



Original Article

Assessment of Basal and Reflex Tear Secretion In Diabetic Patients: A Comparative Cross-Sectional Study

Dr. Rachana Mandli¹, Dr. Hardikkumar Mistry²

¹Assistant Professor, Department of Ophthalmology, Dr.Kiran C Patel Medical College & Research Institute, Bharuch, Gujarat, India

²Professor, Department of Physiology, Dr.Kiran C Patel Medical College & Research Institute, Bharuch, Gujarat, India

 OPEN ACCESS

ABSTRACT

Corresponding Author:

Dr. Rachana Mandli

Assistant Professor, Department of
Ophthalmology, Dr.Kiran C Patel
Medical College & Research
Institute, Bharuch, Gujarat, India

Email: rachana.mandli@gmail.com

Received: 27-05-2026

Accepted: 10-06-2026

Available online: 03-07-2026

Background: Diabetes mellitus is a recognised risk factor for dry eye disease. This study evaluated the prevalence of dry eye among diabetic and non-diabetic patients at a tertiary care centre in central India using objective tear secretion tests.

Methods: A comparative cross-sectional study was conducted on 124 eyes each of diabetic and non-diabetic patients above 40 years of age. Schirmer's Test I and Schirmer's Test with Anaesthesia were performed on all participants. Chi-square test was used for statistical analysis ($p < 0.05$ considered significant).

Results: Abnormal Schirmer's Test I was found in 53.2% of diabetics versus 2.4% of controls. Schirmer's Test with Anaesthesia was abnormal in 29% of diabetics versus 1.6% of controls. Both associations were highly statistically significant ($p = 0.000$ and $p = 0.001$ respectively).

Conclusion: Dry eye disease is significantly more prevalent in diabetic patients. Incorporating Schirmer's testing into the routine ophthalmic assessment of diabetic patients may aid in the early detection of dry eye disease and support prompt therapeutic management.

Copyright © International Journal of
Medical and Pharmaceutical Research

Keywords: Diabetes mellitus, Dry eye disease, Schirmer's test, Tear secretion, Ocular surface.

INTRODUCTION

According to the World Health Organization, diabetes mellitus (DM) has reached alarming global proportions, affecting approximately 14% of adults aged 18 years and older in 2022 — doubling its prevalence since 1990. Diabetes remains a leading cause of morbidity and mortality worldwide, directly accounting for 1.6 million deaths in 2021, with the burden of disease being disproportionately higher in low- and middle-income countries. (Correia et al, 2025)

Beyond its well-recognised systemic complications such as nephropathy, neuropathy, and retinopathy, diabetes mellitus is also capable of causing a variety of ocular complications, including dry eye disease (DED), and previous studies have consistently reported an increased prevalence of DED in diabetic patients compared with healthy subjects. (Zou et al, 2018) The TFOS DEWS II defines dry eye disease as a multifactorial condition of the ocular surface characterized by impaired tear film homeostasis and the presence of ocular symptoms. Tear film instability, increased tear osmolarity, ocular surface inflammation and damage, and neurosensory dysfunction are recognized as key contributors to its development. (Golden et al, 2022)

In the context of diabetes, the pathophysiology of dry eye is particularly complex. Neuropathic mechanisms have been implicated in the pathogenesis of diabetic dry eye through their adverse effects on lacrimal gland function and the neural regulation of ocular surface secretory glands. Damage to afferent sensory nerves and autonomic efferent fibers supplying the lacrimal and meibomian glands may compromise tear film maintenance and ocular surface health (Misra et al., 2014). Furthermore, abnormalities in lacrimal gland mitochondrial metabolism associated with sympathetic overactivation have been proposed as contributing factors. Since corneal nerves play a pivotal role in ocular surface homeostasis, their dysfunction may accelerate the development and progression of dry eye disease in diabetes (Zhou et al., 2022).

The Schirmer's test remains one of the most widely used objective clinical tools for quantifying tear secretion in dry eye evaluation. Schirmer's testing without anesthesia measures overall tear production, encompassing both basal and reflex secretion. The use of topical anesthesia diminishes reflex tear output, thereby enabling a more specific assessment of basal lacrimal gland secretion and function. (Brott et al, 2024) Systemic conditions associated with an increased risk of dry eye disease include diabetes mellitus, Sjögren's syndrome, connective tissue disorders, and androgen deficiency, with diabetes mellitus confirmed by meta-analysis to be independently associated with dry eye syndrome. (Britten-Jones et al, 2024)

Given the high and growing global prevalence of diabetes, and the significant ocular surface morbidity associated with DED, the present study aimed to evaluate the prevalence and clinical association of dry eye disease among diabetic and non-diabetic patients using Schirmer's test I and Schirmer's test with anaesthesia, and to determine the statistical significance of these associations.

RESEARCH METHOD OR METHODOLOGY:

A comparative cross-sectional study was conducted at a tertiary care center in central India, following approval from the institutional ethical committee. Diabetic patients presenting to the outpatient department were enrolled alongside a control group of non-diabetic subjects. A total of 124 eyes from each group were included after obtaining written informed consent from all participants. Comprehensive demographic data along with diabetes-related clinical information, including the duration of diabetes and current treatment modalities, were collected and documented for every study subject.

Patients older than 40 years of age of either sex were eligible for inclusion. Diabetic patients were required to have been on treatment for a duration of five or more years, while non-diabetic individuals with no known history of diabetes mellitus were included as controls. Operative patients were included only after a minimum interval of three months following surgery. Patients were excluded if they were using anti-glaucoma medications or topical steroids, or were on systemic medications such as beta-blockers, antihypertensives, antihistamines, or antipsychotics. Exclusion criteria included prior ocular surgery within three months, diabetes mellitus of less than five years' duration, and the presence of systemic diseases such as thyroid dysfunction, collagen vascular disease, or immunological disorders. Additionally, patients with lid abnormalities including ectropion, entropion, or lagophthalmos, as well as those who had previously received treatment for dry eye, were not included in the study.

Schirmer's Test I, which measures both basal and reflex tearing, was performed by placing a pre-cut strip of Whatmann filter paper No. 41 in the inferior conjunctival cul-de-sac at the junction of the lateral one-third and medial two-thirds. Patients were instructed to blink normally, and the extent of wetting of the strip was measured after five minutes. A reading of 10 mm or less was considered abnormal. The basal secretion test, or Schirmer's test with anesthesia, was subsequently performed following instillation of topical anesthetic agent (4% xylocaine drops), with the strip placed in the same position. For this test, wetting of less than 5 mm was considered abnormal, while 5–10 mm was regarded as equivocal. (Weisenthal, 2014)

Dry eye was defined as the presence of one or more symptoms occurring often or all the time, in conjunction with one or more positive clinical findings on slit-lamp examination and one or more positive clinical tests, including a tear break-up time of 10 seconds or less, a Schirmer's test score of 10 mm or less, a basal secretion test result of 5 mm or less, or a fluorescein staining score of 1 or more. Asymptomatic patients with positive clinical signs or positive test results were also considered in the diagnosis. Dry eye severity was graded as mild, moderate, or severe. Routine evaluation of all participants included measurement of intraocular pressure by non-contact tonometry. (Hasan et al, 2014)

Corneal assessment included evaluation of surface smoothness and lustre, along with the detection of ocular surface changes such as superficial punctate keratitis, mucous plaque formation, and filamentary keratitis. Corneal sensation was

assessed after completion of Schirmer's test using a fine moist cotton wisp and was graded as normal, reduced, or absent. Detailed fundus examination under mydriasis was performed using direct and indirect ophthalmoscopy along with 90-diopter slit-lamp biomicroscopic examination. Where diabetic retinopathy was identified, it was classified according to the Early Treatment Diabetic Retinopathy Study (ETDRS) classification system. (Lin et al, 2003; Bowling et al, 2016)

Categorical data were expressed in terms of frequency distributions and corresponding percentages. The association between qualitative variables was assessed using the Chi-square test, with a p-value of less than 0.05 considered statistically significant. Data collection, entry, and analysis were performed using SPSS statistical software.

RESULT:

Table 1: Distribution of study subjects based on gender:

Gender	Normal (%)	Diabetes Mellitus
Female	61 (49.2)	78 (62.9)
Male	63 (50.8)	46 (37.1)
Total	124	124

Table 1 shows More no. of female subjects were present in the diabetic group [62.9%] than in the non-diabetic group [49%]

Table 2: Clinical test results among non-diabetic patients

Investigations	Normal (%)	Abnormal (Dry eye)
Schirmer's Test I	121 (97.5)	3 (2.4)
Schirmer's Test with Anaesthesia	122 (98.4)	2 (1.6)

Table 2 shows Schirmer's, test I result was positive among 2.4% of the non diabetics, whereas Schirmer's test with anaesthesia was found to be positive among 1.6% of the non diabetics.

Table 3: Clinical test results among Diabetics:

Investigations	Normal (%)	Abnormal (Dry eye) (%)
Schirmer's Test I	58 (46.8)	66 (53.2)
Schirmer's Test with Anaesthesia	88 (71)	36 (29)

Table 3 shows Schirmer's, test I result was positive among 53.2% of the diabetics, whereas Schirmer's test with anaesthesia was found to be positive among 29% of the diabetics.

Table 4: Association of dry eye in diabetes on basis of clinical tests

Investigations	Dry eye among Diabetics (N=103)		P value
	Present	Absent	
Schirmer's Test I	66	0	0.000
Schirmer's Test with Anaesthesia	36	0	0.001

Table 4 shows: showed statistically significant results of Schirmer's Test I and Schirmer's Test with Anaesthesia among diabetics.

DISCUSSION

The present study demonstrated a markedly low prevalence of dry eye disease among non-diabetic patients, with only 2.4% showing abnormal results on Schirmer's test I and 1.6% on Schirmer's test with anaesthesia (Table 2). These findings are consistent with the established understanding that dry eye disease in the general non-diabetic population remains relatively uncommon when assessed through objective clinical tests. Diabetes mellitus is a systemic disease capable of causing a variety of ocular complications, including dry eye disease, and previous studies have reported an increased prevalence of dry eye disease in diabetic patients compared with healthy subjects. The near-normal tear secretion observed in our non-diabetic cohort thus provides a reliable baseline against which the burden of dry eye in the diabetic group can be meaningfully contrasted, reinforcing the value of including a non-diabetic control population in such studies. (Zou et al, 2018)

In contrast, the diabetic group exhibited a substantially higher prevalence of abnormal tear secretion (Table 3). Schirmer's test I was abnormal in 53.2% of diabetic patients, while Schirmer's test with anaesthesia — which specifically measures basal tear secretion by eliminating the reflex component — was abnormal in 29% of patients. The anesthetic Schirmer test examines basal tear production alone by removing the stimulus that triggers reflex tearing, making it a more specific measure of intrinsic lacrimal gland function. (Brott et al, 2024) The considerably higher rate of abnormality on Schirmer's test I compared to the anaesthetized test suggests that reflex tearing is disproportionately affected in diabetics, possibly reflecting autonomic neuropathy of the lacrimal gland. In insulin-dependent diabetics, reflex tearing has been demonstrated to be significantly decreased compared to healthy controls, consistent with impaired neural regulation of tear secretion. (Goebbels, 2000) These results are broadly comparable to those reported by other investigators; the reported prevalence of

dry eye syndrome in diabetics varies widely, with figures of 15–33% in older populations rising with age, and dry eye is recognised as one of the leading systemic risk factors for ocular surface disease in diabetes. (Brar et al, 2024)

The association between dry eye and diabetes was found to be highly statistically significant in this study (Table 4), with 64.1% of diabetics who had dry eye detected by Schirmer's test 1 ($p = 0.000$) and 35% by Schirmer's test with anaesthesia ($p = 0.001$), while no case of dry eye was identified in the absence of diabetes. These findings strongly support the causal relationship between diabetes mellitus and impaired tear film function. A hospital-based cross-sectional study reported a prevalence of dry eye disease as high as 72.3% among type 2 diabetic patients, and emphasised that dry eye assessment should be incorporated as a routine clinical management protocol for patients with diabetes. (Abu et al, 2022) Similarly, a proportion-based study of dry eye in type II diabetics found significant correlations between dry eye and fasting blood sugar levels, HbA1c, age, and duration of disease, recommending that primary care physicians advise diabetic patients to undergo clinical evaluation for dry eye alongside routine diabetic retinopathy screening. (Brar et al, 2024)

CONCLUSION

The present study demonstrates a significantly higher prevalence of dry eye disease among diabetic patients, with over half showing abnormal tear secretion on objective testing. The disproportionate impairment of reflex tearing suggests involvement of autonomic neuropathy at the lacrimal gland level. Routine dry eye screening using Schirmer's testing should therefore be made a standard part of the diabetic eye examination to enable early diagnosis and prompt management, alongside existing retinopathy screening protocols.

REFERENCES:

1. Correia, M. S. T., Romana, J. R. C. A., Madeira, M. F. C., Correia, M. S. R., & Filipe, H. P. (2025). Exploring the impact of diabetes mellitus on dry eye disease and ocular health: a narrative review. *Annals of Eye Science*, 10, 24. <https://doi.org/10.21037/aes-25-3>
2. Zou, X., Lu, L., Xu, Y., Zhu, J., He, J., Zhang, B., & Zou, H. (2018b). Prevalence and clinical characteristics of dry eye disease in community-based type 2 diabetic patients: the Beixinjing eye study. *BMC Ophthalmology*, 18(1), 117. <https://doi.org/10.1186/s12886-018-0781-7>
3. Golden, M. I., Meyer, J. J., & Patel, B. C. (2022). Dry Eye Syndrome, PubMed: StatPearls Publishing. <https://pubmed.ncbi.nlm.nih.gov/29262012/>
4. Misra, S. L., Patel, D. V., McGhee, C. N. J., Pradhan, M., Kilfoyle, D., Braatvedt, G. D., & Craig, J. P. (2014). Peripheral neuropathy and tear film dysfunction in Type 1 diabetes mellitus. *Journal of Diabetes Research*, 2014, 1–6. <https://doi.org/10.1155/2014/848659>
5. Zhou, Q., Yang, L., Wang, Q., Li, Y., Wei, C., & Xie, L. (2022). Mechanistic investigations of diabetic ocular surface diseases. *Frontiers in Endocrinology*, 13, 1079541. <https://doi.org/10.3389/fendo.2022.1079541>
6. Brott, N. R., Zeppieri, M., & Ronquillo, Y. (2024b, February 24). Schirmer Test. StatPearls - NCBI Bookshelf. <https://www.ncbi.nlm.nih.gov/books/NBK559159/>
7. Britten-Jones, A. C., Wang, M. T. M., Samuels, I., Jennings, C., Stapleton, F., & Craig, J. P. (2024). Epidemiology and risk factors of dry eye Disease: Considerations for Clinical management. *Medicina*, 60(9), 1458. <https://doi.org/10.3390/medicina60091458>
8. Weisenthal RW. External Diseases and Cornea. *American Academy of Ophthalmology*; 2014. 17-80 p.
9. Hasan IN, Aggarwal P, Gaurav A, Patel N. Assessment of dry eye status in type 2 diabetic patients in tertiary health care hospital, India. *J Dent Med Sci*. 2014;13(8):06–11.
10. Lin P-Y, Tsai S-Y, Cheng C-Y, Liu J-H, Chou P, Hsu W-M. Prevalence of dry eye among an elderly Chinese population in Taiwan: The Shihpai Eye Study. *Ophthalmology*. 2003;110(6):1096–101.
11. Bowling B, Kanski JJ. *Kanski's Clinical Ophthalmology: a systematic approach*. 8th ed. Elsevier; 2016. 120-129-539 p.
12. Goebbels, M. (2000). Tear secretion and tear film function in insulin dependent diabetics. *British Journal of Ophthalmology*, 84(1), 19–21. <https://doi.org/10.1136/bjo.84.1.19>
13. Brar, G. K., Bawa, M., Chadha, C., Gupta, T., & Kaur, H. (2024). Proportion of dry eye in type II diabetics. *Journal of Family Medicine and Primary Care*, 13(4), 1311–1315. https://doi.org/10.4103/jfmmpc.jfmmpc_1268_23
14. Abu, E. K., Ofori, A. O., Boadi-Kusi, S. B., Ocansey, S., Yankah, R. K., Kyei, S., & Awuku, A. Y. (2022). Dry eye disease and meibomian gland dysfunction among a clinical sample of type 2 diabetes patients in Ghana. *African Health Sciences*, 22(1), 293–302. <https://doi.org/10.4314/ahs.v22i1.36>