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Opthalmology

A PROSPECTIVE STUDY TO ASSESS THE INCIDENCE AND SEVERITY OF DRY EYE AFTER MANUAL SMALL INCISION CATARACT SURGERY

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ABSTRACT **Background:** Cataract surgery is the leading method for treating cataracts, the primary cause of preventable blindness worldwide. However, dry eye disease (DED) is a common postoperative complication, affecting visual outcomes and patient satisfaction. This study aimed to evaluate the incidence and severity of DED following small incision cataract surgery (SICS). **Methods:** A prospective study was conducted at the Ophthalmology Outpatient Department of G.R. Medical College, Gwalior, from January 2021 to June 2022. A total of 100 patients aged 50 years or older, with age-related cataracts, underwent SICS. Preoperative and postoperative assessments, including Schirmer's test, tear film break-up time (TBUT), and fluorescein staining, were performed at 7 and 30 days post-surgery. **Results:** On the 7th postoperative day, 72% of patients had dry eye disease, with 15% mild, 37% moderate, and 20% severe symptoms. By the 30th postoperative day, the incidence dropped to 39%, with 18% mild, 11% moderate, and 10% severe dry eye. Statistically significant differences were noted in TBUT and Schirmer's test results ($p < 0.001$) at both follow-ups. Fluorescence staining showed a decrease in punctate staining from 72% at 7 days to 39% at 30 days ($p = 0.0001$). A higher prevalence of dry eye was observed in females ($p = 0.0240$), and the highest incidence was seen in patients aged 66-70 years. **Conclusion:** Dry eye is a prevalent postoperative complication after cataract surgery, with a significant reduction in symptoms over time. Postoperative management with lubricants and preoperative testing for tear film stability is essential for effective patient care.

KEYWORDS : Cataract surgery, dry eye disease, incidence, severity, Schirmer's test, tear film break-up time, fluorescein staining, postoperative management.

INTRODUCTION

Cataracts are the leading cause of preventable blindness, accounting for approximately three-quarters of blindness worldwide, particularly in developing nations. In many countries, like India, the widely used phacoemulsification technique for cataract surgery is not commonly accessible due to the high costs of equipment and the density of cataracts in the population [1]. Dry eye, a multifactorial disease affecting the tear film and ocular surface, is a common issue that can negatively impact visual outcomes following cataract surgery. It causes symptoms such as discomfort, visual disturbances, and tear film instability, potentially leading to damage to the ocular surface [2].

Dry eye is frequently associated with cataracts, especially in the elderly, and is one of the most prevalent complaints following cataract surgery [3]. The incidence of dry eye among cataract surgery patients ranges widely from 96.6% to 98%, depending on various demographic, clinical, and procedural factors, as well as preoperative risk factors for dry eye [4,5]. Dry eye can significantly affect the visual recovery time, patient satisfaction, and overall quality of life post-surgery [6]. The large variation in the incidence of dry eye may be attributed to differences in assessment methods, the type of ophthalmic solutions used during surgery [7], intraoperative and postoperative medications [8], underlying systemic conditions [9], operating microscope exposure time [10], and the time elapsed since surgery [11].

Several factors contribute to the development of dry eye after cataract surgery. Prolonged use of antibiotic-steroid eye drops containing preservatives like benzalkonium chloride can damage the corneal and conjunctival epithelium [12]. The incision site can lead to a decrease in tear film breakup time and reduced mucus production from the conjunctiva [13]. Surgical incisions also result in decreased corneal sensitivity, disrupting the cornea-lacrimal gland loop, which reduces tear secretion [14]. Additionally, ocular inflammation caused by the surgery can affect tear film generation and stability, and exposure to the operating microscope light can contribute to dryness [13]. Although the symptoms of dry eye are generally transient, they can negatively impact a patient's quality of life, necessitating proper counseling on the temporary nature of the condition.

This study aimed to assess the incidence and severity of dry eye following cataract surgery, shedding light on its widespread impact on patient outcomes and quality of life post-surgery.

MATERIAL & METHODS

After obtaining approval from the Institutional Ethical Committee, this prospective study was conducted at the Ophthalmology Outpatient Department of G.R Medical College, Gwalior, from January 2021 to June 2022. A total of 100 eyes from 100 patients aged 50 years or older, all with age-related cataracts, were enrolled in the study. The patients underwent Small Incision Cataract Surgery (SICS). The primary objective of the study was to assess the incidence and severity of dry eye following cataract surgery in this patient population. Consecutive sampling was employed, with all patients who met the inclusion criteria included in the study after obtaining written informed consent.

Inclusion Criteria

Patients having unilateral or bilateral age related cataract without dry eye features.

Exclusion Criteria

Patients with cataracts other than senile cataracts, pre-existing ocular diseases, those using contact lenses, those on chronic ocular medication, and those who had undergone refractive surgery.

Additionally, patients with a history of ocular allergies or other surface or eyelid disorders, as well as those on medications causing dry eye (e.g., oral beta-blockers, oral contraceptive pills, antihistamines, psychiatric medications, or brimonidine eye drops), were excluded.

Methodology

Preoperative Evaluation

Before the surgery, patients were questioned about dry eye symptoms, such as pricking, burning, and itching sensations. A thorough ocular examination was conducted, including slit lamp examination, Schirmer's test-1, tear film break-up time (TBUT), and fluorescein staining for dry eye. After completing these tests, the patients underwent SICS with a 6-7 mm superior incision. Schirmer's test measured basal and reflex tear production using 35mm Whatsmann no. 41 filter paper, while TBUT assessed the stability of the tear film by measuring the time until the first dark spot appeared on the cornea after a blink. Fluorescein staining was performed to detect ocular surface damage, and staining was graded based on the extent of corneal epithelial involvement.

Surgical Procedure

During surgery, patients were administered eye drops containing tropicamide, phenylephrine hydrochloride, benzalkonium chloride, flurbiprofen, and cyclopentolate to dilate the pupil. A peribulbar block was given with 3 ml of 2% lignocaine, 1:100,000 adrenaline, 2 ml of 0.75% bupivacaine, and 150 units of hyaluronidase. The surgical procedure included a superior partial-thickness incision, capsulorrhexis, hydrodissection, and bimanual irrigation and aspiration. An intraocular lens was then inserted into the capsular bag. Postoperatively, subconjunctival gentamycin and dexamethasone were administered, and the eyes were patched for one day.

Postoperative Evaluation

On the seventh and thirtieth postoperative days, Schirmer's test-1, TBUT, and fluorescein staining were repeated. Dry eye severity was graded using TBUT, Schirmer's test and corneal staining, with categories of normal, mild, moderate, and severe. Patients were classified as having mild, moderate, or severe dry eye if two out of three tests indicated corresponding severity levels. Two normal test results and one abnormal result were considered normal for the patient.

Table 1. Grading Criteria For Dry Eye Severity Using TBUT, Schirmer's Test And Corneal Staining

Grading of Severity of Dry Eye	TBUT (in sec)	Schirmer's Test Score (in mm)	Corneal Staining with Fluorescein
NORMAL	>10 seconds	>15mm	No punctate staining
MILD	6.1 - 10 seconds	10 - 15mm	<1/3 of corneal surface
MODERATE	3.1 - 6 seconds	5 - 9mm	<1/2 of corneal surface
SEVERE	≤3 seconds	≤5mm	>1/2 of corneal surface

Statistical Analysis

The collected data were entered into a Microsoft Excel Sheet. Tables were generated using Microsoft Word and Microsoft Excel version 2010. The data were analyzed using the Statistical Package for the Social Sciences (SPSS) IBM version 18.0. The categorical variables were expressed as percentages, frequency, and proportions and compared using Pearson's Chi-square test or Fisher's exact test, as appropriate. A $p \leq 0.05$ was considered statistically significant.

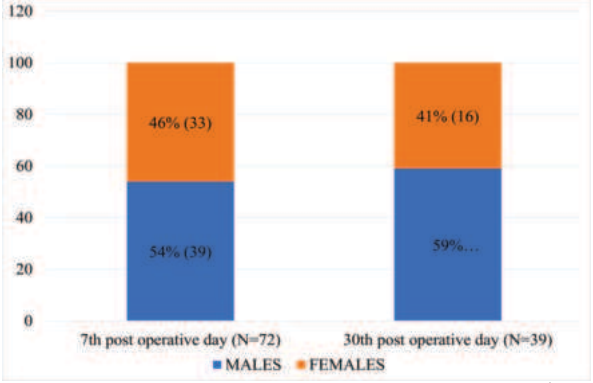
RESULTS

In this study, 100 patients were enrolled, with 58% females and 42% males. The majority of patients were in the older age groups, with 36% in the >65-70 years category, 26% in the >60-65 years group, 20% in the >55-60 years group, and 18% in the >50-55 years group. This distribution highlights the higher prevalence of cataracts and dry eye disease among older individuals, particularly in those aged >65-70 years. [Table 2]

Table 2. Age And Gender Wise Distribution Of Study Participants

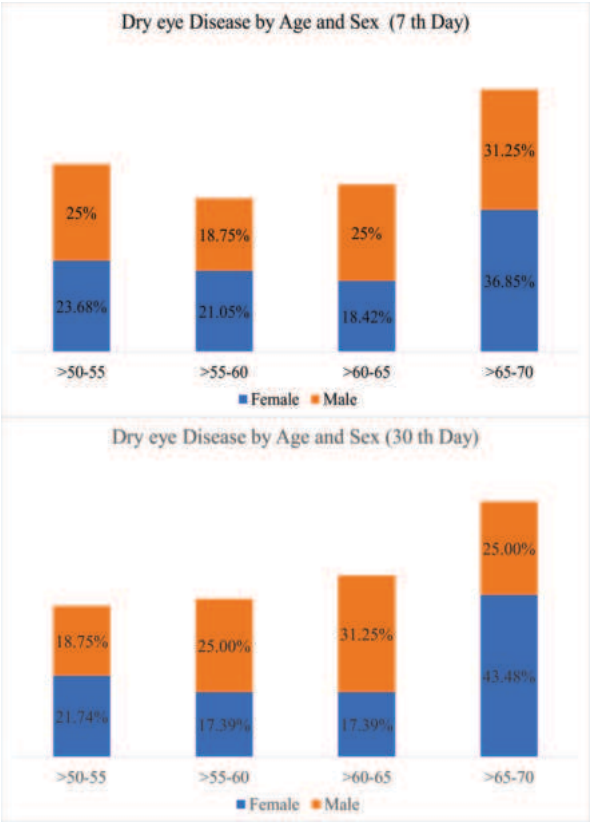
Parameter	No. of patients	Percentage (%)
Gender		
Male	**42**	**42%)**
Females	**58**	**58%**
Age Group Distribution		
>50-55 years	18	18%
>55-60 years	20	20%
>60-65 years	26	26%
>65-70 years	36	36%

On the 7th postoperative day, 72% of patients were affected by dry eye disease, with a higher prevalence in females (54%) compared to males (46%). By the 30th postoperative day, the incidence decreased to 39%, with a higher proportion of females (59%) still experiencing symptoms compared to males (41%). A statistically significant difference was observed in the incidence of dry eye disease after cataract surgery, with females experiencing more dry eye symptoms than males (P = 0.0240). [Graph 1]



Graph 1. Gender based Distribution of Study participants on 7th and 30th postoperative day

On both the 7th and 30th postoperative days, the highest percentage of dry eye disease was observed in the 66-70 years age group. On the 7th day, the 56-60 years age group had the lowest percentage of dry eye disease, while on the 30th day, the 51-55 years age group had the least. This indicates that older age groups, particularly those in the 66-70 years range, are more likely to experience dry eye disease following cataract surgery. [Graph 2]



Graph 2. Age based Distribution of Dry Eye on both the 7th and 30th postoperative days

On fluorescence staining, preoperatively, 100% of patients showed no punctate staining. On the 7th day, 72% of patients exhibited punctate staining, with 37% showing less than half of the corneal surface affected, 20% showing more than half, and 15% showing less than a third. By the 30th day, 39% of patients showed punctate staining, with 26% demonstrating a significant decrease in staining on less than half of the corneal surface (p = 0.0001) and 10% on more than half (p = 0.0482). Notably, 33% of patients showed no punctate staining, suggesting a trend toward improvement in dry eye symptoms over time. [Table 3]

Table 3. The Fluorescein Staining Pattern For Dry Eye Disease At Different Time Points

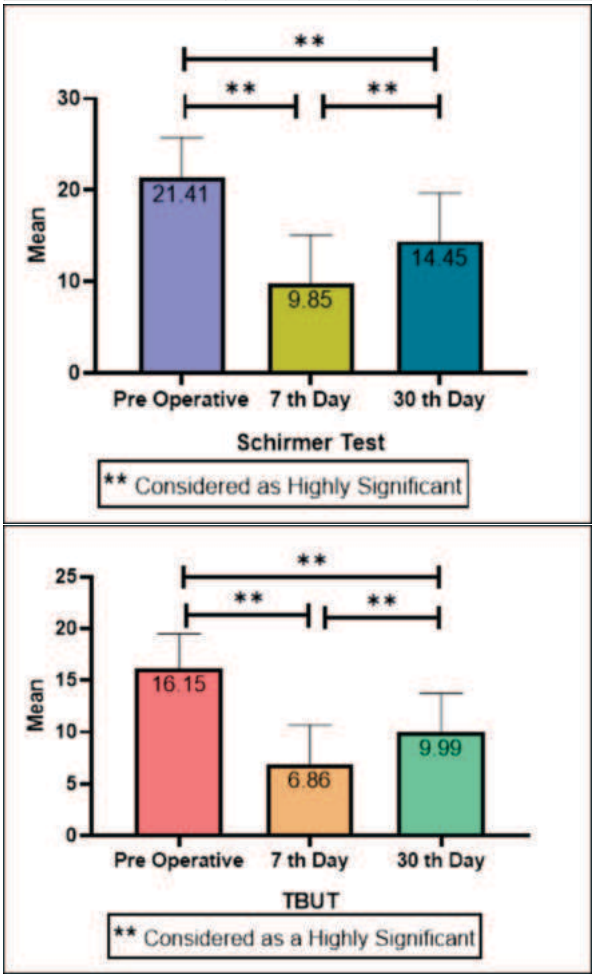
Grading of Dry eye	Staining Pattern	Preoperative	Postoperative	
			7th Day	30th Day
No dry eye	**No Punctate Staining**	100 (100%)	28 (28%)	61 (61%)
Mild	**<1/3 Corneal Surface**	-	15 (15%)	18 (18%)
Moderate	**<1/2 Corneal Surface**	-	37 (37%)	11 (11%)
Severe	**>1/2 Corneal Surface**	-	20 (20%)	10 (10%)

A statistically significant decrease in TBUT was observed from preoperative to the first postoperative week ($p < 0.001$), followed by a statistically significant increase from the first postoperative week to the first month ($p < 0.001$). Similarly, a statistically significant decrease in Schirmer's test results was noted from preoperative to the

first postoperative week ($p < 0.001$), with a significant increase observed from the first postoperative week to the first month ($p < 0.001$). [Table 4, Graph 3]

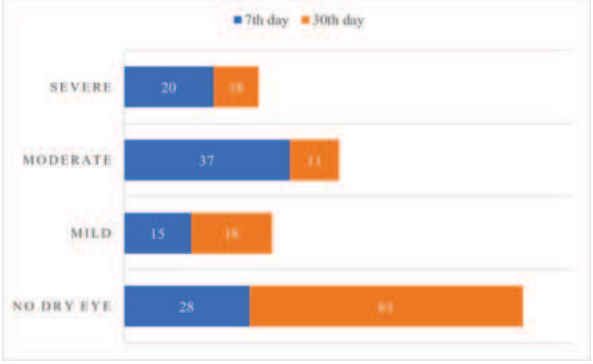
Table 4. Comparison Of Mean Of Pre-op And Post -op Schirmer's Test (in mm) And TBUT test (in sec)

Tests for Dry eye	Preoperative	Postoperative	
		7th Day	30th Day
TBUT (in sec)	16.15 ± 3.33	6.86 ± 3.83	9.99 ± 3.75
		p <0.001	p <0.001
Schirmer's test (in mm)	21.41 ± 4.34	9.85 ± 5.26	14.45 ± 5.25
		p <0.001	p <0.001



Graph 3. Comparison of mean of pre-op and post -op Schirmer's test (in mm) and TBUT test (in sec)

None of the eyes presented with dry eye preoperatively. However, the incidence of dry eye on the 7th postoperative day was 72%, with 15% of patients experiencing mild dry eye, 36% moderate, and 20% severe. By the 30th postoperative day, the incidence decreased to 39%, with 18% mild, 11% moderate, and 10% severe cases. [Graph 4]



Graph 4. Grading of Dry Eye Disease

DISCUSSION

Dry eye disease (DED) is a common condition with multiple potential causes, including age, connective tissue diseases, family history of allergies or diabetes, use of antihistamines, and prior ophthalmic procedures like photorefractive keratectomy and LASIK and its prevalence has been observed to increase following cataract surgery. The present study aimed to evaluate the prevalence and severity of dry eye symptoms after Small Incision Cataract Surgery (SICS) in patients aged 50 years or older. The study was based on a hospital-based cohort at G.R. Medical College, Gwalior, and included a total of 100 patients. The findings from this study contribute valuable data to the growing body of literature on the association between cataract surgery and the onset of dry eye disease, particularly focusing on postoperative symptoms.

Diagnosing dry eye is challenging due to the lack of a single "gold standard" test. A combination of tests, including Schirmer's test, TBUT, and fluorescein staining, was used in this study to evaluate dry eye. Cataract surgery can alter the neurogenic response of the ocular surface, reducing tear secretion, which is consistent with previous findings. The study included 100 participants, with 18% in the 51-55 age group, 20% in the 56-60 age group, 26% in the 61-65 age group, and 36% in the 66-70 age group. The mean age of participants was 61.94 ± 5.58 years, which is consistent with findings from Kasetsuwan et al. [3] and Ishrat S et al. [15] in similar studies.

Prevalence of Dry Eye Disease Post-Cataract Surgery

In the present study, 72% of patients developed dry eye disease in the early postoperative period. Among these, 15% had mild, 37% had moderate, and 20% had severe dry eye disease, with moderate dry eye being most prevalent shortly after cataract surgery. When comparing the prevalence of dry eye disease following cataract surgery in various studies, the results varied. For instance, Ishrat S et al. [15] reported a prevalence of 42%, while Lakshami P S et al. [16] found 29%, and Jayshree M.P. et al. [17] observed 96.6%. The current study's findings of 72% were among the second-highest observed in early postoperative periods, indicating that small incision cataract surgery can significantly affect dry eye disease prevalence.

On the 7th postoperative day, the majority of patients with dry eye disease experienced moderate symptoms (37%), followed by severe symptoms (20%) and mild symptoms (15%). This high incidence of moderate to severe dry eye symptoms suggests that cataract surgery, even when performed using the small incision technique, can lead to a significant temporary deterioration in ocular comfort and tear production.

At the 1-month follow-up, 39% of patients still exhibited dry eye symptoms, with 10% having severe, 11% moderate, and 18% mild dry eye disease. This reduction in severity supports the notion that while cataract surgery can temporarily disrupt the tear film and ocular surface, the condition is self-limiting and generally improves over time. The findings are consistent with other studies, such as those by Ishrat Set al. [15], which showed a significant decrease in dry eye severity over a 3-month period. Jayshree M.P. et al. [17], also reported a significant reduction in dry eye severity from 1 week to 1 month. Ishrat S et al. [3] found that severe dry eye symptoms completely resolved by the end of the month, while Jayshree M.P. et al. [17] observed a decrease from 61.72% to 7.4%, though it never reached zero. Similarly, in our study, severe dry eye symptoms decreased from 20% to 10%, indicating a significant improvement over time.

Gender Differences in Postoperative Dry Eye Disease

A significant amount of research has focused on understanding the gender differences in dry eye prevalence, with studies indicating that dry eye is more common and severe in women, likely due to lower estrogen levels [18]. Anatomical, physiological, and pathophysiological differences between sexes have been observed, particularly in the conjunctival goblet cells and lacrimal and Moll glands [19]. Sex hormones, such as estrogen and androgen, play a crucial role in influencing the tissues of the eyeball, as receptors for these hormones have been found in the conjunctiva, cornea, and Moll glands [20]. These hormonal effects contribute to gender-specific differences in ocular surface cells and tissues, influencing dry eye development [21]. In our study, a higher incidence of dry eye was observed in females (43.48%) compared to males (25%) in the age group of 66-70 years, which is consistent with findings in the study by He Y. et al. [22].

Diagnosis and Diagnostic Methods for Severity of Dry Eye Disease

The severity of dry eye symptoms in this study was categorized as mild, moderate, or severe, based on three main diagnostic tests: Tear Film Breakup Time (TBUT), Schirmer's test, and fluorescein staining. TBUT is widely recognized as a useful indicator of tear film stability, and it was found to be significantly decreased on the 7th postoperative day ($p < 0.001$), but it improved by the 30th day ($p < 0.001$). Schirmer's test, which measures tear production, also showed a significant decrease in tear secretion in the first week after surgery ($p < 0.001$), with a gradual recovery by the 30th day ($p < 0.001$). These results indicate that cataract surgery significantly affects both the quality and quantity of the tear film, leading to dry eye symptoms in the short term, but that recovery is possible as the ocular surface heals.

Fluorescein staining, which assesses the integrity of the ocular surface, showed no punctate staining in 100% of patients preoperatively, but this increased significantly to 72% on the 7th day and 39% on the 30th day. Among the patients with fluorescein staining, the majority showed mild to moderate corneal surface changes. The study found that the highest incidence of punctate staining was observed in patients with moderate dry eye disease, and a significant decrease in staining was noted by the 30th day. This decrease in prevalence aligns with the findings of Saif M.Y. et al. [23], where dry eye disease was present in 95% of patients at one-week post-surgery, reducing to 70% after one month and further declining to 35% by three months. While Rose Bengal staining is a more sensitive method to assess the ocular surface for dry eye, it was not used in this study due to its tendency to cause discomfort, such as pain and burning sensations in postoperative patients.

The study also assessed the Tear Film Break-Up Time (TBUT) in relation to preoperative and postoperative conditions. Statistically significant differences were found both at one week and one month post-surgery ($p < 0.0001$), indicating a substantial decrease in TBUT postoperatively, which is consistent with the findings of Ishrat S et al. [15] who documented a significant decrease in TBUT over a 1-3 month period following cataract surgery ($p = 0.034$). The study by Jayshree M.P. et al. [17] also found a significant decrease in TBUT at one month, though the proportion of affected patients was higher in their study compared to ours.

In terms of Schirmer's test, a significant difference was observed between preoperative and postoperative measurements, both at one week ($p < 0.0001$) and one month ($p < 0.0001$), suggesting a marked decrease in tear production following surgery. This is in contrast to studies like Prabtani RM et al. [24] and Kumari P et al. [25], who found no statistically significant reduction in Schirmer's scores postoperatively. These findings underscore the variability in postoperative dry eye testing results and suggest that Schirmer's test may not be as sensitive in detecting dry eye disease as other methods such as TBUT.

Regarding gender differences, our study showed that women were more likely to develop dry eye disease after cataract surgery than men, although the difference was not statistically significant. This trend has been observed in other studies [26–28], with the disparity often attributed to the higher prevalence of dry eye disease in postmenopausal women. Hormonal changes related to reduced estrogen levels are thought to contribute to this increased vulnerability [18].

The development of surgically-induced dry eye in patients with no prior ocular surface issues is multifactorial. Factors include mechanical damage during surgery, the instability of the tear film due to prolonged exposure to the operating microscope's bright light, and a decrease in goblet cells. Previous studies have shown that exposure to bright surgical lights can worsen dry eye symptoms by contributing to the drying of the ocular surface [29,30]. Despite these challenges, surgically-induced dry eye is typically self-limiting and improves within one to three months, as observed in this study and others [31].

In conclusion, cataract surgery significantly affects the ocular surface, leading to temporary dry eye symptoms. While the condition can trigger or exacerbate pre-existing dry eye disease, it is generally self-limiting and resolves over time. However, ophthalmic surgeons must be prepared to manage these symptoms effectively to ensure optimal postoperative outcomes. Monitoring dry eye symptoms, especially in the early postoperative period, is essential to manage and mitigate the discomfort associated with this common complication of cataract surgery.

CONCLUSION

In conclusion, dry eye is a well-recognized condition with multiple etiologies, and cataract surgery is a significant contributor to its development. This study found that the cumulative incidence of dry eye in cataract surgery patients was 72% at 7 days, decreasing to 39% at 30 days post-surgery. Among the 72% of patients with dry eye at 7 days, the distribution was as follows: 15% mild, 37% moderate, and 20% severe. After one month, 39% of patients still had dry eye, with 10% experiencing severe, 11% moderate, and 18% mild symptoms. Preoperative assessments using tests for tear film generation and stability are essential for identifying patients at risk. For those diagnosed with dry eye, artificial tears and cyclosporine eye drops can provide relief post-surgery.

The study findings suggest that the dryness is typically temporary and tends to resolve within a month. Despite good visual recovery, dry eye remains a common complication following cataract surgery, impacting patient satisfaction. Therefore, we recommend the use of appropriate lubricants during the postoperative recovery period, lasting two to three months, to alleviate dry eye symptoms and improve patient comfort.

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