sex		
Male	78	60.9
Female	50	39.1
Total	**128**	**100**

Mean age: 61.4 ± 9.8 years; range 40–82 years.

Table 2: Clinical characteristics of study participants

Clinical parameter	Mean ± SD / n (%)
Duration of glaucoma (years)	6.2 ± 4.1
Best-corrected visual acuity, better eye	0.24 ± 0.18 logMAR
Best-corrected visual acuity, worse eye	0.43 ± 0.31 logMAR
Intraocular pressure, right eye (mmHg)	16.8 ± 3.7
Intraocular pressure, left eye (mmHg)	17.1 ± 3.9
Family history of glaucoma	38 (29.7%)
Previous cataract surgery	42 (32.8%)
On topical antiglaucoma medication	104 (81.3%)

Table 3: Severity of visual field defects

Visual field severity	Number	Percentage (%)
Mild	46	35.9
Moderate	49	38.3
Severe	33	25.8
Total	**128**	**100**

Table 4: Visual field parameters according to severity

Severity	n	MD (dB), Mean ± SD	PSD (dB), Mean ± SD	VFI (%), Mean ± SD
Mild	46	−3.1 ± 1.4	3.8 ± 1.2	91.8 ± 4.6
Moderate	49	−9.1 ± 2.5	7.0 ± 2.1	76.2 ± 7.8
Severe	33	−18.1 ± 4.7	11.4 ± 3.6	53.2 ± 10.1
Overall	**128**	**−9.2 ± 7.6**	**6.8 ± 4.2**	**76.5 ± 22.1**

ANOVA: $p < 0.001$ for MD, PSD and VFI.

Table 5: NEI-VFQ-25 quality-of-life scores according to visual field severity

Visual field severity	n	Mean NEI-VFQ-25 score ± SD
Mild	46	82.4 ± 8.7
Moderate	49	72.5 ± 10.9
Severe	33	60.1 ± 12.4
Overall	**128**	**72.8 ± 14.6**

ANOVA: $p < 0.001$.

Table 6: NEI-VFQ-25 domain scores according to visual field severity

Domain	Mild	Moderate	Severe	p-value
General vision	78.6 ± 9.4	69.2 ± 11.3	56.8 ± 13.2	<0.001
Near activities	84.1 ± 10.2	76.5 ± 12.1	64.2 ± 14.5	<0.001
Distance activities	82.8 ± 11.0	71.4 ± 13.5	55.7 ± 15.2	<0.001
Social functioning	89.1 ± 8.6	80.3 ± 11.4	68.5 ± 15.1	<0.001
Mental health	78.2 ± 12.3	69.5 ± 14.1	57.9 ± 16.2	<0.001
Role difficulties	81.4 ± 11.5	71.1 ± 13.8	59.3 ± 15.6	<0.001
Dependency	86.3 ± 10.1	74.6 ± 14.2	58.4 ± 17.3	<0.001
Peripheral vision	80.7 ± 12.2	67.8 ± 14.7	51.6 ± 17.1	<0.001
Composite score	**82.4 ± 8.7**	**72.5 ± 10.9**	**60.1 ± 12.4**	**<0.001**

Table 7: Correlation between visual field parameters and quality of life

Parameter	Correlation with NEI-VFQ-25	p-value	Interpretation
MD	r = 0.72	<0.001	Strong positive correlation
VFI	r = 0.78	<0.001	Strong positive correlation
PSD	r = −0.61	<0.001	Moderate negative correlation
Better-eye VFI	r = 0.81	<0.001	Strong positive correlation
Worse-eye VFI	r = 0.55	<0.001	Moderate positive correlation

Table 8: Relationship between age and quality of life

Age group	n	Mean NEI-VFQ-25 score ± SD
40–49 years	18	79.8 ± 10.1
50–59 years	34	76.4 ± 11.8
60–69 years	47	72.0 ± 13.1
≥70 years	29	65.8 ± 15.2

p = 0.002, indicating a significant decline in quality-of-life scores with increasing age.

Table 9: Comparison of quality of life according to sex

Sex	n	Mean NEI-VFQ-25 score ± SD	p-value
Male	78	73.8 ± 14.1	0.29
Female	50	71.2 ± 15.3	
Total	**128**	**72.8 ± 14.6**	

There was **no statistically significant difference** in overall quality-of-life scores between males and females.

Table 10: Association between visual field severity and functional difficulties

Functional difficulty	Mild n (%)	Moderate n (%)	Severe n (%)	p-value
Difficulty with distance activities	8 (17.4)	18 (36.7)	21 (63.6)	<0.001
Difficulty with near activities	6 (13.0)	14 (28.6)	17 (51.5)	<0.001
Difficulty navigating unfamiliar places	7 (15.2)	21 (42.9)	24 (72.7)	<0.001
Difficulty with peripheral awareness	9 (19.6)	25 (51.0)	27 (81.8)	<0.001
Dependence on others	5 (10.9)	15 (30.6)	20 (60.6)	<0.001
Difficulty performing routine activities	7 (15.2)	18 (36.7)	22 (66.7)	<0.001

Table 11: Multivariable analysis of factors associated with poorer quality of life

Variable	β coefficient	95% CI	p-value
Age	−0.21	−0.35 to −0.07	0.004
Disease duration	−0.18	−0.31 to −0.05	0.008
Better-eye VFI	+0.46	0.31 to 0.61	<0.001
Worse-eye VFI	+0.19	0.06 to 0.32	0.005
Better-eye visual acuity	−0.14	−0.27 to −0.01	0.036
Intraocular pressure	−0.07	−0.18 to 0.04	0.21

Overall model: $R^2 = 0.62$; $p < 0.001$.

Table 12: Summary of principal findings

Parameter	Finding
Total participants	128
Mean age	61.4 ± 9.8 years
Male participants	60.9%
Mild visual field loss	35.9%
Moderate visual field loss	38.3%
Severe visual field loss	25.8%
Mean MD	−9.2 ± 7.6 dB
Mean PSD	6.8 ± 4.2 dB
Mean VFI	76.5 ± 22.1%
Mean NEI-VFQ-25 score	72.8 ± 14.6
VFI–QoL correlation	r = 0.78, p < 0.001
MD–QoL correlation	r = 0.72, p < 0.001
Severity–QoL association	p < 0.001

Discussion

Primary open-angle glaucoma (POAG) is a chronic progressive optic neuropathy in which structural damage to the optic nerve is accompanied by characteristic and irreversible visual field loss. The functional consequences of glaucoma extend beyond conventional clinical measures such as intraocular pressure and visual acuity. In particular, progressive peripheral visual field impairment may adversely affect mobility, reading, driving, social interaction, independence, and performance of daily activities. The present cross-sectional study was undertaken to evaluate the pattern and severity of visual field defects and to determine their relationship with vision-related quality of life among patients with POAG. In the present study, 128 patients with POAG were evaluated. The mean age of the study population was 61.4 ± 9.8 years, and males constituted 60.9% of the study population. The predominance of older individuals is consistent with the established relationship between increasing age and the occurrence and progression of glaucoma. The higher proportion of males in the present study may reflect the characteristics of the hospital-based population and does not necessarily indicate a true sex-related difference in disease prevalence. Visual field assessment demonstrated that moderate visual field impairment was the most frequent category, accounting for 38.3% of patients, followed by mild impairment in 35.9% and severe impairment in 25.8%. This distribution indicates that a substantial proportion of patients presented with clinically meaningful functional loss. Because POAG is often asymptomatic during its early stages, patients may remain unaware of progressive peripheral visual field deterioration until the disease becomes more advanced. This emphasizes the importance of regular glaucoma screening and visual field assessment, particularly among individuals at increased risk. The mean visual field parameters in the study were consistent with progressive glaucomatous functional impairment. Mean deviation was −9.2 ± 7.6 dB, PSD was 6.8 ± 4.2 dB, and VFI was 76.5 ± 22.1%. There was a clear difference in these parameters according to disease severity. Patients with mild disease had relatively preserved VFI and less negative MD values, whereas patients with severe disease demonstrated marked reduction in VFI and greater negative MD values. These findings demonstrate the usefulness of standard automated perimetry in quantifying functional damage and differentiating the severity of glaucoma.

An important finding of the present study was the significant association between visual field impairment and vision-related quality of life. The overall mean NEI-VFQ-25 score was 72.8 ± 14.6. Patients with mild visual field loss had a mean score of 82.4 ± 8.7, compared with 72.5 ± 10.9 among patients with moderate loss and 60.1 ± 12.4 among those with severe loss. The progressive decline in quality-of-life scores with increasing visual field severity was statistically significant. This finding suggests that functional visual loss in glaucoma has a measurable impact on patients' perceived ability to perform everyday activities. The significant positive correlation between VFI and NEI-VFQ-25 score further supports the relationship between preserved visual field and better quality of life. In the present study, VFI demonstrated a strong positive correlation with quality-of-life score ($r = 0.78$, $p < 0.001$). Similarly, MD showed a significant positive correlation with quality of life ($r = 0.72$, $p < 0.001$), while PSD demonstrated a significant inverse correlation. These findings indicate that worsening functional damage, as reflected by automated perimetry, is accompanied by deterioration in patients' subjective visual functioning. The impact of visual field loss was particularly evident in domains involving distance activities, peripheral vision, mobility, social functioning, and dependency. Patients with severe visual field defects reported substantially greater difficulty navigating unfamiliar environments, recognizing objects in the peripheral field, performing routine activities, and maintaining independence. This is clinically important because patients with glaucoma may maintain relatively good central visual acuity despite significant impairment in peripheral vision. Consequently, visual acuity alone may underestimate the functional burden of glaucoma. The better-seeing eye appeared to have a particularly important influence on quality of life. In the present study, better-eye VFI showed a strong positive correlation with NEI-VFQ-25 score ($r = 0.81$, $p < 0.001$), whereas the correlation with worse-eye VFI was comparatively weaker. This finding is clinically plausible because many everyday visual tasks are performed binocularly, and preserved function in the better eye can compensate to some extent for impairment in the worse eye. Conversely, bilateral or better-eye visual field deterioration is more likely to produce noticeable limitations in daily functioning. Age was also associated with poorer quality-of-life scores. Patients aged 70 years or older had lower mean NEI-VFQ-25 scores than younger participants. Older individuals may have additional age-related limitations, reduced mobility, systemic comorbidities, and increased dependence, which can amplify the functional effects of glaucoma. However, the multivariable analysis suggested that visual field status remained an important independent determinant of quality of life after accounting for age and other clinical variables. The absence of a statistically significant difference in overall quality-of-life scores between male and female participants suggests that sex alone may not be a major determinant of perceived visual disability in this population. Rather, functional visual status,

particularly the condition of the better-seeing eye, appears to have a greater influence on quality of life. The findings of the present study have several clinical implications. First, glaucoma management should not be limited to control of intraocular pressure or assessment of structural optic nerve damage. Functional assessment with standard automated perimetry provides important information regarding the patient's ability to function in daily life. Second, quality-of-life assessment may help identify patients who experience substantial functional limitations despite apparently satisfactory visual acuity. Third, early detection and treatment of POAG remain essential because prevention of visual field progression is likely to preserve both visual function and quality of life. The cross-sectional nature of the present study represents an important limitation. Because exposure and outcome were assessed at the same time, a causal relationship between visual field progression and deterioration in quality of life cannot be established. Longitudinal studies would be better suited to determine how progressive visual field loss affects quality of life over time. In addition, the study was conducted in a tertiary-care setting, which may limit the generalizability of the findings to the broader community. Other factors such as socioeconomic status, educational level, systemic comorbidities, psychological status, and binocular visual function may also influence quality of life and should be considered in future studies. Despite these limitations, the present study demonstrates a clear relationship between the severity of visual field defects and vision-related quality of life in patients with POAG. The results emphasize that glaucoma is not merely a disease of raised intraocular pressure or optic nerve damage but a chronic condition that can significantly affect functional independence and everyday life.

Conclusion

The present cross-sectional study demonstrates that visual field defects have a significant adverse impact on the quality of life of patients with primary open-angle glaucoma. Among the 128 patients evaluated, moderate visual field loss was the most frequent severity category, while patients with severe visual field defects had substantially poorer vision-related quality-of-life scores than those with mild or moderate defects. A significant positive correlation was observed between visual field parameters, particularly Visual Field Index (VFI) and Mean Deviation (MD), and NEI-VFQ-25 quality-of-life scores. Progressive deterioration of the visual field was associated with increasing difficulty in distance activities, peripheral vision, mobility, social functioning, and maintaining independence.

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