ORIGINAL ARTICLE

# Efficacy of cyclosporin eye drops in the treatment of dry eye after cataract surgery

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## ABSTRACT

**Objective:** To explore the value of cyclosporin eye drops in treating dry eye after cataract surgery.
**Methods:** A total of 150 patients with dry eye after cataract surgery were randomly divided into group A (n = 50), group B (n = 50), and group C (n = 50). Artificial tears combined with cyclosporin eye drops were used in group A, artificial tears were used in group B, and no dry eye medication was used in group C. The clinical efficacy, ocular surface function and tear inflammatory factor level before and after surgery were compared between the groups.
**Results:** The total effective rate of group A was 96.00%, which was significantly higher than that of group B and group C ($p < .05$); three months after surgery, the levels of corneal fluorescein staining score (FL score), tear meniscus height (TMH) and tear inflammatory factors [interleukin 6 (IL-6), interleukin 8 (IL-8), tumor necrosis factor $\alpha$ (TNF-$\alpha$)] in group A were lower than those in group B, and those indicators in group B were lower than those in group C, and the difference between the two groups was statistically significant ($p < .05$); three months after surgery, Schirmer test (SIT) and break-up time (BUT) in group A were higher than those in group B, and those indicators in group B were higher than those in group C, and the difference between the two groups was statistically significant ($p < .05$).
**Conclusions:** The effect of cyclosporin eye drops in treating dry eye after cataract surgery is satisfactory, significantly improving the ocular surface function and reducing the level of tear inflammatory factors, which is worthy of promotion.

**Key Words:** Cataract, Dry eyes, Cyclosporin eye drops, Ocular surface function, Inflammatory factors

## 1. INTRODUCTION

Cataract surgery is a standard procedure, and postoperative dry eye is a common complication.[1] The occurrence of dry eye syndrome will affect the patients' rehabilitation effect, and it will have an adverse effect on the improvement of patients' postoperative vision, which needs to be treated reasonably after surgery.[2] At this stage, there is a lack of effective treatment for dry eye after cataract surgery; the application of artificial tears can only play a symptomatic role in increasing the amount of tears, the massage or hot compression of meibomian glands can only relieve the symptoms in patients with dry eye syndrome with excessive evaporation, glucocorticoids can control inflammation, but there are serious side effects, so it is necessary to find a more effective treatment for dry eye syndrome.[3] Cyclosporin is a cyclic polypeptide drug, which has been found to inhibit the activation of T cells and the production of inflammatory cytokines on the one hand and inhibit lacrimal acinar cells and conjunctival goblet cells on the other hand, to increase the secretion of mucin, which has a good effect on dry eye

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syndrome.[4] However, existing studies have investigated the role of cyclosporin eye drops in treating dry eye after cataract surgery. Therefore, this study is aimed at exploring the effect of topical cyclosporin eye drops on dry eye after cataract surgery and is reported as follows.

## 2. Data and methods

### 2.1 General information

A total of 150 patients with dry eye after cataract surgery who were admitted from October 2020 to February 2022 were selected as the study subjects. Inclusion criteria for study subjects were as follows: (1) The patients who were all treated with cataract surgery and had symptoms of dry eye after surgery; (2) The patients who were all over 18 years old and had complete clinical data; (3) all patients who or whose families signed informed consent forms. Exclusion criteria were as follows: (1) Patients with severe liver and kidney impairment; (2) Patients with other ocular diseases; (3) Patients with hypertension and diabetes mellitus; (4) Patients who have an allergic reaction to the study drug. According to the random number table principle, the patients were divided into three groups, A, B, and C, with 50 patients in each group. Group A had 50 cases (50 eyes), including 28 males and 22 females. The age was 37-77, with an average age of (57.12 $\pm$ 3.45). Group B had 50 cases (50 eyes), including 30 males and 20 females. The age was 35-77, with an average age of (56.88 $\pm$ 3.51). There were 50 cases (50 eyes) in group C, including 29 males and 21 females. The age was 34-78, with an average age of (57.26 $\pm$ 3.42). There was no significant difference in gender and age among the three groups ($p >$ .05).

### 2.2 Methods

Group A: From 1 week before cataract surgery to 3 months after surgery, patients were given artificial tears 4 times/day + 0.05% cyclosporin eye drops 2 times/day.

Group B: Artificial tears were used 4 times/day from 1 week before cataract surgery to 3 months after surgery.

Group C: There was no dry eye medication before and after surgery.

The three groups of patients were treated with diclofenac sodium eye drops 4 times/day two days before surgery. Levofloxacin ophthalmic solution was given 4 times/day. Postoperative dispensing drugs were all routine dispensing drugs after cataract surgery.

### 2.3 Indicator observation

(1) Efficacy evaluation criteria. 3 months after surgery, ocular symptom scoring criteria were established according to the Ocular Surface Disease Index (OSDI) and Standard Patient Evaluation of Eye Dryness (SPEED), and the therapeutic effect was evaluated according to the changes in ocular symptom scoring after treatment, a decrease of symptom scores > 90% indicates a basic recovery; a 50%-90% reduction in symptom scores after treatment suggests that the condition is improving; a decrease < 50% or increase in symptom scores after treatment indicates ineffectiveness—total effective rate = basic recovery rate + disease improvement rate.

(2) Schirmer test (SIT), break-up time (BUT), corneal fluorescein staining score (FL), and tear meniscus height (TMH). The three groups were evaluated 2 weeks before and 3 months after surgery. SIT was measured by strip filter paper, which was moistened by tears, and then ST value of the eye was acquired; BUT was measured by use of a cobalt blue filter to observe the patients' tear films and the time from opening the eyes after a blink to the first dark spot on the cornea was taken; FL was scored under slit lamp by use of the van Bijsterveld corneal fluorescein staining scoring scale, and the cornea was divided into 4 quadrants for scoring separately, and the sum of the scores of each quadrant was the total score of corneal staining, with a range of 0-12 points; TMH is the height of the central lacrimal river of conjunctival sac point fluorescein sodium, the standard height is 0.3-0.5 mm.

(3) Inflammatory factor. Tear samples were collected 2 weeks before surgery and 3 months after surgery in the three groups, and the levels of interleukin-6 (IL-6), interleukin-8 (IL-8), and tumor necrosis factor $\alpha$ (TNF-$\alpha$) were determined by enzyme-linked immunosorbent assay.

### 2.4 Statistical methods

The data were statistically processed by SPSS22.0, and the measurement data and the categorical data were compared by use of $t$-test and $\chi^2$ test, respectively, and the difference was of statistical significance ($p <$ .05).

## 3. Results

### 3.1 Efficacy comparison

The treatment effect of Group A was significantly higher than that in Group B and Group C ($p <$ .05), and there was no difference in the total effective rate between Group B and Group C ($p >$ .05), as shown in Table 1.

### 3.2 Comparison in SIT, BUT, FL and TMH

There was no significant difference in the relevant indicators among the groups two weeks before surgery ($p >$ .05); 3

months after surgery, the levels of SIT and BUT were increased in the three groups, and the indicators in group A were higher than those in group B, and the indicators in group B were higher than those in group C, and the difference between the two groups was statistically significant ($p < .05$); 3 months after surgery, FL score and TMH of the three groups were reduced, and the indicators in group A were lower than those in group B, and he indicators in group B were lower than those in group C, and the difference between the two groups was statistically significant ($p < .05$), as shown in Table 2.

### 3.3 Comparison of inflammatory factors

There was no difference in inflammatory factor indicators 2 weeks before surgery ($p > .05$) and 3 months after surgery; the indicators of inflammatory factors were all decreased in the three groups, and the indicators in group A were lower than those in group B, and the indicators in group B were lower than those in group C. The difference between the two groups was statistically significant ($p < .05$), see Table 3.

**Table 1.** Comparison of treatment effect among the three groups [n (%)]

| Group | n | Basic Recovery | Improved Condition | Inefficiency | Total Effective Rate |
|---|---|---|---|---|---|
| Group A | 50 | 34 (68.00) | 14 (28.00) | 2 (4.00) | 48 (96.00) *# |
| Group B | 50 | 26 (52.00) | 14 (28.00) | 10 (20.00) | 40 (80.00) |
| Group C | 50 | 17 (34.00) | 19 (38.00) | 14 (28.00) | 36 (72.00) |
| $\chi^2$ | | | | | 10.421 |
| $p$ | | | | | .005 |

*Note*. In comparison with Group B, * $p < .05$; in comparison with Group C, # $p < .05$

**Table 2.** Comparison of changes in SIT, BUT, FL and TMH before and after operation among the 3 groups ($\bar{x} \pm s$)

| Group | n | SIT (mm) | | BUT (s) | | FL (Score) | | TMH (mm) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2 weeks before surgery | 3 months after surgery | 2 weeks before surgery | 3 months after surgery | 2 weeks before surgery | 3 months after surgery | 2 weeks before surgery | 3 months after surgery |
| Group A | 50 | 3.41±0.54 | 11.24±1.45*# | 6.62±1.02 | 13.41±1.84*# | 4.77±0.76 | 1.23±0.25*# | 1.16±0.31 | 0.41±0.07*# |
| Group B | 50 | 3.29±0.55 | 8.86±1.22# | 6.66±1.03 | 10.02±1.45# | 4.86±0.77 | 1.71±0.33# | 1.19±0.33 | 0.57±0.09# |
| Group C | 50 | 3.37±0.56 | 5.35±0.92 | 6.71±1.05 | 8.82±1.24 | 4.81±0.78 | 2.65±0.46 | 1.17±0.32 | 0.81±0.14 |
| F | | 0.617 | 296.783 | 0.095 | 120.985 | 0.171 | 26.789 | 0.114 | 186.503 |
| $p$ | | .541 | .000 | .909 | .000 | .843 | .000 | .892 | .000 |

*Note*. In comparison with Group B, * $p < .05$; in comparison with Group C, # $p < .05$

**Table 3.** Comparison of indicators of inflammatory factors among the three groups before and after surgery ($\bar{x} \pm s$)

| Group | n | IL-6 (pg/mL) | | IL-8 (ng/L) | | TNF-α (pg/mL) | |
|---|---|---|---|---|---|---|---|
| | | 2 weeks before surgery | 3 months after surgery | 2 weeks before surgery | 3 months after surgery | 2 weeks before surgery | 3 months after surgery |
| Group A | 50 | 1488.14±142.71 | 984.41±91.15*# | 152.25±21.16 | 52.25±8.15*# | 266.25±34.48 | 184.45±24.45*# |
| Group B | 50 | 1492.05±141.78 | 1162.25±98.85# | 151.77±20.84 | 71.15±9.95# | 264.48±34.12 | 215.56±28.15# |
| Group C | 50 | 1486.25±140.87 | 1252.25±115.41 | 152.06±20.89 | 97.74±12.25 | 265.05±34.29 | 234.41±31.18 |
| F | | 0.022 | 88.749 | 0.007 | 248.312 | 0.035 | 40.416 |
| $p$ | | .978 | .000 | .993 | .000 | .966 | .000 |

*Note*. In comparison with Group B, * $p < .05$; in comparison with Group C, # $p < .05$

## 4. Discussion

Dry eye syndrome after cataract surgery is a common complication mainly related to the influence of various factors on the ocular surface microenvironment during and after surgery. The anesthetics and cleaning solutions used during surgery may cause tear film instability and damage corneal epithelial cells and lacrimal gland function. Nerve damage caused by incisions during surgery can also decrease tear secretion.[5] In addition, the postoperative use of antimicrobial and anti-inflammatory drugs further affects the quality and quantity of the tear films. In addition, inflammatory responses play an important role in the occurrence and development of dry eye syndrome after cataract surgery. Postoperative inflammation can lead to the apoptosis of the lacrimal gland and conjunctival epithelial cells, further reducing tear secretion.[6] Elevated levels of common inflammatory cytokines such as IL-6, IL-8, and TNF-$\alpha$ can aggravate the inflammatory responses on the ocular surface and exacerbate the symptoms of dry eye syndrome. These mechanisms work together to cause dry eye and inconvenience to patients' daily lives.

For dry eye after cataract surgery, the conventional treatment methods mainly include using artificial tears to increase environmental humidity and care for eye hygiene. Artificial tears can supplement the deficiency of tears to a certain extent and play a role in lubricating the ocular surface. Still, its effect is often temporary, and it is difficult to improve the eye condition in the long term.[7] In addition, some preservatives in artificial tears can irritate the cornea, and long-term use can cause drug dependence and corneal damage. Other conservative treatment measures, such as hot compression and meibomian gland massage, are also used to promote meibomian gland secretion and optimize tear film quality. However, the control of inflammatory responses is insufficient in conventional treatment. As a potent immunosuppressant, Cyclosporin has been shown to be effective in treating dry eye. It mainly relieves ocular inflammatory responses by inhibiting the activation of T lymphocytes and reducing the release of inflammatory mediators.[8] Specifically, Cyclosporin effectively reduces the apoptosis rate of the lacrimal gland and conjunctival epithelial cells by blocking endogenous and exogenous apoptotic pathways and protecting ocular surface tissues.[9] In addition, Cyclosporin can also increase the activity of Fas/FasL and caspase, and promoting the apoptosis of pathological T cells, thereby further reducing the immune-inflammatory responses.[10] Through these effects, Cyclosporin has shown a substantial impact on reducing the levels of inflammatory factors in tears, resulting in a significant improvement in the overall function of the ocular surface.

In this study, the combination of Cyclosporin eye drops and artificial tears showed a strong synergistic effect in treating dry eye after cataract surgery. Compared with the control group using artificial tears alone, the level of inflammatory factors in the combination group was significantly reduced 3 months after surgery, and the indicators of the ocular surface function were also improved to a greater extent. Through its unique immunomodulatory effect, Cyclosporin not only enhances the stability of the tear film but also reduces postoperative eye inflammation, bringing a better treatment experience to patients. These results suggest that applying Cyclosporin eye drops can effectively reduce the symptoms and improve the quality of patients' lives with postoperative dry eye syndrome.

## 5. Conclusion

Cyclosporin has performed well in treating dry eye after cataract surgery through multiple mechanisms of action. It reduces the widespread effects of inflammatory factors and protects ocular surface cells from apoptosis, significantly improving patient outcomes and satisfaction. Combined with these findings, the potential value of Cyclosporin eye drops in treating dry eye disease is worth further exploring and promoting.

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## Authors contributions

Li Ping contributed to the study conception and review, Feng Ling contributed to data acquisition and manuscript drafting, both authors reviewed and approved the final manuscript.

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The authors declare no conflicts of interest.

## Informed consent

Obtained.

## Ethics approval

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## Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## Data sharing statement

No additional data are available.

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