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SYSTEMATIC REVIEW

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Dry eye post-cataract surgery: a systematic review and meta-analysis

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Abstract

Significance Cataract surgery is one of the most performed surgical procedures worldwide. As a potential complication following cataract surgery, dry eye has the potential to impact visual outcomes, lower patient satisfaction, and be detrimental to quality of life.

Purpose To evaluate the effect of cataract surgery on dry eye outcomes postoperatively.

Methods We searched Ovid MEDLINE and Embase from 01/01/2010 to 16/08/2021 and included observational studies of participants ≥ 18 years old undergoing any cataract surgical procedure. We compared postoperative dry eye outcomes with baseline including Ocular Surface Disease Index (OSDI), tear break up time (TBUT), Schirmer's I test (ST1), and corneal fluorescein staining (CFS) at short-term (< 1 week) and medium-term (≥ 1 week to 3 months) follow-up.

Results Our search yielded 11,133 records. After title and abstract, and then full text screening, we included 20 studies with 1,694 eyes. There was some evidence indicating a decrease in the TBUT during the short-term (within 1 week) and medium-term (1 week up to 3 months) periods following cataract surgery. There was a considerable degree of heterogeneity between studies across other outcomes. At medium-term follow-up most studies that reported ST1 and CFS showed deterioration of these outcomes but there was conflicting evidence of the effect of cataract surgery on OSDI. The review is limited by variability in follow-up timeframes which were unable capture potential clinical course like peak occurrence and duration.

Conclusion Dry eye may persist up to three months postoperatively following cataract surgery. Further studies are required to determine if dry eye outcomes return to baseline at longer term follow-up.

Keywords Dry eye disease, Post cataract surgery, Systematic review, Meta-analysis, Prevalence

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Introduction

Cataract surgery is the most performed surgical procedure with an estimated 3.7 million cases per year in the US and 20 million worldwide [1]. Modern cataract surgical techniques offer excellent prognosis and low risk of complications [2]. The most common of these techniques include phacoemulsification, extracapsular cataract extraction (ECCE), and manual small incision cataract surgery (MSICS). The volume of cataract surgery is projected to increase dramatically as the population ages [3]. With expected increases in cataract surgical volume and ever-increasing surgeon and patient expectations, it is vital to acknowledge the complications that can potentially occur.

Dry eye disease (DED) is a complex disease characterized by inflammation and a loss of tear film homeostasis with symptoms including stinging, burning, sensitivity to light, blurred vision, and foreign body sensations [4–6]. Herein, we use the term "dry eye" to collectively describe all etiologies of DED. As a possible complication following cataract surgery, dry eye has the potential to impact visual outcomes and lower patient satisfaction. This can be detrimental to quality of life among individuals who have undertaken an elective procedure designed to optimize their vision. Dry eye symptoms following cataract surgery may be secondary to complex and multifactorial reasons. The surgery can damage the corneal surface and corneal nerves, disrupt the tear film, and cause meibomian gland dysfunction and postoperative inflammation at the ocular surface [7–9]. There is also some evidence to suggest that the impact on the incidence of dry eye can vary depending on the specific surgical techniques [7–10]. Therefore, we conducted a systematic review of observational studies to evaluate the impact of cataract surgery on dry eye.

Methods

Eligibility criteria

We included studies in which participants aged 18 and over had undergone cataract surgery of any type and had postoperative dry eye measures compared with baseline or compared between groups undergoing different surgical techniques. We excluded studies in which all participants had baseline dry eye and a history of comorbidities that could affect dry eye outcomes. For studies that included patients with and without pre-existing dry eye and relevant comorbidities, we focused on extracting data from participants without such conditions.

To provide a contemporary evaluation of post-cataract dry eye, we only included observational studies that utilized cohort, case-control, cross-sectional, and case series designs published after January 1, 2010. We excluded randomized controlled trials (RCTs) as they are often not designed to assess harms due to restrictive eligibility criteria with small sample sizes and short follow-up, as well as known issues in collecting and reporting harms [11]. These factors may limit generalizability and hinder RCTs from detecting rare or long-term harmful outcomes, which are more effectively captured in observational studies. The setting of the study encompasses population-based, clinic-based, and secondary healthcare database studies. We also excluded abstracts and studies investigating dry eye treatments. Given the variability in definition and diagnosis of dry eye, we accepted any dry eye definition or diagnosis as employed in included studies. We did not exclude any studies based on language.

Selection of studies

In collaboration with an experienced information specialist from the Strauss Health Sciences Library, University of Colorado Anschutz Medical Campus, we searched Ovid Medline and Embase for studies published from January 1, 2010 to August 16, 2021 [12]. We included relevant controlled vocabulary terms (i.e., medical subject headings in Medline, Emtree terms in Embase) and text words (eTable 1 in the supplement). Two investigators independently screened each record for eligibility at both the title/abstract and full text stages in Covidence® (HT, PM) [13]. Discrepancies in judgements were resolved by discussion or, if needed, adjudication by another investigator (RQ, TL). If there was still uncertainty of whether eligibility criteria were met, we reached out to the study authors to gather more information. If no response was received within 3 weeks, we used information provided in the studies to determine eligibility.

Data extraction and management

One investigator (HT) extracted relevant study characteristics and data points into a data collection form developed in Systematic Review Data Repository Plus (SRDR+) [14]. Another independent investigator (PM, RQ, TL, TL) verified the data for accuracy. Discrepancies were discussed and resolved by consensus and adjudication by a third investigator if needed (RQ, TL).

Our primary outcome measures were:

- dry eye symptoms measured by validated questionnaires such as Ocular Surface Disease Index (OSDI) and 5-item Dry Eye Questionnaire (DEQ-5).

Our secondary outcome measures were:

- tear film stability including tear break up time (TBUT) and non-invasive tear break up time (NITBUT);
- aqueous production measured by Schirmer's I test (ST1) or other tests employed in the included studies;

Table 1 Summary of study characteristics

Study	Country	Comparison Type	Study design	Sample size participants [eyes]	Age	% Females	Cataract surgery method(s)	Follow up period‡	Primary outcome measured	Overall risk of bias
Kohli 2019	India	Before vs. after	Prospective case series	50 [50]	mean 60.6; SD 8.4; range 42–74	52%	Phacoemulsification	Baseline; medium	Yes - OSDI	Low
Chuo 2012	Canada	Before vs. after	Retrospective case series	188 [221]	mean 72.5	52.70%	Phacoemulsification	Medium	No	Moderate
Gonzalez-Mesa 2016	Spain	Before vs. after	Cohort	52 [52]	mean 70.2; SD 7.9 (males) / mean 71.2; SD 8.1 (females)	46.20%	Phacoemulsification	Baseline; medium	Yes - OSDI	Moderate
Han 2014	South Korea	Before vs. after	Cohort	48 [58]	mean 68.3; SD 11.7 years	56.30%	Phacoemulsification	Baseline; medium	Yes - OSDI	Moderate
Kasetsuwan 2013	Thailand	Before vs. after	Prospective case series	92 [92]	mean 67.2; SD 8.3; range 42–84	66.30%	Phacoemulsification	Baseline; short; medium	Yes - OSDI	Moderate
Nazir 2021	Pakistan	Before vs. after	Cohort	136 [NR]	NR	45.60%	ECCE, MSICS	Medium; long	No	Moderate
Xue 2019	China	Before vs. after	Prospective case series	101 [101]	mean 66.3; SD 9.7	53.50%	Phacoemulsification	Baseline; medium; long	Yes - OSDI	Moderate
Zamora 2019	Spain	Before vs. after	Prospective case series	55 [55]	mean 75.8; SD 7.3	50.90%	Phacoemulsification	Baseline; short; medium	Yes - OSDI	Moderate
Iglesias 2018	United States	Before vs. after	Retrospective case series	86 [137]	mean 71; SD 8.6	4.70%	NR	Long	No	High
Oh 2012	South Korea	Before vs. after	Cohort	30 [48]	mean 62; SD 9.7 years	66.70%	Phacoemulsification	Baseline; medium	Yes - OSDI	High
Sajnani 2018	United States	Before vs. after	Cross-sectional	119 [182]	mean 73; SD 8.0	55.50%	Phacoemulsification	Long	Yes - DEQ5	High
Venugopal 2012	India	Before vs. after	Cross-sectional	68 [68]	range 40–80 years	56.30%	MSICS	Medium; long	No	High
Al Saad 2020	Jordan	Intervention comparison	Cohort	40 [40]	mean age: 64.9; SD 9.7	45%	Phacoemulsification, ECCE	Baseline; short; medium	No	Moderate
Bista 2021	Nepal	Intervention comparison	Cohort	100 [100]	MSICS: mean 53.7; SD 7.8 / Phacoemulsification: mean 54.7; SD 8.0	50.7% (MSICS); 64% (phaco)	Phacoemulsification, MSICS	Baseline; short; medium	No	Moderate
Ishrat 2019	India	Intervention comparison	Cohort	96 [100]	mean 63.1; SD 8.3; range 46–85	63.50%	Phacoemulsification, MSICS	Baseline; short; medium	Yes - OSDI	Moderate
Yu 2015	China	Intervention comparison	Cohort	137 [137]	mean 69.0; SD 10.6 (laser) / mean 71.8; SD 10.1 years (phaco)	53.4% (laser); 57.8% (phaco)	Phacoemulsification, FLACS	Baseline; short; medium	Yes - OSDI	High
Jung 2016a	South Korea	Risk factor analysis	Case-control	5 [5]	median 32	34.4% (did not stratify based on cataract surgery)	NR	Baseline	No	Low
Jung 2016b	South Korea	Condition comparison	Prospective case series	35 [35]	mean 65.8; SD 9.9	77.10%	Phacoemulsification	Baseline; medium	Yes - OSDI	Low

Table 1 (continued)

Study	Country	Comparison Type	Study design	Sample size participants [eyes]	Age	% Females	Cataract surgery method(s)	Follow up period‡	Primary outcome measured	Overall risk of bias
Qiu 2020	China	Condition comparison	Cohort	58 [58]	mean 59.8; SD 22.7	39.70%	Phacoemulsification	Baseline; short; medium	No	Moderate
Shimabukuro 2020	Japan	Condition comparison	Prospective case series	19 [19]	mean 74.0; SD 9.4	42.10%	Phacoemulsification	Baseline; short; medium	No	High

‡ Short term - up to 1 week; Medium term - >1 week to 3 months; Long term - >3 months to 6 month; NR - not reported; ECCE - Extracapsular cataract extraction; MSICS - Manual small incision cataract surgery; FLACS - Femtosecond laser assistant cataract surgery; OSDI - ocular surface disease index; DEQ-5–5-item dry eye questionnaire

- ocular surface dye staining such as corneal fluorescein staining (CFS), Lissamine green surface staining (LGSS), or other method employed in the included studies.

We collected outcomes at the longest follow-up time point within each pre-defined period: short-term (within 1 week), medium-term (1 week up to 3 months), and long-term (greater than 3 months). The definitions of follow-up periods were established based on the definitions used in majority of included studies.

Assessment of risk of bias

Two investigators independently assessed risk of bias for each included study using Joanna Briggs Institute risk of bias tools for each specific study design (HT, PM, RQ, TL, TL) [15]. Discrepancies in risk of bias assessments were resolved by discussion or, if needed, adjudication by another investigator (RQ, TL).

Synthesis

We investigated clinical and methodological heterogeneity by assessing dry eye definitions and identified methodological heterogeneity by evaluating study designs and risk of bias. We assessed statistical heterogeneity by calculating the amount of heterogeneity (τ^2) and the contribution of between-study heterogeneity to the total variability across studies (I^2) [16, 17]. We conducted random-effects meta-analyses when at least 2 studies had available results within a follow-up time frame and when the studies were considered homogeneous [18]. We also conducted replicability analysis to check that results from individual studies are mutually corroborative of each other in a meta-analysis [19]. We reported 95% confidence intervals (95% CIs) and 95% prediction intervals (95% PIs) for random-effects model summary estimates. All statistical analyses were conducted using the metaphor package version 3.8.1 in R version 4.2.2 [20].

Results

Our search yielded 11,133 unique titles and abstracts. After reviewing 56 full text reports, we included 20 studies with 1,694 eyes. A total of 7 studies were included in meta-analysis, including 481 eyes (eFigure 1 in the supplement) [10, 21–38].

Nine included studies were cohort studies [10, 22, 23, 27–30, 35, 36], one was case-control studies [25], two were cross-sectional studies [31, 33], and the remaining eight were case-series [21, 24, 26, 32, 34, 37–39]. Twelve studies compared pre- with post-operative outcomes [21–24, 26–28, 31, 33, 34, 37, 39], four studies compared different cataract surgical techniques [10, 30, 35, 36], three studies compared different pre-existing conditions (e.g., meibomian gland dysfunction) [29, 32, 38], and one study performed risk factor analysis (Table 1) [25]. Risk factor analysis evaluated dry eye parameters in relation to risk factors such as cataract surgery.

The median sample size was 63 (ranged from 5 to 188 participants). The study participants were predominantly older, with the average age exceeding 60 years in most studies. Most studies performed phacoemulsification as the cataract surgical technique [10, 21–23, 26–28, 30, 31, 34–37, 39] and other studies performed MSICS [10, 27, 36, 40], ECCE [27, 30], and femtosecond laser assisted surgery [35]. Short-term follow-up was performed in eight studies [10, 29, 30, 32, 35–37, 39], medium-term follow-up was performed in seventeen studies [10, 21–23, 26–30, 32–39], and long-term follow-up was performed in five studies [24, 27, 31, 33, 34]. Among the eleven studies that reported the primary outcome, ten reported OSDI and one reported DEQ-5. Administration of postoperative topical antibiotics and/or topical anti-inflammatory medications (e.g., corticosteroids, non-steroidal anti-inflammatory drugs) was reported in fifteen studies [10, 22–24, 26, 28–32, 34–38] and administration of postoperative topical lubricating drops was reported in one study [10]. Three studies were rated low [26, 28, 38], eleven studies were rated moderate [10, 21–23, 27, 29, 30, 34, 36, 37, 39], and six studies were rated high in risk of bias assessments (Table 1) (eFigure 2 in the supplement) [24, 31–33, 35, 41].

Dry eye symptoms

Our primary analysis of this outcome showed very high levels of heterogeneity between studies. At short-term follow-up (eFigure 3 in the supplement), change in OSDI scores after cataract surgery ranged from – 13.35 (95%CI -14.43, -12.27) to 1.00 (95%CI -0.24, 3.84). At medium-term follow-up (eFigure 3 in the supplement), change in OSDI scores after cataract surgery ranged from – 14.72 (95%CI -16.58, -12.86) to 14.40 (95%CI 11.83 to 16.97). Two studies showed improvement in OSDI score and two studies showed deterioration of OSDI score after cataract surgery at medium-term follow-up (eFigure 3 in the supplement). Another study showed no evidence of a difference from baseline at medium-term follow-up [39]. Of the five studies evaluating OSDI, we judged overall risk of bias to be low in two studies (40%) [22, 38], moderate in two studies (40%) [22, 39], and high in one study (20%) [35].

Tear film stability

Our primary analysis of this outcome showed that there may be a deterioration in the mean change from baseline in TBUT at short-term follow-up (MD -4.09, 95% CI -7.73, -0.46; 3 studies; I^2 97%) and an even smaller decrease at medium-term follow-up (MD -2.01, 95% CI -2.96, -1.05; 7 studies; I^2 97%) (Fig. 1) [10, 26, 30, 34, 36, 38, 39]. We combined the data despite substantial statistical heterogeneity because all study-level estimates, except one, demonstrated decreased TBUT. Of the seven studies evaluating TBUT, we judged overall risk of bias to be low in two studies (29%) [26, 38], and moderate in five studies (71%) [10, 30, 34, 36, 39]. Replicability analysis did not find any non-replicability in any of the studies reporting TBUT changes at short-term or medium-term follow-up.

Meta-analysis for NIBUT (eFigure 3 in the supplement) showed that there may be little to no difference at short-term follow-up (MD -0.74, 95% CI -1.71, 0.23) and at medium-term follow-up (MD 0.30, 95% CI -0.75, 1.35) (eFigure 3 in the supplement) [35]. No statistical heterogeneity is reported for NIBUT analysis because the data came from the same study.

Aqueous production

Our primary analysis of this outcome showed very high levels of heterogeneity between studies. At short-term follow-up, change in ST1 after cataract surgery ranged from – 16.07 (95%CI -17.46, -14.67) to 3.30 (95%CI 1.44, 5.16) (eFigure 3 in the supplement). At medium-term follow-up, change in ST1 after cataract surgery ranged from – 8.79 (95%CI -10.31, -7.28) to 0.90 (95%CI -3.73 to 5.54) (eFigure 3 in the supplement). Most studies showed reduction in ST1 after cataract surgery at medium-term follow-up (eFigure 3 in the supplement). Of the nine studies evaluating ST1, we judged overall risk of bias to be low in two studies (22%) [26, 38], moderate in six studies (67%) [10, 29, 30, 34, 36, 39], and high in one study (11%) [35]. Replicability analysis did not find any non-replicability in any of the studies reporting ST1 changes at short-term or medium-term follow-up.

Ocular surface staining

Our primary analysis of this outcome showed very high levels of heterogeneity between studies. At short-term follow-up, change in CFS after cataract surgery ranged from 0.04 (95%CI -0.02, 0.10) to 0.30 (95%CI 0.27, 0.50) in two studies (eFigure 3 in the supplement). At medium-term follow-up, change in CFS after cataract surgery ranged from 0.12 (95%CI 0.02, 0.23) to 0.17 (95%CI 0.11 to 0.23) in two studies (eFigure 3 in the supplement). At short-term follow-up, change in LGSS after cataract surgery ranged from 0.10 (95%CI 0.08, 0.28) to 0.90 (95%CI 0.65, 1.15) (eFigure 3 in the supplement). At medium-term follow-up, change in LGSS after cataract surgery ranged from 0.20 (95%CI 0.02, 0.38) to 1.40 (95%CI 1.05 to 1.75) (eFigure 3 in the supplement). Of the three studies evaluating CFS and LGSS, we judged overall risk of bias to be moderate in one study (33%) [10] and high in two studies (67%) [32, 35].

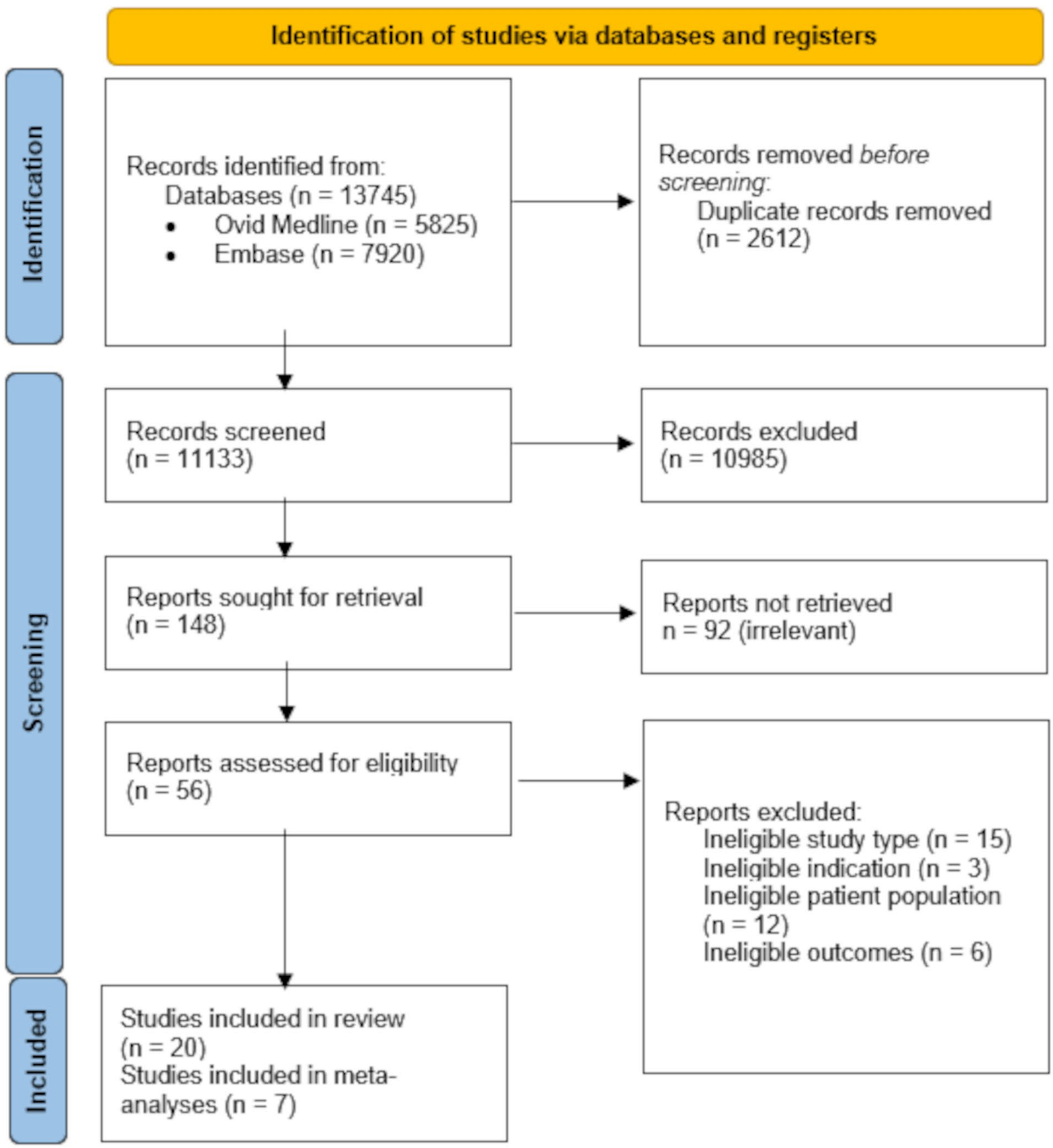

Fig. 1 PRISMA flow diagram

Discussion

This systematic review summarized current data on measures of dry eye in patients after undergoing cataract surgery. We found some evidence indicating a decrease in TBUT during the short-term and medium-term periods following cataract surgery. Results for other outcomes, including OSDI, Schirmer's I test, and ocular surface staining exhibited a considerable degree of inconsistency, precluding the conduct of a meaningful meta-analysis.

For dry eye symptoms, five studies reported OSDI at medium-term follow-up and two of these studies reported at short-term follow-up [35, 39]. The high heterogeneity at all follow-up time points made it difficult to draw robust conclusions regarding the effect of cataract surgery on dry eye symptoms. The heterogenous findings for dry eye symptoms might be explained by variations in clinical interventions or methodological design of the primary studies. For example, two studies that showed improvement in OSDI scores at medium-term follow-up both used a topical combined tobramycin/dexamethasone formulation for post-operative care [22, 35]. In contrast, two studies that showed deterioration in OSDI scores both used a topical fluoroquinolone in combination with prednisolone [26, 38]. We hypothesize that dexamethasone, as a more potent corticosteroid, may reduce symptoms of discomfort more than prednisolone. Otherwise, it is unclear whether the variations in adjunctive post-operative care were the cause of the heterogeneity because neither antibiotic class is known to cause a high incidence of dry eye side effects. We also considered whether the presence of preservatives in peri-operative adjunctive therapy could be the factor contributing to the heterogeneity. However, both studies that used preserved tobramycin/dexamethasone formulations showed an improvement in OSDI scores and the preservative status of most post-operative topical lubricants was unknown [22, 35].

Other unexplored factors such as the potential toxic effects of povidone-iodine and topical anesthetic drop applications, intra-operative drying and irrigation, corneal incision sizes, use of dispersive ophthalmic viscosurgical devices, and variations in surgical trauma and phototoxicity may have influenced the results [42]. Additionally, the use of OSDI as the measurement tool for dry eye post-cataract surgery may have influenced the results. As OSDI incorporates measures of visual function in addition to dry eye sensations, variations in refractive outcomes following cataract surgery (unrelated to dry eye) could have affected the overall OSDI scores between study populations and confounded any changes in sensory dry eye symptoms [43]. Given that dry eye itself can cause refractive error and visual disturbances, this further compounded the potential confounding.

Our results for clinical signs, including Schirmer's I test and corneal fluorescein staining, also demonstrated considerable heterogeneity between study results. At medium-term follow-up most studies that reported Schirmer's I test and corneal fluorescein staining showed deterioration of these outcomes. Tear break up time was the only outcome amenable to meta-analysis. Pooled analysis of TBUT suggested an important reduction at short-term follow-up but only a slight reduction at medium-term follow-up. This is likely due to several factors. First, altered afferent corneal signaling negatively affects the lacrimal functional unit and various components of the tear film [44]. Second, the reduced blink rate observed after cataract surgery may contribute to tear film instability [45, 46]. Finally, a decreased blink rate can delay tear clearance. In procedures like LASIK, this delay is associated with increased inflammatory biomarkers in the tear film, which may compromise its composition and stability [47–50]. However, due to the relatively short follow-up time within the primary studies, we cannot determine if clinical signs eventually return to baseline values [7]. In addition, the difference in the number of studies reporting various clinical signs at different follow-up periods affected our ability to draw conclusions about the temporal course of the condition. A reduction in TBUT of 2 s represents a mild and potentially insignificant clinically change, which may not drastically alter clinical practice or require major adjustments in post-operative, especially if patients do not exhibit noticeable symptoms of dry eye. In contrast, the change in OSDI score from − 14.72 to 14.40 is substantial enough to reclassify a patient's dry eye severity within the OSDI scoring framework.

Our findings support the notion that dry eye may emerge as a complication following cataract surgery, aligning with existing evidence syntheses. A previous systematic review and meta-analysis suggested that TBUT deteriorates after cataract surgery while dry eye symptoms, corneal fluorescein staining, and Schirmer's I test show little to no difference compared with baseline, which agrees with our results [51]. However, this review limited reporting to one month postoperative follow-up and only included studies that performed phacoemulsification. Another systematic review and meta-analysis reported the pooled prevalence of dry eye disease after cataract surgery as 37.4% with considerable statistical heterogeneity [41]. This review also reported that dry eye severity usually peaks at one week after cataract surgery. Similar findings have also been reported in narrative reviews and meta-analyses of the association with general refractive surgeries [52, 53]. Our results suggest similar patterns but a lack of meta-analysis among all outcomes in our review limit comparisons between reviews.

A noteworthy contribution from this review is the revelation that dry eye may persist for up to three months postoperatively. Given the widespread prevalence of cataract surgery, with millions of cases annually, coupled with the adverse impact of dry eye on both quality of life and functionality, the magnitude of this outcome is substantial. Consequently, the practical implication emphasizes the imperative for healthcare providers to incorporate thorough counseling on the potential for postoperative dry eye symptoms in their discussions with patients undergoing cataract surgery. This proactive approach could optimize education of patients to be well-informed and adequately prepared for the postoperative course and sensations, thereby managing expectations and optimizing their overall experience and outcomes. Accommodating patients with language and literacy barriers during these consultations will be essential to minimize potential generation of health disparities [54]. Furthermore, use of peri-operative preservative free drops to optimize the ocular surface prior to cataract surgery may mitigate the risk of post-operative dryness [55].

This review cannot definitively conclude on certain aspects of post cataract dry eye. First and foremost, the included literature does not ascertain the singular cause of dry eye following cataract surgery, as multifactorial influences may contribute to its onset. Additionally, the review does not establish a precise timeline for the peak occurrence of dry eye symptoms, highlighting the dynamic and individualized nature of postoperative experiences. Clinically, patients could begin to experience dry eye symptoms one month after cataract surgery in alignment with tapering of their post-operative topical corticosteroid therapy. However, our medium-term follow-up timeframe which incorporated one week to three months made it difficult to capture this potential clinical course. Furthermore, uncertainties persist regarding the duration of dry eye symptoms, as the literature does not provide data on when or if these symptoms will eventually subside. These complexities underscore the multifaceted nature of the relationship between cataract surgery and dry eye, necessitating continued research and nuanced consideration for a comprehensive understanding of this postoperative complication. Further observational studies with large sample sizes, clinically relevant follow-up time points, longer follow-up periods, careful selection of dry eye symptom measurement tools, and adequate adjustment for possible confounders are needed to explore the topic further.

We followed the recommended approach for conducting a systematic review, adhering to rigorous methodologies, employing reproducible search strategies, and systematically assessing the risk of bias of included studies. We constrained our literature search to the period spanning from January 1, 2010 to the present, aiming to capture the most recent and relevant data in the field. This strategic timeframe was chosen in recognition of the evolving landscape of cataract surgical techniques and intraocular lens choices. We opted not to analyze RCTs, thus narrowing our focus to observational study design which may have less control over bias and confounding. Upon reviewing systematic reviews evaluating dry eye after cataract surgery that did include RCTs, we found that their findings aligned with our reviews, noting a deterioration in TBUT with little to no difference in other outcomes [41, 51]. Another systematic review, also incorporating RCT evidence, demonstrated that signs and symptoms of dry eye returned to baseline approximately three months postoperatively, consistent our findings [56]. Furthermore, our analysis revealed a substantial amount of heterogeneity, particularly in outcomes such as OSDI, Schirmer's I test, and ocular surface staining. This pronounced heterogeneity, coupled with potential biases in the included studies, posed challenges in reaching firm conclusions from the available literature. Subgroup analyses could help explore potential sources of heterogeneity. However, the current dataset lacks sufficient power, limiting formal subgroup analyses, such as stratifying by types of surgery, postoperative medication use, or patient demographics (e.g., age or smoking status). We hope that future research will allow for more detailed subgroup analyses to further clarify these factors.

Conclusions

This systematic review establishes a link between cataract surgery and a reduction in TBUT score extending up to 3-month follow-up period, but not definitively with other outcomes such as OSDI, Schirmer's I test, and ocular surface staining. Clinicians are urged to incorporate the potential for postoperative dry eye symptoms into their discussions with patients undergoing cataract surgery.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12886-024-03841-8.

Supplementary Material 1

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Not applicable.

Author contributions

HT and PM are co-first authors. HT and PM made substantial contributions to the conception of the work, design of the work, acquisition of data, verification of data, analysis of data, interpretation of data, and drafted the worked. MX conducted statistical analyses and replicability analyses. KA and DG assisted in the interpretation of data and assisted in drafting the work. TL, RQ, and TL contributed to verification of data, analysis of data, interpretation of data, and drafted the worked.All authors revised the work, approved the submitted version, and agreed to be personally accountable for their contributions and to ensure that questions related to the accuracy or integrity of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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Data availability

All data generated or analyzed during this study are included in public published article obtained through Ovid Medline and Embase searches. Text words are included in eTable 1 in the supplement.

Declarations

Ethics and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests pertinent to this article. KA is a consultant for Optase, Tarsus, and Dompe. KA is an investigator for Trinity Life Sciences, Claris Bio, and Lexitas. TL reports a grant from National Eye Institute, National Institutes of Health, USA.

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