

Effectiveness of Structured Follow-up Interventions on Glaucoma Awareness and Therapeutic Compliance

Sushan Khadka¹, Anitha Arvind², Jyoti Gangta³

Masters in Optometry, Department of Optometry, School of Health and Allied Sciences (SoHAS), GD Goenka University, Gurugram, India¹

HOD, Department of Optometry, School of Healthcare and Allied Sciences (SoHAS), GD Goenka University, Gurugram, India²

Consultant Optometrist, Director, Vision Nest Eyecare, Shimla, Himachal Pradesh, India³

ABSTRACT

Background: Glaucoma is a chronic, progressive optic neuropathy and remains one of the leading causes of irreversible blindness worldwide. Effective disease control depends largely on long-term adherence to medication and regular follow-up. However, inadequate awareness and poor compliance continue to compromise treatment outcomes. This study evaluated the effectiveness of structured follow-up interventions in improving glaucoma knowledge and therapeutic adherence among newly diagnosed patients. **Methods:** A prospective interventional study was conducted over six months at a tertiary eye care centre in Noida, India. 68 patients aged above 35 years with newly diagnosed glaucoma were enrolled and divided into intervention and control groups. Baseline knowledge was assessed using a validated 14-item glaucoma knowledge questionnaire, while adherence was evaluated using the Morisky Green Levine (MGL) scale. The intervention group received structured follow-up sessions including personalised counselling, intraocular pressure (IOP) charting, educational materials, and reinforcement of drop instillation techniques. Pre- and post-intervention scores were analysed using paired t-tests. **Results:** The intervention group demonstrated significant improvement in mean knowledge scores (3.81 ± 2.65 to 8.71 ± 1.49 ; $p = 0.00000000000000576$) and adherence scores (1.10 ± 0.98 to 0.10 ± 0.30 ; $p = 0.000000734$). Both study objectives showed statistically significant enhancement following structured follow-up. **Conclusion:** Structured follow-up interventions significantly improved glaucoma awareness and medication adherence. Integrating personalised education and reinforcement into routine glaucoma management may enhance long-term therapeutic compliance and reduce the risk of disease progression.

Keywords: ‘glaucoma,’ ‘medication adherence,’ ‘patient awareness,’ ‘interventional strategies,’ ‘educational interventions,’ ‘behavioural interventions,’ ‘topical medications,’ and ‘intraocular pressure.’

INTRODUCTION

Glaucoma is a chronic, progressive optic neuropathy characterised by structural damage to the optic nerve and corresponding visual field loss (Weinreb et al., 2014). It is one of the leading causes of irreversible blindness globally (Quigley & Broman, 2006). Glaucoma is often referred to as the “silent thief of sight” because early stages typically progress without

noticeable symptoms, leading to delayed detection and diagnosis(Tham et al., 2014). As the disease advances, irreversible damage to the optic nerve results in gradual peripheral vision loss and eventually severe visual impairment if left untreated(Tham et al., 2014; Weinreb et al., 2014). Globally, glaucoma affects millions of individuals, and the burden of disease continues to increase due to ageing populations and increasing life expectancy(Kapetanakis et al., 2016; Quaranta et al., 2016; Quigley & Broman, 2006). It is estimated that more than 76 million people worldwide were affected by glaucoma in 2020, and this number is projected to exceed 110 million by 2040(Kapetanakis et al., 2016). Developing countries account for a large proportion of this burden because of limited access to eye care services, lower levels of disease awareness, and delayed diagnosis(Kapetanakis et al., 2016). India carries a significant share of the global glaucoma burden, with several epidemiological studies reporting that glaucoma is one of the major causes of irreversible blindness in the country(George et al., 2010). Despite advancements in diagnostic technologies and therapeutic options, glaucoma continues to contribute substantially to visual disability due to poor awareness, delayed diagnosis, and inadequate treatment adherence(Muir & Lee, 2011).

The primary goal of glaucoma management is to prevent or slow the progression of optic nerve damage by reducing intraocular pressure (IOP), which remains the only proven modifiable risk factor for disease progression(Heijl et al., 2002). Several large clinical trials, including the Early Manifest Glaucoma Trial and the Ocular Hypertension Treatment Study, have demonstrated that lowering intraocular pressure significantly reduces the risk of disease progression and visual field deterioration(Heijl et al., 2002; Kass et al., 2002). Treatment strategies typically include topical ocular hypotensive medications, laser therapy, or surgical intervention, depending on the severity of the disease and patient response to therapy(Heijl et al., 2002). Among these options, topical medications remain the most common first-line treatment, requiring long-term or lifelong adherence to maintain adequate IOP control. However, maintaining consistent adherence to glaucoma medications presents a major challenge in clinical practice(Muir & Lee, 2011). Studies have reported that adherence rates among glaucoma patients vary widely, often ranging between 30% and 70%, depending on the population studied and the method used to measure compliance(Olthoff et al., 2005). Poor adherence to medication can lead to inadequate intraocular pressure control, faster disease progression, and increased risk of irreversible vision loss(Muir & Lee, 2011; Olthoff et al., 2005). Multiple factors contribute to non-adherence, including forgetfulness, lack of knowledge about the disease, improper eye drop instillation technique, complex treatment regimens, medication cost, and inadequate patient-physician communication(Olthoff et al., 2005; Tsai, 2009).

In addition to medication adherence, patient awareness and understanding of glaucoma play a crucial role in effective disease management(Newman-Casey et al., 2015). Several studies have shown that knowledge regarding glaucoma, its risk factors, and the importance of long-term treatment is often limited among patients and the general population(Rewri & Kakkar, 2014). Insufficient awareness can lead to delayed diagnosis, poor treatment compliance, and inadequate follow-up care(Ichhpujani et al., 2012; Rewri & Kakkar, 2014). Therefore, patient

education has become an important component of glaucoma management strategies aimed at improving treatment outcomes. Various interventions have been explored to improve adherence and awareness among glaucoma patients. These include educational counselling, reminder systems, electronic monitoring devices, and patient-centred communication strategies (Tsai, 2009). Randomised controlled trials evaluating educational interventions have reported varying results (Barakat et al., 2024). While some studies demonstrated modest improvements in medication adherence and patient knowledge, others reported limited or short-term benefits (Cate et al., 2014). One potential reason for these inconsistent outcomes is that many interventions focus primarily on medication adherence without addressing broader aspects of patient education, reinforcement of knowledge, and structured follow-up (Friedman et al., 2008; Oltramari et al., 2024).

Structured follow-up interventions that combine counselling, reinforcement of medication techniques, monitoring of intraocular pressure, and educational materials may provide a more comprehensive approach to improving both awareness and therapeutic compliance (Leiby et al., 2021; Rajurkar et al., 2018; Robin & Muir, 2019). Continuous reinforcement through follow-up visits allows patients to clarify doubts, reinforce correct drop instillation techniques (*How To Use Eye Drops - Best Practices & Precautions*, n.d.), and better understand the relationship between treatment adherence and disease progression (Friedman et al., 2008; Tsai, 2009). Visual feedback, such as intraocular pressure monitoring charts, may further enhance patient motivation and engagement in their treatment process. In the Indian context, most existing studies related to glaucoma awareness and adherence have been cross-sectional in nature, primarily assessing levels of knowledge or patterns of medication compliance among patients (George et al., 2010; Rewri & Kakkar, 2014). Limited research has evaluated the effectiveness of structured follow-up educational interventions designed to improve both awareness and therapeutic compliance simultaneously. Furthermore, the relationship between structured counselling, improved disease awareness, and medication adherence remains relatively underexplored, particularly among newly diagnosed glaucoma patients.

Considering these gaps in existing literature, this study aimed to evaluate the effectiveness of structured follow-up interventions on glaucoma awareness and therapeutic compliance. By integrating personalised counselling, reinforcement of eye drops instillation techniques, intraocular pressure monitoring, and distribution of educational materials, the study sought to enhance patient understanding of glaucoma and improve adherence to prescribed treatment. Such interventions may serve as a practical and cost-effective strategy for improving glaucoma management outcomes in routine clinical practice.

MATERIALS AND METHODS

Ethical consideration

Ethical approval was obtained prior to study initiation; this study adheres to the principles of the Declaration of Helsinki and written informed consent was obtained from all patients before data collection.:

Study Design and Setting: This prospective interventional study was conducted over a period of six months at ICARE Eye Hospital, Noida, India.

Sample Size: The sample size was calculated using Cochran's formula and validated using Raosoft software, yielding a total of 68 participants. Patients were randomly assigned to the intervention (n = 34) and control (n = 34) groups.

Inclusion and Exclusion Criteria: Patients aged 35 years or older diagnosed with primary open-angle glaucoma, primary angle-closure glaucoma, normal tension glaucoma, or ocular hypertension within the previous month were included. Individuals with cognitive impairment or advanced glaucoma requiring immediate surgical management were excluded.

Study Tools: Glaucoma knowledge was assessed using a validated 14-item questionnaire adapted from previously published scales. Medication adherence was evaluated using the Morisky Green Levine (MGL) four-item scale. Lower scores indicated better adherence.

Intervention Protocol

The intervention group received structured follow-up interventions that included:

- Personalised counselling sessions
- Education on disease mechanism and risk of progression
- Demonstration and correction of eye drop instillation technique
- IOP charting and explanation of results
- Distribution of educational handouts and visual materials

The control group received routine standard glaucoma care without structured reinforcement.

Data Collection Procedure: Baseline assessment of knowledge and adherence was conducted at enrolment. Follow-up assessments were performed after completion of the structured intervention period.

Statistical Analysis

Data were analysed using SPSS software. Continuous variables were expressed as mean $\pm$ standard deviation. Paired t-tests were applied to compare pre and post intervention scores within the intervention group. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 68 glaucoma patients completed the baseline study questionnaire (34 in the control group and 34 in the intervention group), and 31 in the intervention group completed the follow-up study questionnaire; all of whom were included in this study. In total, 34 participants from the case group 3 patients lost the follow-up.

Table 1. Socio-demographic, (n = 68)

Variable	Category / Statistic	Frequency (n)	Percentage (%)
Age (years)	Mean $\pm$ SD	62.44 $\pm$ 12.89	—
	Median (Range)	65 (26–94)	—
Gender	Male	38	55.9
	Female	30	44.1
Marital Status	Married	68	100
Education Level	No formal education	17	25.0

	Primary/Secondary	12	17.6
	Higher Secondary	10	14.7
	Bachelor's	9	13.2
	Master's	12	17.6
	PhD	3	4.4
	Others	5	7.5
Occupation	Retired	16	23.5
	Housewife	10	14.7
	Unemployed	9	13.2
	Farmer	8	11.8
	Business/Entrepreneur	9	13.2
	Professional/Service	10	14.7
	Others	6	8.9
Residence Type	Urban	23	33.8
	Peri-urban	24	35.3
	Rural	21	30.9
Baseline IOP (mmHg)	Mean $\pm$ SD	24.29 $\pm$ 4.91	—
	Median (Range)	24 (11–38)	—

Table 1 shows that the mean age of the participants was 62.44 ± 12.89 years, with a median age of 65 years. Among the participants, 38 (55.9%) were male, and 30 (44.1%) were female. All participants included in the study were married (100%). Regarding educational status, 25% of the participants had no formal education, while 17.6% had primary/secondary education, 14.7% had higher secondary education, 13.2% had a bachelor's degree, and 17.6% had a master's degree. A small proportion had a PhD (4.4%) or other educational qualifications (7.5%). With respect to occupation, 23.5% of the participants were retired, followed by housewives (14.7%), professional/service workers (14.7%), business/entrepreneurs (13.2%), unemployed individuals (13.2%), and farmers (11.8%), while 8.9% belonged to other occupational categories. In terms of residence, 35.3% of participants were from peri-urban areas, 33.8% from urban areas, and 30.9% from rural areas. The mean baseline intraocular pressure (IOP) among the participants was 24.29 ± 4.91 mmHg, with a median of 24 mmHg (range: 11–38 mmHg).

Table 2: Distribution of Clinical Characteristics of Study Participants (n = 68)

Clinical Variable	Category	Frequency (n)	Percentage (%)
Type of Glaucoma	Primary Angle Closure Glaucoma (PACG)	24	35.3
	Primary Open Angle Glaucoma (POAG)	21	30.9
	Ocular Hypertension	12	17.6

	Normal Tension Glaucoma	11	16.2
	Total	68	100
Duration Since Diagnosis	< 1 month	68	100
	≥ 1 month	0	0
	Total	68	100
Family History of Glaucoma	Yes	21	30.9
	No	32	47.1
	Unknown	15	22.0
	Total	68	100

The distribution of clinical characteristics is presented in Table 2. The most common type of glaucoma observed among the participants was Primary Angle Closure Glaucoma (PACG) (35.3%), followed by Primary Open Angle Glaucoma (POAG) (30.9%), ocular hypertension (17.6%), and normal tension glaucoma (16.2%). All participants were recently diagnosed with glaucoma (<1 month) at the time of enrolment. Regarding family history, 30.9% of participants reported a positive family history of glaucoma, 47.1% reported no family history, while 22% were unaware of their family history.

Table 3: Distribution of Glaucoma Knowledge and Awareness Scores at Baseline (n = 68)

Knowledge Level	Score Range	Frequency (n)	Percentage (%)
Poor	0–5	7	10.3
Moderate	6–10	34	50.0
Good	11–14	27	39.7
Total	—	68	100

As illustrated in Table 3, the baseline assessment of glaucoma knowledge and awareness showed that 50% of participants had a moderate level of knowledge, while 39.7% demonstrated good knowledge, and 10.3% had poor knowledge scores. These findings indicate that although some patients had basic awareness of glaucoma, a considerable proportion lacked adequate understanding of the disease and its management.

Table 4: Pre–Post Analysis of Knowledge and Adherence Scores (Intervention Group) Sample Size (Intervention Group): n = 31

Variable	Mean ± SD (Pre)	Mean ± SD (Post)	t-value	p-value
Knowledge Score	3.81 ± 2.65	8.71 ± 1.49	-14.34	p = 0.000000000000000576

As presented in Table 4, the effect of structured follow-up interventions on knowledge scores was evaluated in the intervention group. The mean knowledge score significantly improved from 3.81 ± 2.65 at baseline to 8.71 ± 1.49 after the intervention. Statistical analysis using a paired t-test showed a highly significant difference ($t = -14.34$, $p = 0.000000000000000576$), indicating a substantial improvement in glaucoma knowledge following the educational intervention.

Table 5: Medication Adherence Score (MGL Scale)

Variable	Mean $\pm$ SD (Pre)	Mean $\pm$ SD (Post)	t-value	p-value
Adherence Score	1.10 ± 0.98	0.10 ± 0.30	6.23	$p = 0.000000734$

Similarly presented in Table 5, medication adherence assessed using the Morisky Green Levine (MGL) adherence scale demonstrated a significant improvement after the intervention. The mean adherence score decreased from 1.10 ± 0.98 at baseline to 0.10 ± 0.30 after the intervention, reflecting improved adherence to prescribed glaucoma medications. This change was also statistically significant ($t = 6.23$, $p = 0.000000734$).

Figure 1: Shows the mean knowledge score increased by 4.90 points (Pre & Post)

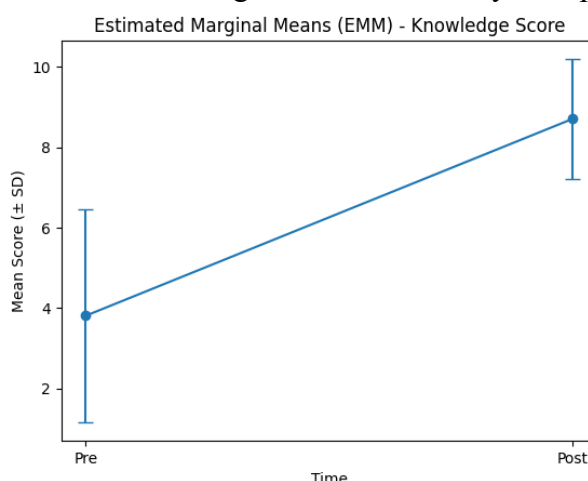


Figure 1 shows a combined analysis of outcome measures further confirmed that both knowledge and medication adherence improved significantly following the structured follow-up intervention. The mean knowledge score increased markedly, while adherence scores showed a significant reduction, indicating better compliance with treatment. These results suggest that structured educational counselling and follow-up interventions play a crucial role in improving patient awareness and adherence to glaucoma therapy.

Figure 2: Shows Pre & Post Medication Adherence Score

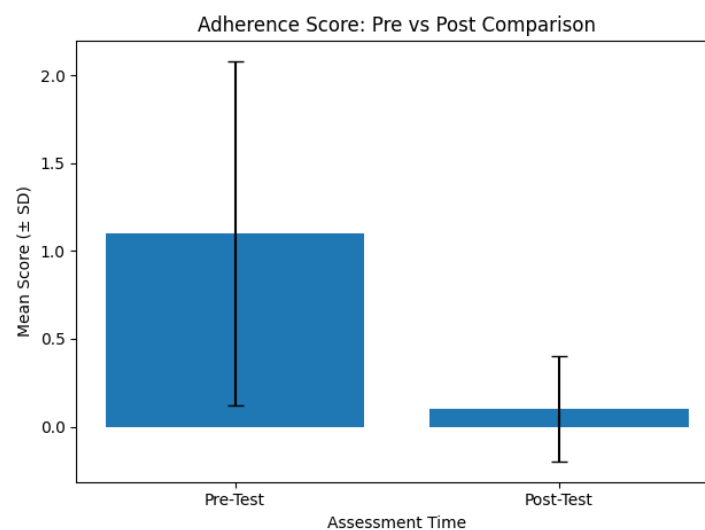


Table 6. Baseline Knowledge, Awareness and Medication Adherence Scores in the Control Group (n = 34)

Variable	Mean ± SD
Knowledge and Awareness Score	10.50 ± 0.99
MGL Adherence Score	0.18 ± 0.39

Table 6 presents the baseline knowledge, awareness, and medication adherence scores of participants in the control group. The mean knowledge and awareness score in the control group was 10.50 ± 0.99 , indicating a relatively good level of baseline understanding regarding glaucoma and its management. The mean Morisky Green Levine (MGL) adherence score was 0.18 ± 0.39 , reflecting relatively good medication adherence among control group participants at baseline. These findings suggest that participants in the control group already demonstrated moderate to good awareness and adherence levels, and no structured follow-up intervention was provided to further enhance these outcomes.

Figure 3. Comparison of Baseline and Post-Intervention Glaucoma Knowledge Scores Between Control and Intervention Groups

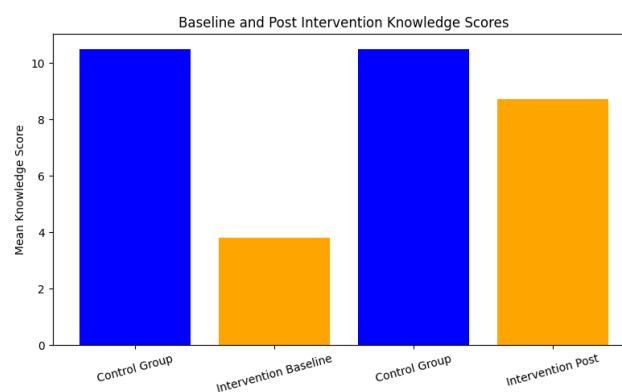


Figure 3 illustrates the comparison of glaucoma knowledge scores between the control and intervention groups at baseline and post-intervention. The intervention group demonstrated a substantial improvement in knowledge scores following structured follow-up interventions, increasing from 3.81 ± 2.65 at baseline to 8.71 ± 1.49 post-intervention. In contrast, the control group maintained similar baseline scores (10.50 ± 0.99) without structured reinforcement. These findings indicate that structured educational follow-up significantly enhanced patient awareness and understanding of glaucoma.

Figure 4. Comparison of Baseline and Post-Intervention Medication Adherence (MGL Score) Between Control and Intervention Groups

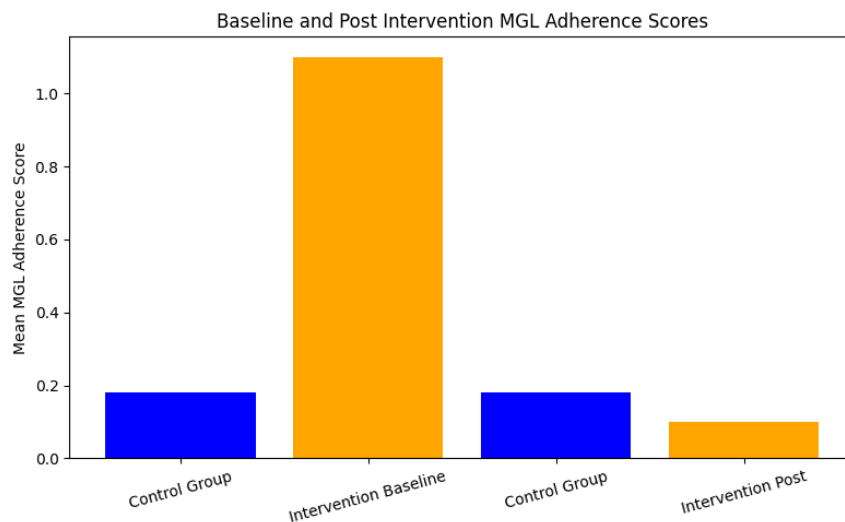


Figure 4 presents the comparison of medication adherence scores using the Morisky Green Levine (MGL) scale between control and intervention groups. The intervention group showed a significant reduction in MGL score from 1.10 ± 0.98 at baseline to 0.10 ± 0.30 following structured follow-up interventions, indicating improved medication adherence. The control group maintained relatively stable adherence scores (0.18 ± 0.39) without structured educational reinforcement. These results suggest that structured follow-up interventions improved therapeutic compliance among glaucoma patients.

DISCUSSION

This study evaluated the effectiveness of structured follow-up interventions in improving glaucoma awareness and therapeutic compliance. The findings demonstrated statistically significant improvements in both knowledge and medication adherence following personalised counselling and reinforcement strategies (Cook & Foster, 2012; Friedman et al., 2008). Glaucoma management poses unique challenges due to its chronic nature and asymptomatic progression (Weinreb et al., 2014). Patients often underestimate disease severity because early stages lack noticeable visual impairment (Quigley & Broman, 2006; Weinreb et al., 2014). Consequently, adherence to long-term topical therapy becomes inconsistent (Olthoff et al., 2005). In this study, baseline knowledge scores reflected limited understanding, supporting

previous literature that reported insufficient awareness among glaucoma patients (Ichhpujani et al., 2012; Rewri & Kakkar, 2014; Sathyamangalam et al., 2009; Sood et al., 2017). Following structured intervention, knowledge scores improved substantially. Educational counselling has been shown to significantly improve patient understanding of glaucoma and the importance of treatment adherence. (Barakat et al. (2024), Fiscella et al. (2018), and Cate et al. (2014) reported that educational sessions significantly improved glaucoma knowledge and patient awareness (Muir & Lee, 2011). Personalised counselling sessions appeared to enhance patient understanding of disease mechanism, risk factors, and the importance of continuous therapy (Muir & Lee, 2011; Sleath et al., 2011). Unlike single-session educational programs reported in earlier studies, this intervention incorporated repeated reinforcement, which may have contributed to better retention of information. Adherence scores also improved significantly. Poor adherence to glaucoma medication has been widely reported in previous studies (Olthoff et al., 2005; Tsai, 2009). Leiby et al. (2021) showed that patient-centred interventions increased adherence to glaucoma follow-up care (Olthoff et al., 2005; Tsai, 2009). The Morisky Green Levine scale demonstrated a reduction in non-adherence behaviours such as forgetfulness and discontinuation of medication. Reinforcement of the drop instillation technique and explanation of IOP readings may strengthened patient motivation and compliance with treatment (Friedman et al., 2008).

Previous studies have shown mixed results regarding educational interventions for glaucoma patients (Gray et al., 2010; Muir & Lee, 2011). Some randomized trials reported modest improvements in medication adherence, while others failed to achieve sustained adherence enhancement. A potential reason for inconsistent findings is the lack of structured follow-up reinforcement. This study addressed this gap by integrating ongoing counselling with monitoring, thereby linking awareness with behavioural compliance (Friedman et al., 2008; Sleath et al., 2011). The findings suggest that structured follow-up interventions can serve as a practical, low-cost strategy in routine clinical settings (Friedman et al., 2008). IOP charting provided visual feedback, which may have improved patient engagement and understanding of disease progression. Educational handouts supported reinforcement outside the clinical setting and may help improve long-term patient education (Muir & Lee, 2011).

CONCLUSION

This study demonstrated that structured follow-up interventions significantly improved glaucoma awareness and medication adherence among newly diagnosed patients. Personalised counselling, reinforcement of drop instillation technique, and IOP monitoring contributed to measurable enhancement in both knowledge retention and therapeutic compliance. Given the chronic and asymptomatic nature of glaucoma, patient education must extend beyond initial diagnosis. Integrating structured follow-up interventions into routine ophthalmic practice may strengthen long-term disease control and reduce the risk of irreversible visual loss.

The findings support the incorporation of systematic educational reinforcement strategies within standard glaucoma care protocols.

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