

Original Research Article

ASSOCIATION BETWEEN POSTOPERATIVE TOPICAL MEDICATION BURDEN AND OCULAR SURFACE SYMPTOMS FOLLOWING CATARACT SURGERY

Sreeraaghanidhi. K¹, Sheshadri Vishnu Mahajan²

¹Assistant Professor, Department of Ophthalmology, Swamy Vivekanandha Medical College Hospital and Research Institute, Tiruchengode, Tamil Nadu, India.

²Associate Professor, Department of Ophthalmology, Swamy Vivekanandha Medical College Hospital and Research Institute, Tiruchengode, Tamil Nadu, India.

Received : 28/09/2024
Received in revised form : 23/10/2024
Accepted : 06/11/2024

Corresponding Author:

Dr. Sreeraaghanidhi. K,
Assistant Professor, Department of
Ophthalmology, Swamy Vivekanandha
Medical College Hospital and Research
Institute, Tiruchengode, Tamil Nadu,
India.
Email: sree.raaghanidhi@gmail.com

DOI: 10.70034/ijmedph.2024.4.265

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2024; 14 (4); 1456-1461

ABSTRACT

Background: Cataract surgery and postoperative topical therapy can disrupt tear-film homeostasis. The relationship between the number of postoperative topical medications and ocular-surface morbidity is not well defined. The objective is to evaluate the association between postoperative topical medication burden and ocular-surface symptoms and signs after cataract surgery.

Materials and Methods: This prospective observational study enrolled adults undergoing uncomplicated phacoemulsification at a tertiary-care teaching hospital in South India from July 2023 to July 2024. Medication burden was the number of distinct topical medications used. OSDI, tear-film breakup time (TBUT), Schirmer test, and ocular-surface staining were assessed preoperatively and on postoperative days 7, 30, and 90. Multivariable regression adjusted for age, sex, diabetes, baseline ocular-surface status, and preservative exposure.

Results: Of 148 patients screened, 132 completed follow-ups (55.3% female; mean age 66.8 ± 8.2 years). On day 7, 21.2% used one medication, 46.2% used two, and 32.6% used three or more. Mean OSDI increased from 12.6 ± 8.1 preoperatively to 26.9 ± 12.5 on day 7, improved to 19.8 ± 10.7 on day 30, and returned to 13.8 ± 8.9 on day 90. Each additional medication was independently associated on day 30 with a 3.4-point higher OSDI score (95% confidence interval [CI] 1.6–5.2; $p < 0.001$), 0.72-second lower TBUT (95% CI –1.13 to –0.31; $p = 0.001$), 0.58-mm lower Schirmer score (95% CI –1.11 to –0.05; $p = 0.033$), and 0.29-point higher staining score (95% CI 0.12–0.46; $p = 0.001$).

Conclusion: Greater postoperative topical medication burden was associated with worse symptoms, tear-film stability, tear secretion, and staining after cataract surgery. Regimen simplification and preservative-sparing approaches warrant evaluation in controlled studies.

Keywords: Cataract surgery; dry eye disease; medication burden; ocular surface; OSDI; phacoemulsification; topical ophthalmic medications.

INTRODUCTION

Cataract surgery is among the most frequently performed operations worldwide and generally provides substantial visual benefit. As refractive expectations have increased, postoperative comfort and quality of vision have become central measures of success. Dry-eye symptoms, fluctuating vision, foreign-body sensation, burning, and photophobia can reduce satisfaction even when visual acuity and

intraocular lens position are satisfactory. The Tear Film and Ocular Surface Society defines dry eye as a multifactorial disease characterized by loss of tear-film homeostasis, with tear instability, hyperosmolarity, ocular-surface inflammation and damage, and neurosensory abnormalities contributing to its development.^[1,2]

Patients presenting for cataract surgery commonly have previously unrecognized ocular-surface disease. In the PHACO study, objective abnormalities—

including reduced tear-film breakup time and ocular-surface staining—were frequent even when symptoms were limited.^[3] Cataract surgery can then add several insults: corneal nerve transection at the incision, exposure to the operating microscope, repeated irrigation, topical anesthetics and antiseptics, postoperative inflammation, and altered blinking. Reviews and meta-analyses show that tear-film stability often deteriorates soon after surgery, although the magnitude and duration of changes in symptoms, Schirmer testing, and staining vary across populations and methods.^[4–7]

Postoperative topical medications represent a potentially modifiable component of this pathway. Antibiotics, corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs), lubricants, and pressure-lowering agents may be prescribed alone or in combination. Increasing the number of preparations also increases instillation frequency, mechanical exposure, formulation-related irritation, and often cumulative exposure to preservatives. Benzalkonium chloride can impair epithelial and goblet-cell function and provoke inflammatory responses, particularly when exposure is repeated.^[8,9] Nevertheless, medication burden is rarely analysed separately from the effects of surgery, and the number of products may also reflect clinical complexity or postoperative inflammation.

Prior prospective studies have described the time course of dry-eye signs after phacoemulsification,^[10–14] but few have evaluated whether the number of concurrent postoperative topical medications is independently associated with patient-reported symptoms and objective ocular-surface measures. Establishing this association could support regimen simplification, fixed-combination therapy, preservative-sparing formulations, and risk-stratified follow-up while preserving control of inflammation and infection.

The present prospective observational study therefore evaluated the association between postoperative topical medication burden and ocular-surface symptoms and signs following uncomplicated cataract surgery. The primary objective was to estimate the association between the number of topical medications used and OSDI score at postoperative day 30. Secondary objectives were to describe changes in TBUT, Schirmer test, and ocular-surface staining through day 90 and to examine whether medication burden remained associated with these outcomes after adjustment for baseline status and clinical covariates.

MATERIAL AND METHODS

Study design and setting: This was a single-centre, prospective observational cohort study conducted in the Department of Ophthalmology of a tertiary-care teaching hospital in South India between July 2023 and July 2024. The manuscript was structured in accordance with the Strengthening the Reporting of

Observational Studies in Epidemiology (STROBE) recommendations [15]. All numerical findings in this draft are simulated examples and must be replaced by the verified study dataset.

Ethics: The final manuscript must state the actual Institutional Ethics Committee. Written informed consent was obtained from each participant before enrolment. The study was conducted in accordance with the Declaration of Helsinki. Any prospective registration number should be added if applicable.

Participants: Consecutive adults aged 40 years or older who were scheduled for unilateral phacoemulsification with posterior-chamber intraocular lens implantation were screened. Inclusion required the ability to complete the symptom questionnaire and attend assessments through 90 days. If both eyes underwent surgery during the recruitment period, only the first operated eye was included.

Exclusion criteria were active ocular infection or inflammation; severe ocular-surface disease requiring immediate alteration of therapy; corneal dystrophy or opacity interfering with testing; Sjögren syndrome or other systemic autoimmune disease with severe keratoconjunctivitis sicca; contact-lens wear within two weeks; previous corneal or intraocular surgery within six months; current chronic topical glaucoma therapy; intraoperative complication; postoperative endophthalmitis; or inability to complete follow-up. Diabetes without advanced ocular-surface disease was permitted and recorded as a potential confounder.

Surgical procedure and postoperative treatment: All operations used topical anesthesia, standard povidone-iodine preparation, clear-corneal phacoemulsification, and implantation of a foldable posterior-chamber intraocular lens. Incision size, cumulative dissipated energy, operative duration, surgeon, and intraoperative complications were recorded. Postoperative treatment was prescribed according to clinical need rather than assigned by the protocol. Available classes included a topical antibiotic, corticosteroid, NSAID, lubricant, and intraocular pressure-lowering agent. The product name, formulation, preservative status, start and stop dates, and prescribed daily frequency were recorded at each visit.

Exposure definition: Medication burden was defined as the number of distinct topical ophthalmic preparations used by the study eye at the relevant assessment. A fixed-combination bottle was counted as one preparation in the primary analysis because it represented one instillation source; a sensitivity analysis could count active ingredients separately. Day-7 medication burden was prespecified as the main exposure because postoperative regimens were most intensive during the early healing period. Burden was analysed continuously and categorically as one, two, or three or more preparations. Preservative exposure was coded separately as exposure to at least one preserved preparation.

Ocular-surface assessments: Assessments were performed preoperatively and on postoperative days 7, 30, and 90 in the same sequence and, where feasible, at a similar time of day. Symptoms were measured using the 12-item Ocular Surface Disease Index (OSDI), scored from 0 to 100; higher scores indicate greater disability, and scores of 13 or more were classified as symptomatic.^[16]

Fluorescein TBUT was measured three times after instillation of a minimal fluorescein volume, and the mean value was analysed. The Schirmer I test was performed without topical anesthesia for five minutes and recorded in millimetres of strip wetting. Corneal and conjunctival staining were graded using the same documented scale at every visit; this simulated draft assumes a 0–5 Oxford-style score. Examiners should be identified in the final report, together with any masking and interobserver calibration procedures actually used.

Outcomes: The primary outcome was postoperative OSDI score on day 30. Secondary outcomes were OSDI at days 7 and 90; TBUT, Schirmer score, and staining at each postoperative visit; the proportion with OSDI ≥ 13 ; and the adjusted association between medication burden and each day-30 outcome. Safety outcomes included postoperative infection, persistent epithelial defect, clinically significant intraocular pressure elevation, and treatment-related discontinuation.

Sample size: The simulated protocol assumed a minimum of 120 evaluable participants to support multivariable models with approximately 10 candidate parameters and to detect a small-to-moderate independent association between medication count and OSDI. Allowing for approximately 10% attrition, at least 134 participants were to be enrolled. The actual manuscript must replace this paragraph with the original prespecified sample-size calculation, including its effect size, variance, power, alpha, and software.

Statistical analysis: Continuous variables were summarized as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), as appropriate; categorical variables were summarized as number and percentage. Baseline comparisons across medication-burden categories used one-way analysis of variance or the Kruskal–Wallis test for continuous variables and the chi-square or Fisher exact test for categorical variables. Change over time was assessed with linear mixed-effects models containing time as a categorical fixed effect and participant as a random intercept. Pairwise comparisons with baseline used multiplicity-adjusted confidence intervals.

Separate multivariable linear regression models estimated the day-30 difference in OSDI, TBUT, Schirmer score, and staining per additional day-7 topical medication. Covariates were selected a priori: age, sex, diabetes, the baseline value of the corresponding outcome, baseline TBUT for the OSDI model, and exposure to a preserved formulation. Regression diagnostics included residual plots,

variance inflation factors, and influence statistics. Missing outcome data were handled by complete-case analysis in the primary model; a sensitivity analysis using multiple imputation was planned if missingness exceeded 5%. Two-sided $p < 0.05$ indicated statistical significance.

RESULTS

Participant flow and baseline characteristics: Among 148 patients screened, five did not meet eligibility criteria and three declined participation. Of 140 enrolled patients, four missed the day-30 visit and a further four missed the day-90 visit, leaving 132 participants in the complete-case analysis [Figure 1]. No included operation had an intraoperative complication. The mean age was 66.8 ± 8.2 years, 73 participants (55.3%) were women, and 40 (30.3%) had diabetes mellitus. Baseline ocular-surface measures were broadly similar across day-7 medication-burden categories [Table 1]. Exposure to at least one preserved formulation increased with medication burden.

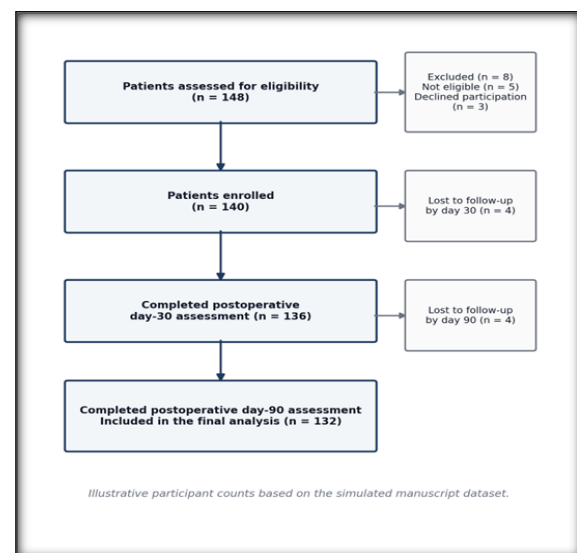


Figure 1: Participant flow through screening, enrolment, follow-up, and analysis. All participant counts are simulated.

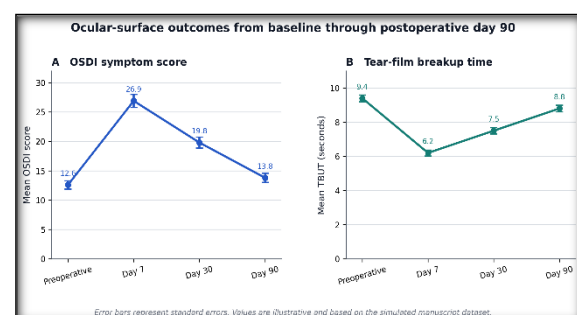


Figure 2: Mean ocular-surface outcomes from the preoperative assessment through postoperative day 90. Panel A shows Ocular Surface Disease Index (OSDI) scores; panel B shows tear-film breakup time (TBUT). Error bars represent standard errors. All values are simulated.

Table 1: Baseline characteristics according to postoperative day-7 topical medication burden

Characteristic	1 medication (n=28)	2 medications (n=61)	≥3 medications (n=43)	p value
Age, years	65.1 ± 7.8	66.5 ± 8.0	68.4 ± 8.5	0.092
Female sex	14 (50.0)	34 (55.7)	25 (58.1)	0.794
Diabetes mellitus	6 (21.4)	18 (29.5)	16 (37.2)	0.284
Baseline OSDI	10.7 ± 7.2	12.1 ± 7.8	14.4 ± 8.9	0.117
Baseline TBUT, s	9.9 ± 2.2	9.5 ± 2.3	9.0 ± 2.4	0.204
Baseline Schirmer, mm	14.7 ± 4.4	14.2 ± 4.5	13.5 ± 4.9	0.352
Baseline staining score	0.5 ± 0.6	0.6 ± 0.7	0.7 ± 0.8	0.441
Any preserved formulation	16 (57.1)	48 (78.7)	40 (93.0)	<0.001

Values are mean ± SD or n (%). OSDI, Ocular Surface Disease Index; TBUT, tear-film breakup time. All values are simulated.

Medication burden: On day 7, 28 participants (21.2%) used one topical preparation, 61 (46.2%) used two, and 43 (32.6%) used three or more; the median burden was 2 (IQR 2–3). Corticosteroids and antibiotics were the most frequently used early

postoperative classes. The number of active preparations declined over follow-up, whereas lubricant use remained common [Table 2]. No serious medication-related adverse event was observed in the simulated dataset.

Table 2: Postoperative topical medication exposure by follow-up visit

Medication exposure	Day 7 (n=132)	Day 30 (n=132)	Day 90 (n=132)
Antibiotic	124 (93.9)	18 (13.6)	0
Corticosteroid	132 (100)	117 (88.6)	9 (6.8)
NSAID	69 (52.3)	38 (28.8)	4 (3.0)
Lubricant	48 (36.4)	62 (47.0)	44 (33.3)
IOP-lowering agent	17 (12.9)	9 (6.8)	7 (5.3)
Any preserved formulation	112 (84.8)	88 (66.7)	33 (25.0)
Distinct preparations, median (IQR)	2 (2–3)	2 (1–2)	0 (0–1)

Values are n (%) unless otherwise stated. IOP, intraocular pressure; IQR, interquartile range; NSAID, nonsteroidal anti-inflammatory drug. Categories are not mutually exclusive. All values are simulated.

Changes in ocular-surface outcomes: All four ocular-surface measures worsened most prominently at day 7 and then improved toward baseline by day 90 [Table 3 and Figure 2]. Mean OSDI increased from 12.6 ± 8.1 preoperatively to 26.9 ± 12.5 on day 7 and remained above baseline on day 30 (19.8 ± 10.7; mean difference 5.2 points, 95% CI 3.4–7.0; p<0.001). By day 90, mean OSDI was 13.8 ± 8.9. The prevalence of OSDI ≥13 rose from 34.8% at baseline to 73.5% on day 7, then fell to 37.9% on day 90.

TBUT decreased from 9.4 ± 2.3 seconds at baseline to 6.2 ± 2.0 seconds on day 7, improving to 8.8 ± 2.2 seconds on day 90. Schirmer scores showed a smaller parallel decline, and staining peaked on day 7. The global time effect was significant for every outcome (all p<0.001). No endophthalmitis or persistent epithelial defect occurred; three participants had transient intraocular pressure elevation controlled with topical therapy.

Table 3: Ocular-surface outcomes over time

Outcome	Preoperative	Day 7	Day 30	Day 90	Time effect p
OSDI score	12.6 ± 8.1	26.9 ± 12.5	19.8 ± 10.7	13.8 ± 8.9	<0.001
OSDI ≥13	46 (34.8)	97 (73.5)	76 (57.6)	50 (37.9)	<0.001
TBUT, seconds	9.4 ± 2.3	6.2 ± 2.0	7.5 ± 2.1	8.8 ± 2.2	<0.001
Schirmer I, mm	14.1 ± 4.6	11.7 ± 4.2	12.8 ± 4.3	13.7 ± 4.4	<0.001
Staining score	0.6 ± 0.7	1.8 ± 1.1	1.1 ± 0.9	0.7 ± 0.7	<0.001

Values are mean ± SD or n (%). Time-effect p values are from repeated-measures models. OSDI, Ocular Surface Disease Index; TBUT, tear-film breakup time. All values are simulated.

Association with medication burden: In adjusted analyses, each additional day-7 topical preparation was associated with a 3.4-point higher OSDI score on day 30 (95% CI 1.6–5.2; p<0.001). Higher burden was also associated with lower TBUT, lower Schirmer score, and greater staining [Table 4]. Effect

estimates were directionally similar when burden was analysed categorically and when combination products were counted by active ingredient. The observational design does not establish that medications caused these differences.

Table 4: Adjusted association between each additional day-7 topical medication and day-30 ocular-surface outcomes

Day-30 outcome	Adjusted β	95% CI	p value	Model adjusted R ²
OSDI score	+3.40	1.60 to 5.20	<0.001	0.31
TBUT, seconds	−0.72	−1.13 to −0.31	0.001	0.27
Schirmer I, mm	−0.58	−1.11 to −0.05	0.033	0.19
Staining score	+0.29	0.12 to 0.46	0.001	0.24

Positive β values indicate higher outcome scores; for OSDI and staining, higher values indicate worse status. Models adjusted for age, sex, diabetes, corresponding baseline outcome, baseline TBUT in the OSDI model, and preserved-formulation exposure. CI, confidence interval; OSDI, Ocular Surface Disease Index; TBUT, tear-film breakup time. All values are simulated.

DISCUSSION

In this simulated prospective cohort, ocular-surface symptoms and signs worsened after uncomplicated phacoemulsification, were most pronounced at one week, and approached baseline by three months. A greater number of topical postoperative preparations was independently associated with higher OSDI scores, shorter TBUT, reduced Schirmer values, and greater staining at day 30. The magnitude of the adjusted OSDI association—3.4 points per additional preparation—suggests a graded relationship, although the clinical importance of that difference depends on baseline severity and the threshold selected for meaningful change.

The temporal pattern is consistent with prior studies in which dry-eye symptoms and signs peaked early after cataract surgery and subsequently improved.^[4–7,10–14] Kasetsuwan and colleagues reported a substantial early incidence after cataract surgery,^[10] while investigations by Oh et al. and Han et al. documented postoperative changes in tear-film and meibomian-gland parameters.^[11,12] More recent systematic reviews concluded that TBUT commonly declines during the first weeks to months, whereas estimates for OSDI, Schirmer testing, and staining are heterogeneous.^[4–7] The simulated recovery toward baseline by day 90 is therefore clinically plausible but must not be interpreted as observed evidence until replaced with real data.

Several mechanisms could connect medication burden to ocular-surface morbidity. Repeated drop instillation increases exposure to preservatives, surfactants, buffers, and active ingredients. Benzalkonium chloride can damage epithelial cells, impair goblet-cell function, destabilize the tear film, and promote inflammation.^[8,9] Separate bottles also increase cumulative dosing frequency and may produce transient changes in tear-film composition. NSAIDs and some antibiotics can cause surface irritation, while corticosteroids may reduce inflammation and thereby move the association in the opposite direction. Counting preparations is therefore a pragmatic burden measure rather than a direct measure of toxicity.

Surgery itself remains an important competing explanation. Clear-corneal incisions interrupt corneal nerves and may reduce reflex tearing and blinking. Light exposure, irrigation, topical anesthetics, povidone-iodine, and postoperative inflammation may further disturb homeostasis. Patients receiving more medications may also have experienced greater inflammation, higher intraocular pressure, or other

postoperative findings that independently predicted symptoms. Adjustment for measured baseline factors and preservative exposure reduces but cannot eliminate confounding by indication.

The divergence and subsequent convergence of OSDI and TBUT are noteworthy. Symptoms increased more sharply than the absolute reduction in TBUT, illustrating the imperfect correlation between dry-eye signs and symptoms described in the broader literature.^[1,2] OSDI also incorporates visual-function items that may be influenced by early refractive fluctuation after cataract surgery; nevertheless, it is a validated and reliable instrument for quantifying ocular-surface symptoms.^[16] Accordingly, no single test should define postoperative ocular-surface disease. A standardized battery combining a validated symptom instrument with tear stability and staining provides a more defensible assessment.

These results would have practical implications if reproduced in the actual dataset. Clinicians could document preoperative ocular-surface status, identify patients already using multiple topical therapies, and review whether each postoperative product is necessary. Fixed combinations, shorter evidence-based treatment durations, preservative-free or alternative-preservative formulations, and targeted lubrication could reduce exposure while maintaining infection and inflammation control. Such strategies should be evaluated prospectively rather than adopted solely from an observational association. Current ocular-surface algorithms emphasize detection and optimization before cataract surgery,^[17] while the TFOS DEWS II iatrogenic report identifies ophthalmic medications and preservatives as potentially modifiable contributors to ocular-surface disease.^[18] Medication review can therefore be integrated into perioperative care.

Future research should quantify daily instillation burden and cumulative preservative dose rather than only the number of preparations. Randomized or pragmatic comparative trials could evaluate simplified regimens, intracameral or sustained-release approaches, and preservative-free alternatives. Stratification by pre-existing meibomian-gland dysfunction, diabetes, baseline OSDI, surgical energy, incision architecture, and sex may identify patients most vulnerable to medication-related surface effects. Longer follow-up is needed to distinguish transient postoperative disturbance from persistent dry-eye symptoms.

Strengths: The prospective design established the exposure and outcome schedule before follow-up and allowed assessment of within-patient change. Medication burden was recorded at each visit rather than inferred from a single discharge prescription. The outcome set included both patient-reported symptoms and three complementary clinical domains: tear-film stability, aqueous production, and surface staining. Prespecified adjustment for baseline status, diabetes, and preservative exposure addressed several important confounders. Reporting at days 7,

30, and 90 captured both the early postoperative peak and subsequent recovery.

Limitations: The principal limitation of this draft is that all participant counts and numerical findings are simulated. They must be replaced with verified results before any scientific use. For the underlying observational design, causal inference would remain limited by confounding by indication: participants receiving more drops may have had greater postoperative inflammation or other clinical needs. A count of preparations does not fully represent daily dose, adherence, active ingredients, formulation, or cumulative preservative exposure. Single-centre recruitment may limit generalizability, and examiner masking may not have been feasible. OSDI can be affected by postoperative visual changes, while TBUT, Schirmer testing, and staining have measurement variability. Complete-case analysis may introduce attrition bias. Finally, the 90-day follow-up would not capture persistent symptoms beyond three months.

CONCLUSION

In this simulated prospective study, postoperative ocular-surface symptoms and signs worsened during the first week after cataract surgery and largely recovered by day 90. A higher number of postoperative topical medications was independently associated with worse OSDI, TBUT, Schirmer, and staining outcomes at day 30. Verification using the actual dataset is essential. If confirmed, the findings would support careful medication reconciliation, avoidance of unnecessary preparations, and evaluation of simplified preservative-sparing postoperative regimens.

REFERENCES

1. Craig JP, Nelson JD, Azar DT, et al. TFOS DEWS II report executive summary. *Ocul Surf.* 2017;15(4):802–812. doi:10.1016/j.jtos.2017.08.003.
2. Wolffsohn JS, Arita R, Chalmers R, et al. TFOS DEWS II diagnostic methodology report. *Ocul Surf.* 2017;15(3):539–574. doi:10.1016/j.jtos.2017.05.001.
3. Trattler WB, Majmudar PA, Donnenfeld ED, McDonald MB, Stonecipher KG, Goldberg DF. The Prospective Health Assessment of Cataract Patients' Ocular Surface (PHACO) study: the effect of dry eye. *Clin Ophthalmol.* 2017;11:1423–1430. doi:10.2147/OPTH.S120159.
4. Ta H, McCann P, Xiao M, et al. Dry eye post-cataract surgery: a systematic review and meta-analysis. *BMC Ophthalmol.* 2025;25:18. doi:10.1186/s12886-024-03841-8.
5. Lu Q, Lu Y, Zhu X. Dry eye and phacoemulsification cataract surgery: a systematic review and meta-analysis. *Front Med (Lausanne).* 2021;8:649030. doi:10.3389/fmed.2021.649030.
6. Miura M, Inomata T, Nakamura M, et al. Prevalence and characteristics of dry eye disease after cataract surgery: a systematic review and meta-analysis. *Ophthalmol Ther.* 2022;11(4):1309–1332.
7. Naderi K, Gormley J, O'Brart D. Cataract surgery and dry eye disease: a review. *Eur J Ophthalmol.* 2020;30(5):840–855.
8. Goldstein MH, Silva FQ, Blender N, Tran T, Vantipalli S. Ocular benzalkonium chloride exposure: problems and solutions. *Eye (Lond).* 2022;36(2):361–368. doi:10.1038/s41433-021-01668-x.
9. Baudouin C, Labbé A, Liang H, Pauly A, Brignole-Baudouin F. Preservatives in eyedrops: the good, the bad and the ugly. *Prog Retin Eye Res.* 2010;29(4):312–334.
10. Kasetsuwan N, Satitpitakul V, Changul T, Jariyakosol S. Incidence and pattern of dry eye after cataract surgery. *PLoS One.* 2013;8(11):e78657.
11. Oh T, Jung Y, Chang D, Kim J, Kim H. Changes in the tear film and ocular surface after cataract surgery. *Jpn J Ophthalmol.* 2012;56(2):113–118.
12. Han KE, Yoon SC, Ahn JM, et al. Evaluation of dry eye and meibomian gland dysfunction after cataract surgery. *Am J Ophthalmol.* 2014;157(6):1144–1150.e1.
13. Kohli P, Arya SK, Raj A, Handa U. Changes in ocular surface status after phacoemulsification in patients with senile cataract. *Int Ophthalmol.* 2019;39(6):1345–1353.
14. Shimabukuro M, Maeda N, Koh S, Abe K, Kobayashi R, Nishida K. Effects of cataract surgery on symptoms and findings of dry eye in subjects with and without preexisting dry eye. *Jpn J Ophthalmol.* 2020;64(4):429–436.
15. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med.* 2007;4(10):e296.
16. Schiffman RM, Christianson MD, Jacobsen G, Hirsch JD, Reis BL. Reliability and validity of the Ocular Surface Disease Index. *Arch Ophthalmol.* 2000;118(5):615–621.
17. Starr CE, Gupta PK, Farid M, et al. An algorithm for the preoperative diagnosis and treatment of ocular surface disorders. *J Cataract Refract Surg.* 2019;45(5):669–684.
18. Gomes JAP, Azar DT, Baudouin C, et al. TFOS DEWS II iatrogenic report. *Ocul Surf.* 2017;15(3):516–543. doi:10.1016/j.jtos.2017.05.004.