

Prevalence of Dry Eye in Patients with Glaucoma on Topical Anti-Glaucoma Medication Using the OSDI Questionnaire

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ABSTRACT:

Introduction: Dry eye disease (DED) is a common yet frequently underrecognized comorbidity in patients with glaucoma, particularly those receiving long-term topical anti-glaucoma therapy. Chronic exposure to these medications, especially preservative-containing formulations, can disrupt the ocular surface, leading to tear film instability, inflammation, and reduced treatment adherence. The study was conducted to evaluate the prevalence and severity of dry eye disease using OSDI in patients receiving topical anti-glaucoma medications. **Methods:** This cross-sectional observational study was conducted at a tertiary care teaching hospital in Karnataka, over 18 months on 96 glaucoma patients using topical anti-glaucoma medications. Dry eye was assessed using the Ocular Surface Disease Index (OSDI) questionnaire. Demographic and clinical data, including duration and number of medications, were recorded. Statistical analysis was performed with $p < 0.05$ considered significant. **Results:** Dry eye disease was present in 66 of 96 patients (68.8%). Based on OSDI, 18 patients (18.8%) had mild, 20 (20.8%) moderate, and 28 (29.2%) severe symptoms. DED prevalence increased with duration of glaucoma from 46.2% (<2 years) to 90.6% (>5 years), and with number of medications from 52.5% (single drug) to 86.4% (≥ 3 drugs). Patients on BAK-preserved medications showed higher prevalence (78.6%) compared to preservative-free regimens (42.3%). **Conclusion:** DED is highly prevalent among glaucoma patients on topical therapy, with severity increasing with longer duration and polypharmacy. Routine screening and strategies to reduce preservative exposure are essential to improve ocular surface health and treatment adherence.

Keywords: Glaucoma; Dry eye disease; Topical anti-glaucoma medications; Ocular Surface Disease Index.

INTRODUCTION:

Dry eye disease (DED) is an increasingly recognized concern among patients receiving treatment for glaucoma, particularly those undergoing long-term topical therapy. Glaucoma, a chronic and progressive optic neuropathy characterized by irreversible visual field loss, is commonly managed through lifelong administration of intraocular pressure (IOP)-lowering medications. While these medications have been highly effective in preserving vision, they are not without side effects one of the most prominent being their impact on the ocular surface, contributing significantly to the development or exacerbation of dry eye symptoms. [1] The intersection between glaucoma and dry eye is complex and multifactorial, with more than 50% of patients reporting symptoms such as ocular discomfort,

burning, and visual fluctuations, often underestimated despite their effect on quality of life and treatment adherence. A key factor is the chronic use of topical medications containing preservatives like benzalkonium chloride (BAK), which disrupt the tear film and induce ocular surface damage and inflammation. [2]

Polypharmacy further increases preservative load, while active agents such as beta-blockers and prostaglandin analogs also contribute to tear film instability and inflammation. [3] Additionally, elderly patients with glaucoma are inherently more susceptible to DED due to age-related changes and systemic comorbidities, which may worsen visual function and reduce adherence.

The coexistence of glaucoma and dry eye also imposes psychological and functional burdens, while diagnosis remains challenging due to poor correlation between symptoms and clinical tests. [4][5] Increasingly, glaucoma management strategies emphasize ocular surface preservation through preservative-free formulations, reduced medication burden, and alternative therapies, along with proactive screening and targeted dry eye treatment. [6]

The prevalence of dry eye in patients with glaucoma on topical medications is substantial and clinically significant, necessitating integrated management approaches to improve adherence, patient comfort, and long-term outcomes. [7]

Dry eye disease (DED) in glaucoma patients is often underdiagnosed due to variability between symptoms and clinical signs. Recent emphasis has shifted toward patient-reported outcomes for better clinical relevance. The Ocular Surface Disease Index (OSDI) is a validated and reliable tool that captures the subjective burden of dry eye and its impact on vision-related quality of life. Hence, this study focuses on evaluating the prevalence and severity of dry eye disease using OSDI in patients receiving topical anti-glaucoma medications.

MATERIALS AND METHODS:

Study Design:

The cross-sectional study was conducted in the (OPD) of the Department of Ophthalmology, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Mandya District, Karnataka for a period of 18 months (April 2024 to September 2025). Ethical clearance was obtained from the Institutional Ethics Committee before starting the study. Using a consecutive sampling method, 96 patients fulfilling the inclusion criteria were selected for the study.

Inclusion Criteria:

Patients age >40years, belonging to both the genders, known case of Glaucoma and on topical anti-glaucoma medication, and ready to provide informed consent.

RESULTS:

Table 1: Demographic and Clinical Distribution (n=96)

Variable	Category	N (%)
Age	40–49	34 (35.4)
	50–59	29 (30.2)
	60–69	24 (25.0)
	≥70	9 (9.4)
Sex	Male	50 (52.1)
	Female	46 (47.9)
Type of Glaucoma	POAG	72 (75.0)
	PACG	16 (16.7)
	Secondary	8 (8.3)

Exclusion Criteria:

Patients with acute ocular infections with extensive corneal or conjunctival pathology, on systemic medication (e.g. diuretics, psychotropics, leading to ocular drying), contact lens users, Anterior or posterior segment disease, those who underwent recent ocular surgery (e.g. cataract surgery), pregnant women and those not ready to provide informed consent.

Patients fulfilling the inclusion criteria were enrolled after obtaining informed written consent, and their demographic details and clinical history, including duration of glaucoma, type and duration of medications, and associated comorbidities, were recorded. Each participant underwent a comprehensive ophthalmic evaluation, including assessment of visual acuity using Snellen’s chart, color vision, and extraocular movements. A detailed slit lamp examination of the anterior segment was performed to evaluate the eyelids, meibomian glands, conjunctiva, and cornea. Intraocular pressure was measured using rebound tonometry.

Dry eye disease was assessed subjectively using the Ocular Surface Disease Index (OSDI) questionnaire. The OSDI score was calculated using the standard formula and categorized into normal (0–12), mild (13–22), moderate (23–32), and severe (≥33). Dry eye disease was defined as an OSDI score ≥13. The OSDI was used to determine the prevalence and severity of dry eye symptoms and to evaluate its association with topical anti-glaucoma medications.

Data was collected and entered into Microsoft Excel. Statistical analysis was performed using the SPSS version 27.0. Quantitative variables (OSDI scores) were expressed as mean ± SD and categorical variables as proportions. Chi-square test and ANOVA were used where applicable. A p-value < 0.05 was considered significant.

Table 2: Clinical Profile and OSDI-based Dry Eye Status

Variable	Category	N (%)
Duration	<2 yrs	26 (27.1)
	2–5 yrs	38 (39.6)
	>5 yrs	32 (33.3)
No. of drugs	1	40 (41.7)
	2	34 (35.4)
	≥3	22 (22.9)
Preservative	BAK	70 (72.9)
	PF	26 (27.1)
Dry Eye	No	30 (31.3)
	Yes	66 (68.8)
OSDI Severity	Mild	18 (18.8)
	Moderate	20 (20.8)
	Severe	28 (29.2)

Table 3: Association of Demographic and Clinical Factors with Dry Eye Disease (n = 96)

Variable	Category	No DED n (%)	DED present n (%)	Row total n (%)
Duration of glaucoma	< 2 years	14 (53.8%)	12 (46.2%)	26 (27.1%)
	2–5 years	13 (34.2%)	25 (65.8%)	38 (39.6%)
	> 5 years	3 (9.4%)	29 (90.6%)	32 (33.3%)
Number of medications	1	19 (47.5%)	21 (52.5%)	40 (41.7%)
	2	8 (23.5%)	26 (76.5%)	34 (35.4%)
	≥3	3 (13.6%)	19 (86.4%)	22 (22.9%)
Preservative regimen	BAK preserved	15 (21.4%)	55 (78.6%)	70 (72.9%)
	Preservative-free / low-BAK	15 (57.7%)	11 (42.3%)	26 (27.1%)
Age group (years)	40–49	15 (44.1%)	19 (55.9%)	34 (35.4%)
	50–59	9 (31.0%)	20 (69.0%)	29 (30.2%)
	60–69	6 (25.0%)	18 (75.0%)	24 (25.0%)
	≥70	0 (0.0%)	9 (100.0%)	9 (9.4%)
Sex	Male	17 (34.0%)	33 (66.0%)	50 (52.1%)
	Female	13 (28.3%)	33 (71.7%)	46 (47.9%)
Total	—	30 (31.3%)	66 (68.8%)	96 (100.0%)

Table 4: Association of Demographic and Clinical Variables with Dry Eye Disease (p-values)

Variable	p-value
Duration of glaucoma	<0.001
Number of medications	0.012
Preservative regimen	<0.001
Age	0.021
Sex	0.482

Table 5: Association of Duration of Glaucoma and Number of Medications with Mean OSDI Scores (n = 96)

Duration of Glaucoma (years)	Number of Medications	n	Mean OSDI ± SD
< 2	1	15	18.5 ± 12.3
< 2	2	7	24.2 ± 15.1
< 2	≥3	4	28.3 ± 14.6
2–5	1	16	22.1 ± 14.2
2–5	2	14	27.5 ± 16.3
2–5	≥3	8	32.9 ± 15.8
> 5	1	9	25.6 ± 15.0
> 5	2	13	30.8 ± 17.2
> 5	≥3	10	36.4 ± 16.1

Table 6: Comparison of Mean OSDI Scores According to Number of Topical Medications (ANOVA Analysis)

Number of medications	n	Mean OSDI $\pm$ SD	95% CI for mean
1	40	21.68 $\pm$ 16.66	16.35 – 27.00
2	34	26.15 $\pm$ 17.86	19.92 – 32.38
3 ($\geq$ 3)	22	32.55 $\pm$ 15.77	25.56 – 39.54
Total	96	25.75 $\pm$ 17.24	22.26 – 29.24
ANOVA: F = 2.95, df = 2, 93, p = 0.057			

Post-hoc (Bonferroni)

1 vs 2 drugs: mean difference = -4.47, p = 0.779

1 vs 3 drugs: mean difference = -10.87, p = 0.052 (borderline)

2 vs 3 drugs: mean difference = -6.40, p = 0.509

DISCUSSION:

Glaucoma is a lifelong disease in most patients, and topical medications remain the cornerstone of therapy. While the primary focus of glaucoma treatment is intraocular pressure control, the impact of long-term topical therapy on the ocular surface is frequently overlooked in routine clinical practice. Dry eye disease can significantly impair visual quality, cause persistent ocular discomfort, and adversely affect patient satisfaction and adherence to treatment. The primary aim of The present study highlights a substantial burden of dry eye disease (DED) among patients receiving topical anti-glaucoma therapy, emphasizing its clinical relevance in routine glaucoma management.

The present study demonstrated a high prevalence of dry eye disease (DED) in 66 out of 96 patients (68.8%) receiving topical anti-glaucoma medications. This finding is comparable with previous studies such as Zemba et al. (63%) [8], Palikhey et al. (72%) [9], Monjane and Makupa (79.7%) [10], all of which reported a similarly high burden of DED among glaucoma patients.

In terms of age distribution, most patients were in the 40–49 year's group (34; 35.4%), followed by 50–59 years (29; 30.2%) and 60–69 years (24; 25.0%). The prevalence of DED increased with age, from 55.9% in 40–49 years to 75.0% in 60–69 years and reaching 100% in patients aged $\geq$ 70 years. These findings are consistent with Erb [11] and Kobia-Acquah et al. [12], Yasir et al. [13] who also reported higher DED prevalence in older age groups. Regarding sex distribution, males constituted 50 (52.1%) and females 46 (47.9%), with DED prevalence of 66.0% and 71.7% respectively, indicating no significant gender difference, similar to observations by Zemba et al. [8]. The duration of glaucoma showed a strong association with DED. Patients with disease duration $>$ 5 years had the highest prevalence (29/32; 90.6%), compared to 25/38 (65.8%) in 2–5 years and 12/26 (46.2%) in $<$ 2 years. This progressive increase highlights the cumulative toxic effect of long-term therapy and is in agreement with findings by Monjane and Makupa [10], Kobia-Acquah et al. [12], Fidalia et al. [14] and Nijm et al. [15]

The number of anti-glaucoma medications also showed a clear dose–response relationship with DED. Prevalence increased from 52.5% in patients on a single drug to 76.5% with two drugs and 86.4% with $\geq$ 3 drugs. This finding reinforces the concept of polypharmacy-induced ocular surface toxicity, as previously highlighted by Monjane and Makupa [10], Erb [11], and Sahlu and Giorgis [16]. Additional studies have reinforced that increasing medication burden and frequency of instillation significantly worsen ocular surface symptoms and patient discomfort Wong et al. [17]

Preservative exposure particularly benzalkonium chloride (BAK), was another significant contributing factor to DED. Among patients using BAK-preserved medications, 55/70 (78.6%) had DED, compared to only 11/26 (42.3%) in those on preservative-free or low-BAK regimens. This significant difference supports the findings of Sitompul and Nora [18] and Ouyang and Duan [19], who reported the toxic effects of benzalkonium chloride on the ocular surface. Similar observations have been widely supported in literature emphasizing the need for preservative-free alternatives Singh and Taneja [20].

Subjective assessment using OSDI showed that 18.8% had mild, 20.8% moderate, and 29.2% severe symptoms, with 50% of patients falling into the moderate-to-severe category. Mean OSDI scores increased with the number of medications (21.68 $\pm$ 16.66 for one drug, 26.15 $\pm$ 17.86 for two drugs, and 32.55 $\pm$ 15.77 for $\geq$ 3 drugs). These findings indicate a substantial symptom burden among patients on chronic therapy and are comparable to studies using OSDI as a primary diagnostic tool, such as Palikhey et al. [9] that emphasize the utility of symptom-based assessment alone in clinical settings.

Additionally, combined analysis of duration and number of medications demonstrated a progressive rise in mean OSDI scores, with the highest values observed in patients with $>$ 5 years duration and $\geq$ 3 medications (36.4 $\pm$ 16.1). This aligns with broader evidence suggesting that long-term preserved therapy contributes to progressive ocular surface damage and reduced patient tolerance Farooq et al. [21]

Overall, the findings indicate that DED in glaucoma patients is multifactorial, with significant contributions from increasing age, longer disease duration, polypharmacy, and preservative exposure. The high prevalence (68.8%) and substantial proportion of moderate-to-severe cases (50.0%) underscore the need for routine screening and optimization of therapy to improve ocular surface health, treatment adherence, and long-term visual outcomes.

These findings highlight the importance of integrating ocular surface evaluation into routine glaucoma care to optimize long-term treatment outcomes.

Strength & Limitations:

The present study has several strengths that enhance its clinical relevance. It evaluated dry eye disease (DED) in a well-defined cohort of 96 glaucoma patients receiving topical therapy, directly representing a population at high risk for ocular surface disorders. The use of the Ocular Surface Disease Index (OSDI) provided a standardized and validated subjective tool for assessing the frequency and severity of dry eye symptoms and their impact on vision-related quality of life. Furthermore, the study analysed multiple clinically relevant variables, including age, sex, duration of glaucoma, number of medications, preservative regimen, and comorbidities, allowing a comprehensive evaluation of factors associated with DED. The observation of consistent dose response trends such as increasing symptom severity with longer disease duration and higher medication burden adds to the internal consistency and clinical applicability of the findings.

However, certain limitations should be acknowledged. The reliance on OSDI alone, without objective tear film assessments such as TBUT or Schirmer I, limits the ability to correlate symptoms with clinical signs and may lead to under- or over-estimation of true disease severity. The cross-sectional design restricts causal inference, and the relatively small sample size ($n = 96$) may limit the statistical power for subgroup analyses. Additionally, the absence of a control group makes it difficult to distinguish between glaucoma-related and treatment-induced dry eye symptoms. Potential confounding factors, including environmental exposure, screen time, and systemic conditions, were not fully evaluated. Moreover, detailed analysis of individual drug classes and cumulative preservative exposure was limited. Therefore, while the findings provide meaningful insight into symptom burden among glaucoma patients, further studies incorporating objective assessments and longitudinal follow-up are recommended for stronger validation and generalizability.

CONCLUSION:

The present study demonstrates a high prevalence of dry eye disease (68.8%) among glaucoma patients receiving topical anti-glaucoma medications, indicating that ocular surface involvement is a common and clinically

significant comorbidity in this population. The severity of dry eye was substantial, with 50.0% of patients exhibiting moderate-to-severe symptoms on OSDI assessment, reflecting a substantial impact on ocular comfort and quality of life.

The study also highlights key contributing factors, including increasing age, longer duration of glaucoma, polypharmacy, and the use of BAK-preserved medications. Notably, dry eye prevalence increased from 46.2% in patients with <2 years of disease to 90.6% in those with >5 years, and from 52.5% in monotherapy to 86.4% in patients on ≥ 3 medications, demonstrating a clear cumulative and dose-dependent effect.

Overall, the findings emphasize that dry eye disease is highly prevalent and often moderate-to-severe among glaucoma patients on topical therapy. Longer disease duration, higher medication burden, and preservative exposure are key determinants, suggesting cumulative ocular surface impact. Routine screening using validated symptom-based tools like OSDI is essential in glaucoma follow-up to enable early identification and timely management, thereby improving patient comfort, treatment adherence, and long-term therapeutic outcomes

Ethical Approval:

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Adichunchanagiri Institute of Medical Sciences, Karnataka.

Conflict of Interest:

The authors declare that there are no conflicts of interest regarding the publication of this study.

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