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Efficacy of Warm Compress Therapy in Enhancing Tear Film Quality and Reducing Postoperative Dry Eye Syndrome after Cataract Surgery: A Randomized Controlled Trial

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KEYWORDS

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DECLARATIONS

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ABSTRACT

Background: Dry eye disease is a multifactorial condition often exacerbated by cataract surgery, leading to discomfort and visual disturbances. Meibomian gland dysfunction, a key cause of dry eye disease, contributes to tear film instability, which can be managed with warm compress therapy. **Objective:** To evaluate the effectiveness of perioperative warm compress therapy in improving tear film stability and reducing dry eye symptoms following cataract surgery. **Methodology:** This randomized controlled trial involved 60 participants aged 50 to 70 years with moderate to severe dry eye symptoms and tear film instability, as indicated by high ocular surface disease index scores. Patients were randomly assigned to an intervention group, receiving warm compress therapy after surgery, and a control group receiving standard dry eye treatments for six weeks. Perioperative and postoperative evaluations included the ocular surface disease index and a standardised patient evaluation of eye dryness questionnaire to measure dry eye symptoms and quality of life. The normality of the data was assessed using the Shapiro-Wilk test. Independent and paired sample t-tests were used to analyse the parametric difference between and within each group, respectively, to assess improvement in tear film stability and symptom reduction. **Results:** Warm compress therapy mean standardised patient evaluation of eye dryness questionnaire at day one was 20.37±3.85 before the treatment and 2.37±1.36 after the treatment, mean score of the control group before treatment was 17.41±2.4, after the treatment was 5.38±1.5. The mean score of ocular surface disease index scores of the warm compress therapy before and after treatment was 75.48±9.09, 18.07±4.45. The mean score of ocular surface disease index of the control group before and after treatment was 54.11±11.3, and 31.41±6.2, respectively. The mean difference in ocular surface disease index was 22.7 ($p \leq 0.05$). **Conclusion:** Significant difference was found between both groups; the warm compress therapy group shows greater improvement in dry eye symptoms and tear film quality, while warm compress therapy offers a significant benefit in managing dry eye after cataract surgery.

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INTRODUCTION

Dry eye disease (DED) is a condition affecting the tear film, resulting from either insufficient tear production or increased tear evaporation. This imbalance can cause damage to the surface of the eye and lead to symptoms such as discomfort and visual disturbances.[1] Prevalence of DED post-cataract surgery differs in patients, but studies indicate that a significant percentage of patients experience it is ranging between 29% to 42%. Studies reported that 42% of eyes were affected in the first week post-surgery, reduced to 15% at one month and 9% at three months. It is a multifactorial condition that results in tear film instability, ocular surface inflammation, and increased tear film osmolality.[2] Commonly seen in ophthalmology and optometry, dry eye disease presents with symptoms such as dryness, burning, stinging, light sensitivity, pain, fatigue, and blurred vision. Clinical signs include reduced tear production, tear film instability, and ocular surface damage.[3]

Keratoconjunctivitis sicca is a frequently encountered condition characterised by dry eyes, particularly following surgery. Common symptoms include eye dryness, irritation, redness, discharge, blurred vision, and eye fatigue. Warm compress therapy plays an effective role in relief for dry eyes by improving oil gland function and enhancing oil flow into the eyes, stability for the tear film.[1] Warm compress therapy also reduces eye twitching from muscle spasms. Resulted from extremely dry eyes, relieve pain and reduce swelling by increasing blood flow to the eyes and surrounding tissues, especially those with blood vessel abnormalities that can affect tear production. Cataract is one of the most common causes of loss of useful vision.[4]

The phacoemulsification process may worsen these symptoms, with post-surgery dry eye reported in 10-42% of cases. There is a significant incidence of dry eye after surgery, particularly with phacoemulsification and small-incision cataract surgery (SICS), though the condition was transient, resolving within one month for most patients. Ocular symptom scores often decline in the 1-3 months after surgery. Given these potential issues, it may be beneficial for surgeons to address ocular surface disease before performing cataract surgery.[5,6] Cataract surgery might cause or exacerbate dry eye symptoms. Due to the surgery procedure, the nerves on the surface of the eye might be temporarily disrupted, affecting tear production in patients.[7] The purpose of this study is to assess how effective perioperative warm compress therapy (WCT) is in enhancing tear film stability and alleviating dry eye symptoms after cataract surgery.

METHODOLOGY

The design of this study was a single-blinded, randomized controlled trial. The study's sample size was determined using G-Power version 3.1.9.7.[8] A sample size of 54, with a 10% dropout error, was estimated to be 60. The sampling technique used was a non-probability, convenient sampling technique. As per permission of the Head of the Department of Ophthalmology, data was collected from Hakeem Mahmood Trust Hospital, Alam Chowk, Gujranwala, over 10 months.

Participants aged 50 to 70 years,[9] scheduled for cataract surgery (both unilateral and bilateral).[10] Postoperative moderate to severe dry eye symptoms were assessed using the ocular surface disease index (OSDI).[11] Patients excluded include those with OSDI, indicating severe DED.[12] Patients with systemic diseases (e.g., rheumatoid arthritis, lupus) that affect tear production or who are using medications that severely reduce tear production (e.g., chronic use of antihistamines or systemic corticosteroids), patients with significant pre-existing corneal pathology (e.g., corneal dystrophies, corneal scars) that could affect the results of cataract surgery or WCT.[13] Patients with active ocular infections (e.g., conjunctivitis, keratitis) or inflammation at the time of screening or surgery.[10] Patients with a history of previous ocular surgeries (excluding cataract surgery) in the study eye, such as refractive surgery (LASIK, PRK) or corneal transplants.[2] Patients with a known allergy or contraindication to warm compress therapy or its components.[4] Pregnant or breastfeeding women, as the safety of WCT in these populations has not been established.[14]

Participants in Group A received warm compress therapy after cataract surgery. Targeted eyelid temperature was 40° Celsius. A single application of warm compression applied for 5 to 10 minutes once in week for 6 weeks to improve tear quality. Hot towels require frequent reheating to maintain eyelid temperatures above 40° Celsius.[4] Participants in Group B received standard care or a placebo treatment (conventional dry eye

management methods, such as artificial tears or no additional treatment).[15] Data was analysed using SPSS version 23. The normality of the data was assessed using the Shapiro-Wilk test. As per the distribution of the data, independent and paired sample t-tests were used to analyse the parametric difference between and within each group, respectively. Data was analysed using these t-tests to assess improvement in tear film stability and symptom reduction. The p-value ≤0.05 was considered statistically significant.

RESULTS

The total number of participants is 54, there are 29(53.7%) females, 25(46.3%) males, with 27 subjects in each group. Almost 21 participants were with the right eye affected and 33 were left eye. About 29 females and 25 males participated with a mean age of (59.48±6.9), a mean weight of (87.15±15.3), a mean height of (5.1±0.59) and a mean value of body mass index (BMI) was 38.43±9.98. Mean score of standardised patient evaluation of eye dryness (SPEED) of the WCT group before the treatment was 20.37±3.85, and after the treatment was 2.37±1.36. The mean difference of Speed is 18. Table 1 shows that the SPEED mean score of the control group before treatment was 17.41±2.4, and after the treatment was 5.38±1.5. While the mean difference was 12.03 ($p<0.05$), which shows there is a significant difference between the WCT group and the control group, the WCT group shows greater improvement in dry eye symptoms and tear film quality.

Mean score of OSDI of WCT group before and after the intervention was 75.48±9.09, and 18.07±4.45; while the mean difference was 57.77. As shown in Table 1, the mean OSDI score for the control group decreased from 54.11 ± 11.3 before treatment to 31.41 ± 6.2 after treatment, with a mean difference of 22.7. The p-value of less than 0.05 indicates a statistically significant improvement. However, the WCT group exhibited a more substantial improvement in both dry eye symptoms and tear film quality compared to the control group.

DISCUSSION

This trial aimed to compare the effectiveness of warm compress therapy with standard eye care in improving tear film quality and alleviating postoperative dry eye symptoms following cataract surgery. To evaluate outcomes, the SPEED and OSDI questionnaires were utilised. WCT and standard eye care were applied. This study focused on two types of interventions used to improve dry eyes and tears. film quality. The results of the current study suggested that WCT showed improvement after the treatment, more than

Table 1: Within and between-group differences

	Mean	Mean Difference		Std. Deviation	p-value
Pre-SPEED	18.89	15.01		3.52	0.000
Post-SPEED	3.87			2.09	
Pre-OSDI	64.80	40.05		14.84	0.000
Post-OSDI	24.74			8.62	
	Groups	**Mean Difference**	**Mean**	**Std. Deviation**	**p-value**
Pre-SPEED	A	2.96	20.37	3.85	0.001
	B		17.41	2.43	
Post-SPEED	A	-3.00	2.37	1.36	0.000
	B		5.38	1.53	
Pre-OSDI	A	21.37	75.48	9.09	0.000
	B		54.11	11.38	
Post-OSDI	A	-13.33	18.07	4.45	0.000
	B		31.41	6.29	

standard eye care. In WCT, the mean SPEED at day one was group before the treatment was 20.37±3.85, and after the treatment was 2.37±1.36, mean difference of SPEED is 18.0. The mean score of SPEED of the control group before treatment was 17.41±2.4, after the treatment was 5.38±1.5, while the mean difference was 12.03.

The mean score of OSDI of the WCT group before the treatment was 75.48±9.09, and after the treatment was 18.07±4.45. The mean difference was 57.77, and the mean score of OSDI of the control group before the treatment was 54.11±11.3 and after the treatment was 31.41±6.2. The mean difference in OSDI was 22.7, with a p-value of less than 0.05, indicating a statistically significant difference between the WCT group and the control group. Notably, the WCT group demonstrated a greater improvement in dry eye symptoms and tear film quality compared to the control group.

These findings are similar to a study by Da Hu Wang et al., which evaluated the efficacy and safety of disposable eyelid warming masks for treating DED caused by Meibomian gland dysfunction. That study concluded that the masks were both effective and safe, suggesting they may serve as a promising treatment option for patients with this condition.[16] Another study conducted by Yang et al. in 2024 explored the impact of dry eye on the reproducibility of keratometry (K) measurements in cataract surgery candidates.

Yang et al.'s study further reinforces the idea that effective management of DED before cataract surgery can enhance the precision of keratometry and reduce refractive errors.[17] Another study conducted by Wen et al. in 2020 conducted a meta-analysis to evaluate the clinical efficacy of sodium hyaluronate combined with conventional eye drops for treating dry eye after cataract surgery. However, the authors called for further high-quality studies to confirm the long-term safety and efficacy of sodium hyaluronate in this context.[18]

A 2019 study by Yu Fei Gao et al. compared the anti-inflammatory effects of intense pulsed light therapy with a combination of tobramycin/dexamethasone and warm compress treatment in patients with DED associated with Meibomian gland dysfunction. The study found that IPL therapy was more effective in improving tear breakup time and Meibomian gland expressibility, as well as in reducing levels of inflammatory markers IL-17A and IL-1β in the tears, over a one-month treatment period.[19]

CONCLUSION

Warm compress therapy shows significant variations in enhancing tear film quality and reducing postoperative dry eye syndrome after cataract surgery versus standard eye care. Both interventions were effective in improving patient outcomes, but the warm compress therapy group showed greater improvement in dry eye symptoms and tear film quality.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.
Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.
Competing interests: None
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CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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