RESEARCH ARTICLE

# COMPARISON OF TEAR FILM DYSFUNCTION AFTER PHACOEMULSIFICATION BETWEEN DIABETICS AND NON-DIABETICS

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***ABSTRACT***

***Objectives:*** *To compare early postoperative tear film break-up time (TBUT) after phacoemulsification between diabetic and non-diabetic cataract patients.*

***Study design:*** *Quasi-experimental (comparative) study.*

***Place and duration of study:*** *Ophthalmology Department, Fauji Foundation Hospital, Rawalpindi, Pakistan; July 2024 – September 2024.*

***Patients and methods:*** *Sixty-six patients scheduled for phacoemulsification with intraocular lens implantation were enrolled by consecutive non-probability sampling: 33 long-standing diabetics (> 5 years) and 33 non-diabetics. Exclusion criteria included prior ocular surface disease, significant meibomian gland dysfunction, prior ocular surgery, topical ocular medication use, or complicated surgery. All surgeries used a 2.8 mm temporal clear corneal incision under topical anesthesia. TBUT was measured at slit lamp using fluorescein one day preoperatively and one day postoperatively. TBUT <10 s was considered abnormal. Statistical analysis employed paired-samples t-tests for within-group comparisons and independent-samples t-tests for between-group comparisons (SPSS v23); p<0.05 was considered significant.*

***Results:*** *Mean preoperative TBUT did not differ between groups (diabetics 12.70±3.72 seconds; non-diabetics 12.79±3.65 seconds; p=0.92). Postoperatively, TBUT decreased in both groups, with a significantly greater reduction in diabetics (7.36±2.16 seconds) than non-diabetics (10.42±3.56 seconds) (p<0.01).*

***Conclusion:*** *Diabetic patients experienced a significantly larger early postoperative decline in TBUT following phacoemulsification compared with non-diabetics. Consideration should be given to prophylactic or early postoperative lubricants for diabetic patients to mitigate dry-eye symptoms.*

***Keywords:*** *Tear film break-up time, diabetic, dry eye, phacoemulsification*

## INTRODUCTION

The tear film is an important part of the ocular anatomy. Not only does it serve as a source of nutrition and oxygen but also acts as a lubricant to the ocular surface, preventing it from drying and allowing the palpebral conjunctiva to easily slide over the cornea without causing any abrasive damage. Tears are vital for maintaining comfort, safeguarding against infections, controlling inflammation, facilitating the healing of trauma or surgery-related injuries, removing debris, and sustaining clear vision.[1] Problems arise, however, when there is inadequate tear production or excessive tear evaporation which may lead to dry eye symptoms manifested as dryness, discomfort, pain, a gritty sensation, blurry vision, redness, foreign-body sensation, and visual disturbances. These symptoms can greatly interfere with daily activities like reading, driving, and using screens or visual display devices.[2] Given the prevalence of dry eye syndrome, estimated at around 18.7% in Pakistan[3] and approximately 11.59% globally[4], this represents a significant issue that warrants careful attention and effective management.

Several factors can contribute to the onset of this condition. Cataract surgery is one such factor in which the clear corneal incision (CCI) made during the procedure compromises the integrity of the ocular surface, potentially leading to tear film dysfunction. Additionally, the prolonged use of preservative-

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containing topical medications after surgery can contribute to the development of dry eye symptoms. A large-scale systematic review concluded that 37.4% of patients with no dry eye disease developed it after cataract surgery.[5]

Another known risk factor for dry eye syndrome is diabetes. Persistent hyperglycemia leads to disrupted tear film dynamics and osmolarity, triggers the inflammatory cascade, and activate the innate immune response, which subsequently causes oxidative stress.[6] The prevalence of type 2 diabetes in Pakistan was estimated to be around 10% in a recent systematic review[7] which predisposes a large population to dry eye syndrome. Globally, approximately 541 million adults report having impaired glucose tolerance, a significant risk factor for developing type 2 diabetes.[8] The occurrence of dry eye has also been linked to glycated hemoglobin levels, with higher glycated hemoglobin levels being associated with a greater incidence of dry eye.[9] Many diabetic patients report symptoms such as a foreign body sensation and burning, which indicate possible tear film abnormalities.

Although dry eye is common after cataract surgery and diabetic patients are known to have tear film abnormalities, limited research has examined the combined impact of diabetes and phacoemulsification on early postoperative tear film stability. Understanding this relationship is important for guiding postoperative care and preventing ocular surface complications. This study was designed to compare early postoperative TBUT changes as an indicator of tear film dysfunction between diabetic and non-diabetic patients undergoing phacoemulsification with intraocular lens implantation..

## PATIENTS AND METHODS

A quasi-experimental study involving 66 patients comprising 33 diabetics and 33 non-diabetics was conducted at Fauji Foundation Hospital Rawalpindi Pakistan from July 2024 to September 2024 following ethical approval (vide letter no. No. 852/RC/FFH/RWP dated: 20/06/2024). Patients who were scheduled to undergo cataract surgery were selected from the ophthalmology outpatient department via non-probability consecutive sampling. Patients who were known diabetics for at least 5 years and taking medication for it were included in the diabetic group and their blood glucose levels were monitored throughout the study. The study protocol, patient information sheet, and consent form were approved by the Institutional Ethics Committee. Informed consent was secured from all participants.

The exclusion criteria comprised a history of conjunctival or corneal disorders, significant meibomian gland dysfunction (MGD), prior eye surgeries, and any systemic conditions that might influence tear production. Furthermore, any patients who had a complicated surgery as well as patients already using any topical eye medications were also excluded.

All participants underwent phacoemulsification under topical anaesthesia using 0.5% proparacaine. A foldable intraocular lens was placed in the capsular bag via a 2.8 mm temporal clear corneal incision. Postoperatively, patients were prescribed moxifloxacin 0.5% and prednisolone acetate 1% every two hours for the first week. Oral mefenamic acid tablets were provided as needed for pain relief. Patients were assessed both preoperatively and on the first postoperative day, with evaluation including slit-lamp examination, corneal fluorescein staining, tear film assessment, and measurement of TBUT.

For the TBUT test, the patient was seated at the slit lamp. While the patient gazed upward, the lower eyelid was carefully retracted, and a moistened fluorescein strip was placed in the inferior fornix. The patient was asked to blink three times and then look straight ahead. The cornea was subsequently examined at low magnification with a cobalt blue filter on the slit-lamp microscope. The duration between the final blink and the emergence of the first dry spot on the cornea was noted. A TBUT of less than 10 seconds was deemed abnormal.

A paired samples t-test was conducted to assess the statistical significance of the difference in TBUT between the preoperative and postoperative measurements in both groups while independent samples t-test determined inter-group statistical significance of preoperative and postoperative TBUT. p-value was kept significant at $<0.05$. All data analyses were conducted using SPSS for Windows version 23.

## RESULTS

A total of 33 diabetic and 33 non-diabetic patients participated in the study. Sixty-two of these were females while the remaining 4 were male. The ages of all subjects ranged from 44 to 79 with a mean of $62.86 \pm 6.9$. Among males the mean age was $68 \pm 10.42$ while among females it was $62.53 \pm 6.62$. Both groups showed a decrease in mean pre-op TBUT: diabetic patients had a mean pre-op TBUT of 12.70s $\pm 3.72$ while the non-

diabetic patients' mean pre-op TBUT was 12.79s ±3.65. The p-value was 0.92. Mean post-op TBUT among diabetics was 7.36s ±2.16 while in non-diabetics the mean post-op TBUT was 10.42s ±3.56. The p-value was <0.01 indicating a significant difference in both groups.

**Table 1: Comparison of Tear Film Break-Up Time (TBUT) in Diabetic and Non-Diabetic Patients Undergoing Phacoemulsification**

| Parameter | Non-diabetic n=33 | Diabetic n=33 | *p*-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| Pre-op TBUT (seconds) | 12.79 ±3.65 | 12.70 ±3.72 | 0.92 |
| Post-op TBUT (seconds) | 10.42 ±3.56 | 7.36 ±2.16 | <0.01 |

## DISCUSSION

Multiple factors play a role in the development of dry eye after surgery. It is known that cataract surgery can lead to disruption of tear film due to a number of reasons as were described in a review article. These include corneal nerve severing, prolonged exposure to microscope lighting, the use of a speculum, and the heat produced by phacoemulsification devices.[10] The irritated ocular surface often accumulates chemical mediators, such as free radicals, cyclooxygenase and proteolytic enzymes due to inflammation. Moreover, the loss of goblet cells and dysfunction of the meibomian glands following cataract surgery can also lead to evaporative dry eye syndrome. Diabetes is also a known contributor to dry eye symptoms. It leads to epithelial barrier dysfunction, which in turn results in corneal complications and eventual lacrimal functional unit impairment.[11] The impaired epithelial barrier function has also been correlated with increased serum HbA1c levels.[11] Numerous corneal complications result from diabetes mellitus including epithelial defects and corneal ulcers which also cause DES.[12] Diabetic patients with peripheral neuropathy have been found to exhibit impaired corneal neurons and decreased corneal sensitivity.[13] Patients with diabetes have also been found to experience chronic tear secretion deficiency and tear film dysfunction.[14]

Both these factors have been extensively investigated in research however their combined effects have not been given the same regard. Increased incidence of dry eye symptoms in early postoperative period can be very harmful especially if it leads to constant eye rubbing by the patient, possibly resulting in wound leakage, iris prolapse and, in some cases, postoperative endophthalmitis. Therefore, for the prognosis of good vision any untoward symptoms need to be dealt with promptly. So far there have not been any general guidelines that cater to the needs of diabetic patients that may be predisposed to dry eye symptoms. If these symptoms can be forecasted then the harm, they may bring about in early postoperative period can be mitigated if appropriately managed.

There have been extensive studies that compare the tear film dysfunction of diabetics with non-diabetics using many parameters including TBUT, tear film height, Schirmer test and corneal staining. Literature however is deficient in describing the use of these parameters in figuring out the superadded effect of surgical interventions such as phacoemulsification and evaluating the compounded effect that it may result in.

It was reported in a study with 83 participants using various examination techniques that among diabetics Schirmer test and TBUT were reduced and higher grades of keratoepitheliopathy score and rose bengal staining were present as compared to non-diabetics while conjunctival impression cytology showed goblet cell loss and conjunctival squamous metaplasia among diabetics as compared to non-diabetics.[15] One study investigated the difference in tear film osmolar concentration as well as other tear film parameters in 51 diabetic patients and 20 non-diabetics to reveal a significantly increased tear film osmolarity among patients with increased HbA1c (>8%) and in patients with a longer duration of DM.[16] However, they also noted insignificantly lower Schirmer and TBUT scores among diabetics. Additionally, the outcomes of these tests were unaffected by the patients' glycemic control status. We noted a minor decrease in TBUT in diabetics with some variation in values.

Postoperative thickness of the lipid layer of the tear film is reported to correlate with duration of diabetes leading to significant thinning one month after surgery, resulting in subsequent dry eye symptoms.[17] According to a study the incidence of dry eye following phacoemulsification was 9.8% which was significant.[18] Another study found no significant association between factors like age, gender, place of residence, occupation, BMI, or the type of surgery (whether SICS or phacoemulsification) and the occurrence of dry eye at both 7 days and 1 month postoperatively but in the phacoemulsification group,

an exposure time exceeding 15 minutes was notably linked to a higher risk of dry eye at the first follow-up.[19] Our findings strongly suggest that there is a clear difference in reduction of TBUT of diabetics as compared to non-diabetics in early postoperative period. Since our results suggest that incidence of dry eye symptoms in the early post-operative period is quite high, we suggest including a topical lubricant while prescribing postoperative medication to diabetics. Postoperative use of diquafosol 3% was found to be superior to hyaluronic acid [20] and could be considered as an alternative to conventional topical lubricants for better outcome.

There were a number of limitations of our study. Since we only scrutinised the early postoperative period in all patients our study did not spread much light on the long-term outcome of dry eye symptoms of diabetics undergoing cataract surgery which we feel is important. The sample size, though adequate, could be enlarged for a better representation of the population. Other factors that may involve or affect tear film dysfunction should ideally also be factored in when investigating the tear film. Utilizing other parameters such as lipid layer thickness, in evaluating tear film dysfunction may also be of benefit.

## CONCLUSION

Diabetic patients demonstrated a significantly greater postoperative reduction in TBUT compared with non-diabetics. Incorporating prophylactic or early postoperative topical lubricants such as dextran, hypromellose, or polyacrylic acid may help mitigate early dry-eye changes in diabetic individuals. Further studies assessing long-term postoperative outcomes in diabetics, including effects on TBUT, tear film osmolarity, and dry-eye symptom development, are warranted.

## CONFLICT OF INTEREST

All authors state that they have no conflicts of interest.

## ETHICAL STATEMENT

All subjects gave their informed consent for inclusion before they participated in the study. All procedures performed in this study involving human participants were conducted ethically according to the ethical standards of the Ethical Review Board of Fauji Foundation Hospital after awarding of the certificate of ethical approval (Ref No. 852/RC/FFH/RWP).

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**Authors' Contributions:**

Wali Waqar Qureshi: Conception of study/Designing/ Planning, Experimentation/Study Conduction, Analysis/Interpretation/Discussion, Manuscript Writing, Critical Review, Facilitated for Reagents/Material Analysis

Maham Fazal: Experimentation/Study Conduction, Analysis/Interpretation/Discussion, Manuscript Writing

Tehmina Nazir: Manuscript Writing, Critical Review

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