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Effect of early artificial tear administration on dry eye symptoms following phacoemulsification cataract surgery



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HIGHLIGHTS

Early postoperative administration of artificial tear after phacoemulsification reduces dry eye symptoms and improves ocular surface stability.

ABSTRACT

Methods: This prospective, single-blind, interventional parallel-group study included 32 eyes of 32 patients undergoing phacoemulsification cataract surgery. Patients were randomly allocated into two groups: one group received artificial tears (AT) starting the day after surgery (AT group, n = 16), while the other did not receive artificial tears (No AT group, n = 16). Schirmer I test (without anaesthesia) was used to evaluate dry eye, and the OSDI questionnaire was used preoperatively and at 1 and 3 weeks postoperatively. Statistical analysis was conducted using Mann–Whitney test, paired t-test, Cochran's Q test, and Fisher's Exact test, with $p < 0.05$ considered statistically significant.

Results: Baseline demographics characteristics, BCVA, and preoperative OSDI scores were comparable between groups. At week 1 postoperatively, dry eye incidence was higher in the No AT group (68.7%) compared with the AT group (37.5%), though this difference was not statistically significant ($p = 0.077$). At week 3, the AT group demonstrated a significantly lower incidence of dry eye (12.5%) compared with the No AT group (50.0%) (OR = 0.14, $p = 0.036$). Within-group analysis showed a significant improvement in Schirmer test results over time in the AT group ($p = 0.041$), but not in the No AT group ($p = 0.091$). Postoperative OSDI scores exhibited a significant decline across both groups; however, the AT group demonstrated a markedly superior reduction at week 1 ($p = 0.018$) and week 3 ($p = 0.0003$) follow-up intervals.

Conclusion: Early postoperative administration of artificial tears significantly reduces dry eye incidence and symptoms severity following cataract surgery. Artificial tears appear to facilitate faster ocular surface recovery and improve

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patient-reported outcomes without affecting visual acuity. Incorporating artificial tears into routine postoperative care may enhance comfort and quality of life in patients undergoing cataract surgery.

Key words: phacoemulsification, dry eye syndromes, artificial tears

INTRODUCTION

Cataract surgery is one of the most frequently performed ophthalmic procedures worldwide and is highly effective in restoring visual function. Despite its success and safety profile, postoperative ocular surface disturbances remain a common concern. Surgical factors such as corneal nerve transection, exposure to microscopic light, ocular surface inflammation, and the use of topical medications may disrupt tear film homeostasis and reduce tear secretion. These alterations can compromise ocular surface stability and contribute to the development or exacerbation of dry eye disease (DED) [1, 2].

DED is characterized by tear film instability and ocular surface inflammation, often resulting in symptoms such as ocular discomfort, burning sensation, itching, conjunctival redness, photophobia, and fluctuating or blurred vision. Even patients without a prior history of dry eye may experience postoperative symptoms due to transient disruption of corneal innervation and tear film dynamics. Given that more than 20 million cataract surgeries are performed annually worldwide, postoperative dry eye represents a clinically relevant issue affecting patient satisfaction and visual quality after surgery [3].

Previous study had reported a considerable incidence of dry eye symptoms following cataract surgery. While some patients experience spontaneous recovery within the first month, others continue to experience persistent tear film instability and subjective discomfort. These symptoms may negatively impact postoperative recovery, patient comfort, and overall quality of life [4].

Artificial tears are widely used as first-line therapy for the management of dry eye disease and postoperative ocular surface irritation. These lubricating agents help stabilize the tear film, improve ocular surface hydration, and reduce mechanical friction during blinking [5]. Although artificial tears are commonly prescribed after cataract surgery, the optimal timing and clinical benefits of early postoperative administration remain insufficiently investigated.

Furthermore, many previous studies have focused either on objective clinical parameters or subjective symptoms assessment alone. Few studies have simultaneously evaluated both objective tear production measurements, such as the Schirmer test, and patient-reported symptom outcomes, such as the Ocular Surface Disease Index (OSDI).

Therefore, the present study aimed to evaluate the effect of early postoperative administration of artificial tears on dry eye symptoms following cataract surgery. By correlating objective tear secretion measurements obtained through the Schirmer I test with subjective symptom scores measured using the OSDI questionnaire, this study seeks to provide a more comprehensive assessment of the role of artificial tears in improving postoperative ocular surface recovery.

METHODS

This is a prospective, interventional, single blind study on 32 eyes from 32 patients (16 males and 16 females). All the patients were recruited from December 2025 to February 2026 during ophthalmologic appointments at an eye center. We included all patients who were aged 18 and over who would undergo phacoemulsification. This prospective, parallel-group study was conducted under the supervision of the Ethics Committee of Prima Indonesia University. National Health Research and Development Ethics Committee (KEPKKN) number: 019/KEPK/UNPRI/XII/2025. Written informed consent was obtained from all participants prior to enrolment in the study. Ethical compliance was maintained throughout the trial in accordance with the Declaration of Helsinki.

The required sample size was determined using a 95% confidence level and 80% power ($\alpha = 0.05$, $\beta = 0.2$). Assuming an expected difference in osmolarity of 1 and $\sigma = 0.90$ based on prior studies, the initial requirement was 13 participants in each group. To ensure statistical robustness against patient dropout, we expanded the enrolment to 16 patients per group.

Randomization was employed to divide the patient population into two study groups, each consisting of 16 patients who received artificial tears the day after cataract surgery was done, and 16 other patients did not receive artificial tears after the cataract surgery. Severity of dry eye symptoms was evaluated using the OSDI instrument, with

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scores ranging from 0 to 100. A single designated person performed all clinical measurements to ensure consistency. The subjective symptom scoring, Schirmer I test (without anaesthesia), was performed by the same investigator before treatment and 1 week and 3 weeks after cataract surgery. The administration of topical eye drugs was restricted before each visit to avoid potential confounding effects on ocular surface evaluations. Statistical evaluations were performed with SPSS, employing paired t-test for intra-group comparison and Fisher's Exact test for categorical variables. The threshold for statistical significance was set at $p < 0.05$.

Surgical technique

To minimize surgical variability, all phacoemulsification procedures were conducted using standard equipment and performed by the same senior surgeon under topical anaesthesia. Before surgery, all patients were given levofloxacin eye drops. For surgical preparation, pupillary dilation was done by instilling tropicamide for a total of 3 doses prior to surgery.

A main corneal incision of approximately 2.75 mm was created at the limbus, followed by two side-port incisions measuring 1.0 mm each at the 3 o'clock and 9 o'clock positions. Phacoemulsification was performed using the stop-and--chop technique, in which a central dimple was first created in the nucleus using the phaco tip, followed by a chopping motion to divide the nucleus into smaller fragments. After the initial "stop" phase, controlled pressure was applied to chop the nucleus, reducing the need for excessive ultrasound energy and minimizing the risk of posterior capsule rupture. The resulting nuclear fragments were then emulsified and aspirated using a peristaltic pump system, followed by intraocular lens implantation. This technique allows for efficient cataract removal while maintaining control and safety.

RESULTS

The study was conducted on 32 eyes of 32 patients, divided equally between an artificial tear (AT) administration group (n = 16) and No AT usage group (n = 16). There is no loss to follow-up patients in the study, and therefore, all patients enrolled were included in the study.

Patients were divided into the AT and No AT groups. The means age was comparable between the AT group: 61.19 (±9.96), range 40–79 years, and the No AT group: 60.81 (±10.62), range 40–76 years, with no statistically significant difference ($p = 0.919$). The proportion of female participants was also similar between groups (56.25% in the AT group vs. 50% in the No AT group; $p = 0.723$) (tab. 1).

Preoperative best-corrected visual acuity (BCVA) (logMAR) did not differ significantly between the AT and No AT groups: 1.34 (±0.82) vs 1.49 (±0.74), respectively; $p = 0.592$. Postoperatively, BCVA improved in both groups. At week 1, the AT group showed a mean BCVA of 0.42 (±0.61) compared with 0.57 (±0.84) in the No AT group. BCVA change from pre-operation to weeks 3 post-operation was 1.08 (±0.87) in the AT group and 1.17 (±0.68) in the No AT group, which was also not significantly different between groups ($p = 0.738$) (tab. 1).

Overall, baseline demographics and visual acuity outcomes were comparable between the AT and No AT groups, with no statistically significant differences observed at any time point.

FIGURE 1

Prevalence of dry eye symptoms over time.

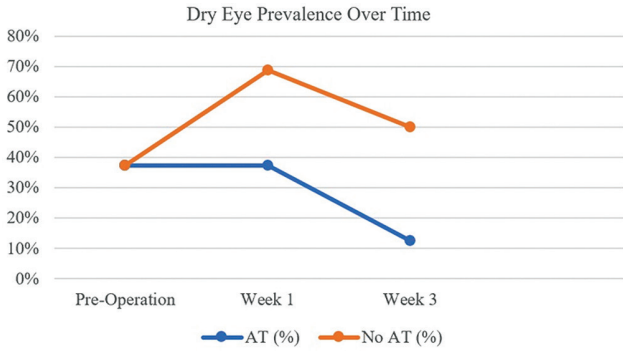


TABLE 1

Baseline demographic and clinical characteristics of the study population.

Characteristic	Mean (±SD), range		P-value
	AT	No AT	
Age (years)	61.19 (±9.96), 40–79	60.81 (±10.62), 40–76	0.919 (independent t-test)
Female, n (%)	9 (56.25%)	8 (50%)	0.723 (chi-square)
BCVA (logMAR)			
Pre-operation	1.34 (±0.82), 0.10–2.48	1.49 (±0.74), 0.5–2.48	0.592 (independent t-test)
1 week	0.42 (±0.61), 0.10–2.08	0.57 (±0.84), 0–2.48	0.969 (Mann–Whitney)
3 weeks	0.27 (±0.51), 0–2.08	0.32 (±0.61), 0–2.48	0.677 (Mann–Whitney)
Change from pre-operation to 3 weeks post-operation	1.08 (±0.87), -0.05–2.38	1.17 (±0.68), 0–2.48	0.738 (independent t-test)

AT – artificial tears; BCVA – best-corrected visual acuity; SD – standard deviation.

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Figure 1 depicts the prevalence of dry eye symptoms at the pre-operation, week 1, and week 3 in patients treated with AT compared with those without AT. At baseline, both groups show comparable dry eye prevalence. A marked increase is observed at week 1, particularly in the No AT group. By week 3, dry eye prevalence decreases in both groups, with a substantially heightened reduction in the AT group, indicating improved recovery over time compared with patients not receiving AT.

Schirmer test comparison of week 1 and week 3 was shown in table 2. At week 1, there was no statistically significant difference in dry eye incidence between the AT and No AT groups (Fisher's exact test, OR = 0.27, P = 0.077). The therapeutic benefit of artificial tears was clearly evidenced at week 3, with the AT group maintaining a significantly lower frequency of dry eye cases than the No AT group (OR = 0.14, p = 0.036) (tab. 2).

The comparison of dry eye proportions at baseline, week 1, and week 3 is provided in table 3. Cochran's Q test demonstrated that Schirmer test status evolved significantly over time when analyzed within each study arm (preoperative baseline, week 1, and week 3) in the AT group (Cochran's Q = 6.4, p = 0.041). In contrast, the No AT group did not show a statistically significant change in Schirmer test status across the three time points (Cochran's Q test = 4.8, p = 0.091) (tab. 3).

Table 4 presents a comparison of mean Ocular Surface Index (OSDI) scores between patients receiving artificial tear administration and those without artificial tears at three time points: before surgery, 1 week after surgery, and 3 weeks after surgery. Values are expressed as mean (±standard deviation), with the corresponding range shown in parentheses.

Before surgery, the mean OSDI score was slightly lower in the AT group compared with the No AT group; however, this difference was not statistically significant (p = 0.123). At week 1 after surgery both groups showed a marked decrease in OSDI scores, with significantly lower scores observed in the AT group compared with the No AT group (p = 0.018). By week 3 after surgery OSDI scores further decreased in both groups, with the AT group showing a substantially greater improvement than the No AT group. This difference was highly statistically significant (p = 0.0003) (tab. 4).

Overall, these findings indicate that artificial tear administration is associated with a more pronounced and sustained reduction in postoperative OSDI scores compared with no artificial tear use.

DISCUSSION

This study aimed to determine the effectiveness of artificial tear administration in alleviating dry eye symptoms after a specific surgical procedure. The results demonstrate that

TABLE 2

Comparison of Schirmer test dry eye incidence between groups at week 1 and week 3.

Time Point	Group	No dry eye, n (%)	Dry eye, n (%)	Total	Statistical test	Test Statistic	p-value
Week 1	No AT	5 (31.3%)	11 (68.7%)	16	Fisher's exact	OR = 0.27	0.077
	AT	10 (62.5%)	6 (37.5%)	16			
Week 3	No AT	8 (50.0%)	8 (50.0%)	16	Fisher's exact	OR = 0.14	0.036
	AT	14 (87.5%)	2 (12.5%)	16			

TABLE 3

Change in Schirmer test dry eye status over time within each study group.

Group	Pre, n (%)	Week 1, n (%)	Week 3, n (%)	Cochran's Q (df = 2)	p-value
AT	6 (37.5%)	6 (37.5%)	2 (12.5%)	6.40	0.041
No AT	7 (43.8%)	11 (68.8%)	8 (50.0%)	4.80	0.091

TABLE 4

Mean comparison of OSDI in two different groups.

Characteristic	Control/Treatment	Artificial tear administration		Overall
		AT	No AT	P value
OSDI	before surgery	53.09 (±11.01), 42.08–64.10	60.25 (±14.12), 46.13–74.37	0.123 (independent t-test)
	1 week after surgery	25.06 (±9.31), 15.75–34.37	34.36 (±10.40), 23.96–44.76	0.018 (Mann–Whitney)
	3 weeks after surgery	8.77 (±3.45), 5.32–12.22	17.10 (±7.03), 10.07–24.13	0.0003 (independent t-test)

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patients who received artificial tear starting on the first postoperative day experienced a significantly lower incidence of dry eye and greater improvement in symptom severity compared with those who did not receive artificial tears. These findings support the role of artificial tear as a beneficial adjunct in postoperative ocular surface management.

Our findings reveal a marked difference between the groups receiving artificial tear and those without artificial tear. Preoperatively, both groups exhibited similar rates of dry eye symptoms. However, at week 1, there was a notable increase in dry eye prevalence, particularly in the No AT group, which showed a prevalence of 68.7%. This increase aligns with the typical postoperative dry eye symptoms often observed in patients following surgery [6]. Interestingly, the AT group displayed a significant reduction in dry eye symptoms by week 3, with only 12.5% of the patients in the AT group reporting dry eye symptoms, compared to 50% in the No AT group. These results highlight that early intervention with artificial tears facilitates faster symptomatic relief and prevents the worsening of ocular discomfort following surgery [7].

The statistical tests used in this study, including Fisher's exact test, demonstrated that while the difference between the groups was not statistically significant at week 1 ($p = 0.077$), the reduction in dry eye symptoms observed in the AT group at week 3 was statistically significant ($p = 0.036$). The odd ratio (OR) further supported the advantage of artificial tear, showing that the AT group had a significantly lower incidence of dry eye at week 3 compared to the No AT group (OR = 0.14). Similar findings have been reported in other studies evaluating the impact of artificial tear on postoperative dry eye [8].

In terms of Schirmer test scores, significant clinical improvements were noted in the AT group compared to the No AT group (Cochran's $Q = 6.4$, $p = 0.041$), suggesting that artificial tear administration led to a more rapid recovery in tear production postoperatively. In contrast, the No AT group did not demonstrate a statistically significant change over the 3 time points (Cochran's $Q = 4.8$, $p = 0.091$), indicating that the lack of artificial tear resulted in slower recovery. These findings are consistent with previous studies demonstrating the beneficial effects of artificial tear on tear production and eye lubrication following surgery [8].

The improvement in Schirmer test values in the AT group should be interpreted as reflecting enhanced tear film retention and ocular surface protection rather than increased lacrimal secretion. By reducing surface irritation and mechanical stress, artificial tear may help preserve functional tear dynamics during the early postoperative period. In contrast, the absence of supplemental lubrication in the No AT group may have resulted in prolonged tear film instability and delayed recovery, consistent with the lack of statistically significant change in Schirmer scores in that group. Similar findings have been reported in previous studies evaluating artificial tear use following ocular surgery [8].

Age, gender distribution, and preoperative BCVA were comparable between both groups, which strengthens the internal validity of the study. The BCVA did not show significant changes between the groups at 1 week and 3 weeks postoperatively, supporting the conclusion that the improvements in dry eye symptoms were likely independent of visual acuity or other demographic factors [9].

A secondary endpoint of the study was the comparison of OSDI scores, which reflect the overall impact of dry eye symptoms on quality of life. Baseline OSDI assessments revealed no statistically significant variation between the AT and No AT group ($p = 0.123$), ensuring the 2 cohorts were well-matched prior to intervention. However, at week 1 and week 3 post-surgery the AT group exhibited significantly lower OSDI scores, suggesting a more favourable recovery trajectory in terms of symptom burden. These results reinforcing the benefits of AT administration in postoperative care [10, 11]. Previous study emphasizes that proactive lubrication, particularly with preservative-free formulations, is essential to counteract surgically induced dry eye and the toxic effects of concurrent preserved postoperative medications [12].

The significantly better Schirmer test and OSDI outcomes observed in the AT group suggest that adjunctive lubrication may facilitate postoperative ocular surface recovery. Although artificial tear do not exert direct anti-inflammatory effects, they are known to improve tear film stability and reduce ocular surface desiccation, which may alleviate postoperative irritation and discomfort [13]. This likely contributed to the lower OSDI scores observed in the AT group at both postoperative time points, indicating a reduced symptom burden and improved patient-reported outcomes [14].

Concerns that artificial tear may interfere with the efficacy of concurrent postoperative anti-inflammatory medications appear largely theoretical. Most commercially available artificial tear formulations are designed for concomitant use with topical therapies and are unlikely to significantly impair drug penetration. Improved ocular surface comfort may also enhance patient tolerance and adherence to prescribed postoperative regimens. Taken together, these results reinforce the clinical utility of artificial tear as a safe, effective adjunctive therapy for mitigating postoperative ocular discomfort and optimizing tear film stability, without suggesting a replacement for standard anti-inflammatory therapy [15].

CONCLUSION

Artificial tear administration should be incorporated into postoperative management to reduce dry eye symptoms after surgery. The AT group experienced a significant re-

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duction in both the prevalence of dry eye and OSDI scores compared to the No AT group. These findings suggest that artificial tear should be considered as part of the postoperative care regimen to improve recovery and quality of life for patients. In addition, routine preoperative screening for dry eye is essential to identify at-risk patients and allow for appropriate perioperative management. Expanding this research to include more diverse patient groups and longer-term assessments will be vital in solidifying these results and tailoring evidence-based management strategies for postoperative dry eye symptoms.

Clinical implications

The findings of this study suggest that artificial tear administration plays a significant role in managing postoperative dry eye symptoms, providing evidence for its clinical utility. By reducing dry eye prevalence more significantly than in the No AT group, the results support the incorporation of AT as a standard part of postoperative care for patients undergoing surgeries that are known to induce dry eye symptoms. Furthermore, the reduction in OSDI scores indicates that AT may improve the overall quality of life for these patients, making it a valuable addition to their recovery protocol [16].

Limitations and future directions

While this study provides promising results, there are some limitations that should be addressed in future research. The sample size is relatively small, and a larger, multicenter study would be valuable to confirm these findings. Additionally, the study follow-up period was limited to 3 weeks, preventing evaluation of longer-term ocular surface outcomes.

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Data analysis: Miranda Howen.
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None.

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Ethics:
The content presented in the article complies with the principles of the Helsinki Declaration, EU directives and harmonized requirements for biomedical journals. This study was approved by the Ethics Committee of Prima Indonesia University (Approval No: 019/KEPK/UNPRI/XII/2025).

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