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Dilemma created or dilemma solved? Correlation between clinical findings, Visual Field and Optical Coherence Tomography changes in patients of glaucoma :-- disparities and similarities.

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ABSTRACT:

BACKGROUND: Severity of the glaucoma needs to be assessed by correlating both clinical and investigation-based findings. The two major assessment tools include visual field (VF) analysis-subjective test and OCT-RNFL , is an objective test. In the early stage of glaucoma, reliability of the VF is less as compared to OCT-RNFL, while OCT-RNFL based evaluation shows floor effect in severe cases of glaucoma. The purpose is to correlate clinical findings with both the investigations.

METHOD: A cross-sectional, observational study was performed on a total of 54 patients (3 patients with one eye) that is 105 eyes, between the age of 40 years to 75 years. Ocular examination was done for best corrected visual acuity, Intraocular pressure measured with Goldmann Applanation Tonometry(GAT), Cup Disc Ratio(CDR) with the help of 78D lens, Visual Field with Octopus 900, Retinal Nerve Fiber Layer(RNFL) thickness and average Rim disc ratio measure with Optical Coherence Topography(OCT) with CIRRUS HD-OCT 500. Clinical diagnosis of glaucoma severity was classified using CDR. VF-based diagnosis of glaucoma severity was done based on Grading standards of visual field defects. OCT-RNFL based severity was classified using the Disc Damage Likelihood Scale. Appropriate statistical methods were used to analyse the data.

RESULTS: Out of 54 patients (105 eyes), 21.9% of patients were diagnosed with normal to mild, 54.3% with moderate and 23.8% with advance damage by clinical examination. While with VF 31.4% mild, moderate 43.8% and severe 24.8%. and with OCT 37.1% mild , 40.0% with moderate, 22.9% severe glaucoma damage.

CONCLUSION: Determination of the severity of glaucoma can best assessed by correlating the clinical picture of the patient with VF and OCT-RNFL. VF is a subjective method while OCT RNFL is an objective investigation. difference in both can change the management. Consider use of both clinical and investigation-based diagnosis to grade severity of the disease.

Key words: Glaucoma ,correlation ,visual field ,optical coherence tomography

INTRODUCTION:

Glaucoma is a group of disorders whose common feature is progressive degeneration of the optic nerve, with loss of retinal ganglion cells, thinning of the Retinal Nerve Fiber layer, and increasing excavation of the optic disc[1]. Since glaucoma is a progressive disease, physicians are constantly searching for reliable tools to monitor it over time. Epidemiological studies on glaucoma involving adults aged 40 years and above have estimated glaucoma prevalence between 2.7 and 4.3% among Indians [2]. Undetected glaucoma, hence untreated glaucoma, results in faster progression, early visual impairment, and blindness. In India, the proportion of undiagnosed glaucoma is estimated at 90% Therefore, early detection is the key to prevention of glaucoma associated blindness. The prevalence of glaucoma increases with increasing age after the age of 40 years[3] Hence, people coming for presbyopia glasses are at risk of glaucoma. Before optical coherence tomography, determination of glaucoma progression relied heavily on clinical assessment of the optic nerve, comparison of disc photos over time and visual field analysis. Visual field analysis is a very subjective test and largely depends on patients' compliance and has a learning curve. These fluctuations are more severe in glaucoma patients than in normal individuals.[4] In contrast to visual field assessment, OCT is an objective test. Retinal nerve fiber layer thickness represents the ganglion cell axons before they enter the optic nerve. Loss of retinal nerve fiber layer can be observed in red-free photos and is quantified with OCT.[5] It provides objective, quantitative, high-resolution images of the optic nerve and retina. severity of the glaucoma needs to be assessed by correlating both clinical and investigation-based findings.In the early stage of glaucoma, the reliability of the test is less as compared to OCT-RNFL, while the OCT-RNFL based evaluation shows floor effect in severe cases of glaucoma. VF is a subjective method while OCT-RNFL is an objective investigation. difference in both can change the management of the disease. The purpose of this study is to correlate clinical findings with both the investigations and to determine how much we can rely on the same.

MATERIALS AND METHODS:

A cross-sectional, observational study was performed on a total of 54 patients (3 patients with one eye) that gave us 105 eyes for the study, between the age of 40 years to 75 years in a western regional institute of ophthalmology in India from October 2023 to march 2024. The subjective parameters which were taken into consideration were age and gender along with patients' ID number. Ocular examination was done for Best Corrected Visual Acuity, Intraocular pressure measure with Goldmann Applanation Tonometry (GAT), Cup Disc Ratio(CDR) -Fundoscopic examination with the help of 78 Diopter lens. The Visual Field Analysis or Perimetry test was done with the help of an octopus 900 machine, Retinal Nerve Fiber Layer thickness and an average size disc with rim disc ratio measured with the help of Optical Coherence Topography machine CIRRUS HD-OCT 500.

Inclusion criteria:

- All patients who are already diagnosed with glaucoma.
- With reliable visual field and OCT-RNFL and OCT-CDR(Optic nerve head analysis).
- Patients with no epithelial corneal edema.
- Patients with no contraindication for dilated assessment of glaucoma.
- Best corrected visual acuity of 6/12 or better.

Exclusion criteria:

- Patients having any other ocular abnormality, including corneal abnormalities, corneal infections, uveitis or posterior segment diseases.
- Patients in whom OCT parameters cannot be evaluated such as the one with the corneal opacities.
- Patients with unreliable VF (RF>20) or unreliable OCT (<7 signal strength) examination.
- Past history of any ocular disease or trauma.

Clinical diagnosis of glaucoma based on its severity was made depending on the CDR to Normal, Moderate and Severe. Normal ($0 \leq CDR \leq 0.5$); moderate ($0.5 \leq CDR \leq 0.8$); and severely glaucomatous ($0.8 \leq CDR \leq 1$)[6]. Visual field-based diagnosis of glaucoma severity was done based on Grading standards of visual field defects. Mild (clear VF or mild VF defect) , Moderate (Moderate VF defect), severe (severe or diffuse VF defect)[7]. OCT-RNFL based diagnosis of glaucoma severity was made based on the disc damage likelihood scale [Rim to disc ratio (R/D) for an average size disc 1.5 mm to 2 mm] Mild or Normal (0.4 - 0.5 both stage 0a and 0b), moderate or at risk (0.1 - 0.3 both stage 1 and 2), severe or glaucomatous damage (0.01 to no rim both stage 3 and 4)[8]. The compilation of the data was done and each eye was classified separately based on clinical findings, VF findings and OCT findings. Appropriate statistical methods were used to analyse the data.

RESULTS:

Demographic characteristics and general distribution of data:

A total of 105 eyes from 54 patients, including 3 patients with one eye each, were included in the analysis. The mean age of the cohort was 50.83 years (SD 10.08), with a male-to-female ratio of 66.7% to 33.3% (Table 1). Most subjects (35.2%) had best-corrected visual acuity of 6/12 . The mean intraocular pressure was 13.96 mm-Hg (SD 1.89) in the right eye and 15.08 mm-Hg (SD 3.20) in the left eye. The average cup-to-disc ratio was 0.60 in both eyes, with standard deviations of 0.15 in the right eye and 0.16 in the left eye.

Table 1:

	Mean (95% CI)	Standard Deviation (SD)	Median
AGE	50.83(48.08-53.59)	10.08	52
IOP/GAT RE	13.96(13.09-14.14)	1.89	14
IOP/GAT LE	15.08(14.19-15.96)	3.20	15
CDR WITH 78D RE	0.60(0.56-0.65)	0.15	0.6
CDR WITH 78D LE	0.60(0.56-0.60)	0.16	0.6

Clinical examination diagnosed 21.9% of patients with normal to mild glaucoma damage, 54.3% with moderate damage, and 23.8% with advanced damage. In comparison, visual field (VF) analysis classified 31.4% of patients have mild glaucoma, 43.8% with moderate, and 24.8% with severe damage. Optical coherence tomography (OCT) revealed 37.1% of patients with mild damage, 40.0% with moderate damage, and 22.9% with severe glaucoma damage (Table 2). Across all three classifications, the majority of patients were found to have moderate glaucoma damage.

Table 2:

		Count (n= 105)	%
CLINICAL DIAGNOSIS	Normal	23	21.9%
	Moderate	57	54.3%
	Severe	25	23.8%
VISUAL FIELD BASED DIAGNOSIS	Mild	33	31.4%
	Moderate	46	43.8%
	Severe	26	24.8%
OCT BASED DIAGNOSIS	Mild	39	37.1%
	Moderate	42	40.0%
	Severe	24	22.9%

Clinical diagnosis v/s Visual Field-based diagnosis:

Clinical examination of 105 eyes revealed that 23 eyes (21.9%) exhibited normal to mild glaucoma damage. Among these 23 eyes, visual field analysis classified 21 eyes (91.3%) as mild cases and 2 eyes (8.7%) as moderate cases (Table 3). Clinical examination identified 57 eyes (54.3%) as moderately damaged, of which visual field analysis categorized 42 eyes (91.3%) as moderate, 12 eyes (21.1%) as mild, and 3 eyes (5.3%) as severe (Figure 2). Additionally, clinical examination determined 25 eyes (23.8%) as severely damaged; visual field analysis confirmed 23 eyes (92.0%) as severe and reclassified 2 eyes (8.0%) as moderate (Figure 2).

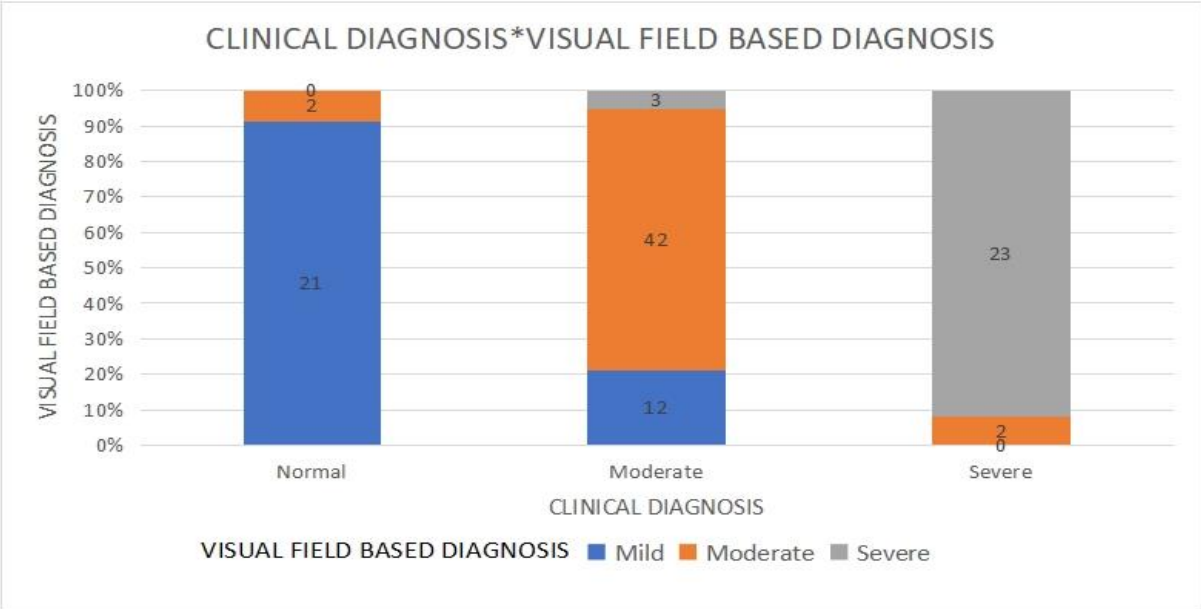
Table 3:

*VISUAL FIELD BASED DIAGNOSIS * CLINICAL DIAGNOSIS*						
			CLINICAL DIAGNOSIS			Total
			Normal	Moderate	Severe	
VF Based	Mild	Count	21	12	0	33
		% within VISUAL FIELD BASED DIAGNOSIS	63.6%	36.4%	0.0%	100.0%
		% within CLINICAL DIAGNOSIS	91.3%	21.1%	0.0%	31.4%
	Moderate	Count	2	42	2	46
		% within VISUAL FIELD BASED DIAGNOSIS	4.3%	91.3%	4.3%	100.0%
		% within CLINICAL DIAGNOSIS	8.7%	73.7%	8.0%	43.8%
	Severe	Count	0	3	23	26
		% within VISUAL FIELD BASED DIAGNOSIS	0.0%	11.5%	88.5%	100.0%
		% within CLINICAL DIAGNOSIS	0.0%	5.3%	92.0%	24.8%
Total		Count	23	57	25	105
		% within VISUAL FIELD BASED DIAGNOSIS	21.9%	54.3%	23.8%	100.0%

	% within CLINICAL DIAGNOSIS	100.0%	100.0%	100.0%	100.0%
Weighted Kappa		0.76			
Standard error		0.05			
95% CI		0.66 to 0.86			

Measurement of agreement among the two methods of examination was calculated using weighted kappa (Linear) and was good (0.76).

FIGURE 1:



Clinical diagnosis v/s OCT RNFL based diagnosis:

Clinical examination of 105 eyes found that 23 eyes (21.9%) had normal to mild glaucoma damage. Among these 23 eyes, optical coherence tomography (OCT) identified 22 eyes (95.7%) as mild cases and 1 eye (4.3%) as moderate (Table 4). Of the 57 eyes (54.3%) classified as moderately damaged based on clinical examination, OCT categorized 17 eyes (29.8%) as mild, 37 eyes (88.1%) as moderate, and 3 eyes (5.3%) as severe (Figure 3). Additionally, clinical examination determined that 25 eyes (23.8%) had severe damage; OCT analysis confirmed 21 eyes (88.0%) as severe and reclassified 4 eyes (16.0%) as moderate (Figure 2).

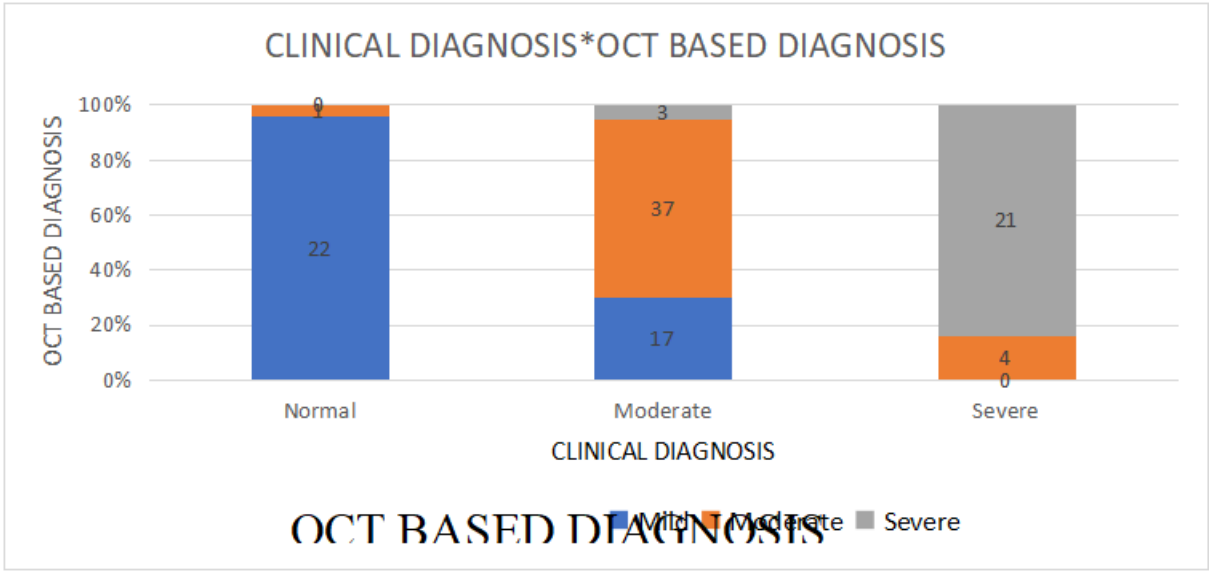
TABLE 4:

*OCT BASED DIAGNOSIS * CLINICAL DIAGNOSIS*						
			CLINICAL DIAGNOSIS			Total
			Normal	Moderate	Severe	
OCT Based	Mild	Count	22	17	0	39
		% within OCT BASED DIAGNOSIS	56.4%	43.6%	0.0%	100.0%
		% within CLINICAL DIAGNOSIS	95.7%	29.8%	0.0%	37.1%

	Moderate	Count	1	37	4	42
		% within OCT BASED DIAGNOSIS	2.4%	88.1%	9.5%	100.0%
		% within CLINICAL DIAGNOSIS	4.3%	64.9%	16.0%	40.0%
	Severe	Count	0	3	21	24
		% within OCT BASED DIAGNOSIS	0.0%	12.5%	87.5%	100.0%
		% within CLINICAL DIAGNOSIS	0.0%	5.3%	84.0%	22.9%
Total		Count	23	57	25	105
		% within OCT BASED DIAGNOSIS	21.9%	54.3%	23.8%	100.0%
		% within CLINICAL DIAGNOSIS	100.0%	100.0%	100.0%	100.0%
Weighted Kappa			0.70			
Standard error			0.05			
95% CI			0.59 to 0.80			

Measurement of agreement among the two methods of examination was calculated using weighted kappa (Linear) and was good (0.70).

FIGURE 2:



Visual field-based diagnosis v/s OCT-RNFL based diagnosis:

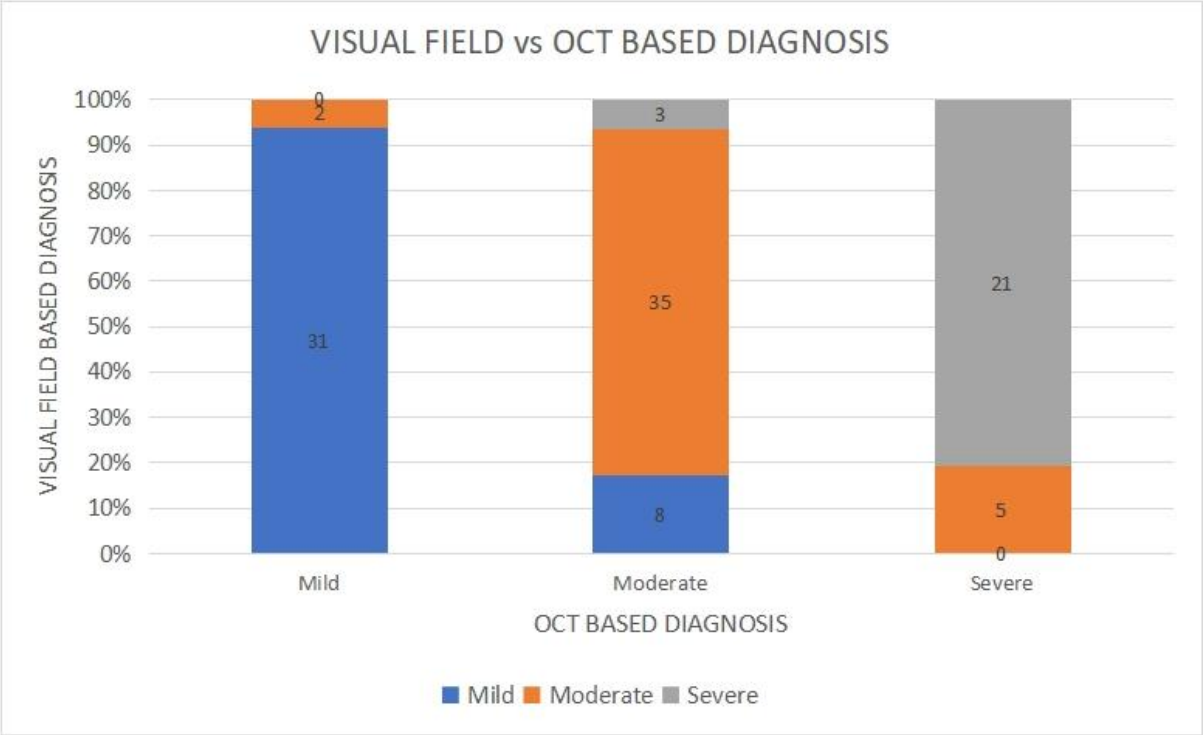
TABLE 5:

	VISUAL FIELD BASED DIAGNOSIS		
	Mild	Moderate	Severe

		n	Row%	Column%	n	Row%	Column%	n	Row%	Column%
OCT BASED DIAGNOSIS	Mild	31	79.5%	93.9%	8	20.5%	17.4%	0	0.0%	0.0%
	Moderate	2	4.8%	6.1%	35	83.3%	76.1%	5	11.9%	19.2%
	Severe	0	0.0%	0.0%	3	12.5%	6.5%	21	87.5%	80.8%
Weighted Kappa					0.79					
Standard error					0.05					
95% CI					0.70 to 0.88					

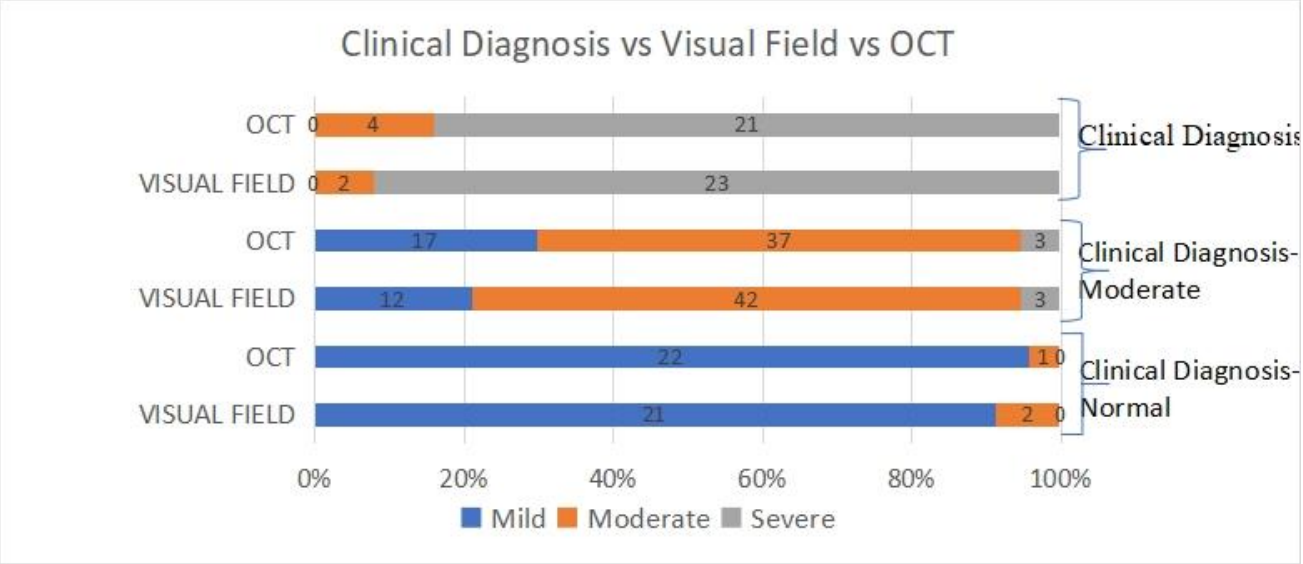
Measurement of agreement among the two methods of examination was calculated using weighted kappa (Linear) and was good to very good (0.79).

FIGURE 3:



Clinical v/s Visual Field v/s OCT RNFL diagnosis:

FIGURE 4:



DISCUSSION:

The main purpose of this study was to find corelation between glaucoma severity assessment done based on clinical examination and investigation-based examination. As there are multiple modalities available for monitoring progression of glaucoma, the use of the same largely depend on patients' profile and symptoms. Although glaucoma can be classified in to different subtype based on cause, age and its relation with aetiology, in this study we mainly focused on routine outdoor patient coming for regular follow up examination. In this study we tried to corelate clinical finding with the VF and OCT and how they help to grade the severity of the disease.

Glaucoma is a chronic, progressive, optic neuropathy caused by group of ocular condition which led to damage of optic nerve with loss of visual function. Monitoring progression is an essential part of disease management. OCT has proven to be a quantitative and reliable tool for monitoring. However, it should be used in conjunction with clinical evaluation and visual field testing. In early glaucoma, OCT-RNFL may be important for patients normal or unreliable visual field tests. In moderate glaucoma , the correlation between OCT measurements and VF testing helps to confirm progression. In advance glaucoma, we need to be aware of the floor effect in the OCT RNFL measurements and consider combined use of both clinical and investigation-based diagnosis.

Our study provides a comprehensive analysis of glaucoma damage assessment using clinical examination, visual field (VF) analysis, and optical coherence tomography (OCT). All three methods identified moderate glaucoma damage as the most prevalent category, with clinical examination diagnosing 54.3% of patients as moderate, while VF analysis and OCT diagnosed 43.8% and 40.0% of patients as moderate, respectively. This alignment with existing literature emphasizes the importance of moderate glaucoma as the most common stage encountered in clinical settings.

The consistency in the classification of moderate glaucoma across all three methods underscores their complementary roles in assessing the disease. Utilizing multiple diagnostic approaches can provide a more accurate and comprehensive evaluation of glaucoma progression, supporting effective management strategies.

However, there were notable variations in the identification of mild and severe cases between the three methods. Clinical examination classified 21.9% of patients as having normal to mild damage, whereas VF analysis and OCT identified higher proportions of mild damage, at 31.4% and 37.1%, respectively. These discrepancies may result from differences in sensitivity and specificity, with OCT offering detailed structural information and VF analysis focusing on functional loss.

For severe glaucoma damage, clinical examination and VF analysis showed higher proportions of severe cases, at 23.8% and 24.8%, respectively, compared to 22.9% identified by OCT. This suggests that VF analysis may be more attuned to detecting functional damage, while OCT may present a more conservative assessment of structural changes.

CONCLUSION

In conclusion, the study demonstrates that clinical assessment, visual field (VF) analysis, and optical coherence tomography (OCT) offer complementary methods for evaluating glaucomatous eyes. The consistency and good agreement among these diagnostic tools support their combined use for a comprehensive understanding of ocular damage, enhancing the ability to develop effective management plans for patients with glaucoma.

The integration of these three approaches improves glaucoma management by allowing clinicians to make more informed decisions regarding treatment and monitoring disease progression. Future research should focus on refining these diagnostic tools and exploring their combined use to further improve glaucoma care.

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