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Prevalence and clinical assessment of dry eye among diabetic patients

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Abstract:
Dry eye disease (DED) is a common ocular complication of Type II diabetes mellitus (T2DM), associated with tear film instability and ocular surface damage. This cross-sectional observational study evaluated 110 patients with T2DM using symptom assessment, Schirmer's test, Tear Break-Up Time (TBUT), fluorescein staining and Rose Bengal staining, with findings correlated with HbA1c levels and diabetes duration. DED was diagnosed in 48 (43.6%) patients, with burning, redness and watering being the most frequent symptoms. Abnormal Schirmer's test and TBUT were observed in 44.5% and 40.0% of patients, respectively. DED severity was significantly associated with longer diabetes duration (χ^2 = 28.642, p = 0.001) and poorer glycemic control, as reflected by higher HbA1c levels (χ^2 = 41.378, p = 0.001). Thus, data shows a high prevalence of DED among patients with T2DM and highlight the importance of routine ocular surface assessment and optimal glycemic control for early detection and prevention of vision-threatening complications.

Keywords: Dry eye disease (DED), type II diabetes mellitus (T2DM), glycemic control, ocular surface disorders

Background:
Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from insulin resistance and impaired insulin secretion **[1]**. The increasing global burden of T2DM has led to a rise in its systemic complications, including several ocular disorders such as diabetic retinopathy, cataract, glaucoma, corneal abnormalities and dry eye disease (DED), which significantly affect visual function and quality of life **[2].** Dry eye disease is a multifactorial disorder of the ocular surface characterized by tear film instability, inflammation and neurosensory abnormalities, causing symptoms including ocular irritation, burning, foreign body sensation, and redness and fluctuating vision **[3].** Diabetes is a recognized risk factor for DED because chronic hyperglycemia impairs lacrimal gland function, reduces corneal sensitivity, induces oxidative stress and disrupts tear film homeostasis, resulting in ocular surface damage **[4].** Several studies have reported a higher prevalence of dry eye among patients with diabetes compared with healthy individuals. Both longer duration of diabetes and poor glycemic control have been associated with reduced tear secretion, shorter tear breakup time and increased severity of dry eye, suggesting that cumulative hyperglycemic damage contributes to progressive ocular surface dysfunction **[5, 6].** As diabetic corneal neuropathy may reduce ocular symptoms despite significant disease, routine screening using clinical tests such as Schirmer's test, tear breakup time and ocular surface staining is essential for early diagnosis and management **[7–10].** Therefore, it is of interest to evaluate the prevalence of dry eye disease among patients with Type 2 diabetes mellitus and to describe its association with diabetes duration and glycemic control.

Materials and Methods:
This study was carried out in a hospital setting, focusing on patients diagnosed with Type II Diabetes Mellitus who were visiting the Ophthalmology and Medicine outpatient departments during the designated timeframe. A total of 110 individuals participated in the study. Those with a confirmed diagnosis of Type II Diabetes Mellitus who expressed a willingness to participate were enrolled following the acquisition of written informed consent. Individuals who had undergone eye surgery in the last six months, were experiencing an active eye infection, had autoimmune conditions, used contact lenses, had significant eyelid issues, or had any condition recognized to independently lead to dry eye were not included in the study. Following the acquisition of informed consent, demographic information such as age and gender was documented. Information about the length of diabetes, treatment background and recent blood sugar levels was gathered from medical records and discussions with patients. Glycemic control was evaluated by examining the latest glycated hemoglobin (HbA1c) value documented in the patient's records. All participants received a thorough eye examination. Assessment of dry eye was conducted utilizing standard clinical evaluation techniques, which included symptom evaluation, the TBUT. The Schirmer I test was performed without the use of topical anesthesia by positioning standardized filter paper strips in the lower fornix of both eyes and assessing the degree of wetting after duration of five minutes. Tear Break-Up Time was assessed

after the application of fluorescein dye, noting the duration from the final blink to the emergence of the initial dry area on the corneal surface. Individuals meeting the diagnostic criteria for a specific ocular condition based on clinical observations were classified as experiencing that condition.

Statistical analysis:
The data were analyzed with SPSS 26.0. Continuous variables were reported as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. A p-value below 0.05 was considered significant.

Results:
Table 1 presents the responses of 110 patients with Type II diabetes mellitus to the dry eye questionnaire. The most frequently reported symptom was a burning sensation, observed in 68 (61.8%) patients. Redness was noted by 61 (55.5%) patients, whereas watering of eyes was seen in 58 (52.7%) patients. A gritty sensation was experienced by 52 patients, accounting for 47.3%, while 49 patients, or 44.5%, reported eye dryness. Stickiness was observed in 39 (35.5%) patients, while eye sticking was recorded in 37 (33.6%) patients. Crusting was the least frequently observed symptom, noted in just 8 (7.3%) patients. These findings suggest that eye irritation and discomfort were prevalent among the diabetic patients who participated in the study. **Table 2** presents a summary of the clinical test results utilized for diagnosing dry eye disease. Tear Break-Up Time was found to be abnormal in 44 (40.0%) patients, while Schirmer's test was abnormal in 49 (44.5%) patients. Fluorescein staining revealed irregular results in 32 (29.1%) patients, while Rose Bengal staining showed abnormal findings in 41 (37.3%) patients. These observations reveal different levels of tear film instability and ocular surface damage within the studied diabetic group. **Table 3** show cases the occurrence and intensity of dry eye disease within the group of participants involved in the study. Out of the total 110 patients, 48 (43.6%) were diagnosed with a condition affecting the eyes, while 62 (56.4%) patients had normal findings in their ocular surface. Among the individuals impacted, moderate dry eye was the most prevalent category, observed in 23 (20.9%) patients. Mild dry eye was present in 19 (17.3%) patients, while severe dry eye was observed in 6 (5.5%) patients. The findings indicate that almost half of the individuals with diabetes showed signs of dry eye disease. In a group of individuals with diabetes for 1–5 years, 50 displayed normal eye assessments, while just 10 showed different levels of dryness in their eyes. In the group with a duration of 6–10 years, 25 patients exhibited dry eye disease with varying levels of severity. In individuals with diabetes lasting 11–20 years, only 2 individuals exhibited normal findings, while 13 individuals presented with dry eye disease, including 4 individuals with severe dry eye. Statistical analysis revealed that a longer duration of diabetes correlates with an increase in the severity of dry eye disease **(Table 4). Table 5** illustrates the relationship between glycemic management and the severity of dry eye conditions. Individuals with HbA1c levels below 5.6% mostly exhibited normal eye conditions, while those with inadequate glycemic management revealed a greater occurrence and intensity of dry eye disease. Among individuals with HbA1c levels exceeding 8%, 29 individuals experienced different degrees of dry eye disease, including 5 individuals with severe dry eye. The relationship between HbA1c levels and the severity of dry eye was statistically significant (χ^2 = 41.378,), indicating that inadequate management of blood sugar levels is closely linked to the onset and advancement of dry eye disease in individuals with Type II diabetes.

Table 1: Response to dry eye questionnaire

Symptom	Response	Frequency	Percent
Eye Feeling Dry	Negative	61	55.5
	Positive	49	44.5
Gritty Feeling	Negative	58	52.7
	Positive	52	47.3
Burning Sensation	Negative	42	38.2
	Positive	68	61.8
Stickiness	Negative	71	64.5
	Positive	39	35.5
Watering	Negative	52	47.3
	Positive	58	52.7
Redness	Negative	49	44.5
	Positive	61	55.5
Crusting	Negative	102	92.7
	Positive	8	7.3
Eye Stuck	Negative	73	66.4
	Positive	37	33.6

Table 2: Clinical test results of dry eye

Tests	Normal	Abnormal
Tear Break-Up Time	66	44
Schirmer's Test	61	49
Fluorescein Staining	78	32
Rose Bengal Staining	69	41

Table 3: Prevalence and severity of dry eye

Severity	Number of Patients
Mild	19
Moderate	23
Severe	6
Normal Patients	62
Total	110

Table 4: Association of duration of diabetes with dry eye

Duration (Years)	Normal	Grade 1	Grade 2	Grade 3
1–5	50	6	4	0
6–10	10	8	15	2
11–20	2	5	4	4
Total	62	19	23	6

P Value = 0.001

Table 5: Association of glycemic control with dry eye

HbA1c (%)	Normal	Grade 1	Grade 2	Grade 3
< 5.6	29	1	1	0
5.6–7.0	23	3	4	0
7.1–8.0	6	6	3	1
> 8.0	4	9	15	5
Total	62	19	23	6

P Value = 0.001

Discussion:
The findings of the present study revealed that 43.6% of the study participants were diagnosed with dry eye disease,

indicating that ocular surface abnormalities are common among individuals with diabetes. Symptoms like a burning sensation; redness, watering and a gritty feeling were often reported, underscoring the significant discomfort faced by this group. In the current investigation, the most frequently noted symptom was a burning sensation, accompanied by redness and watering of the eyes. These findings support the observations noted by So *et al*. **[11]**. Who showed that individuals with diabetes often encounter symptoms associated with tear film instability and issues with the ocular surface. Persistent elevated blood sugar levels have been linked to issues with the tear-producing glands, decreased tear production and damage to corneal nerves. The occurrence of dry eye disease noted in the presentresearch was 43.6%, aligning with findings documented in recent literature. Lim *et al*. **[12]** in their systematic review, indicated that diabetes mellitus notably heightens the risk of dry eye disease due to alterations in tear film quality, reduced corneal sensitivity and inflammation of ocular surface. The review highlighted that individuals with diabetes consistently show less favorable ocular surface parameters compared to those without the condition. The findings in this study reinforce the increasing evidence that dry eye disease is a significant ocular complication linked with diabetes mellitus. Clinical evaluation indicated irregularities in Tear Break-Up Time, Schirmer's test, fluorescein staining and Rose Bengal staining in a significant number of patients. These findings indicate the existence of tear film instability and damage to the ocular surface. As outlined in the TFOS DEWS II Pathophysiology Report by Craig *et al*. **[13]** the instability of the tear film and increased osmolarity play crucial roles in the onset of dry eye disease. Metabolic alterations linked with diabetes can intensify these processes via inflammatory pathways and oxidative stress, leading to a gradual decline in ocular surface function. A significant link was observed between the duration of diabetes and the severity of dry eye disease. Similar findings have been reported by Stapleton *et al*. **[14]** who highlighted that prolonged systemic disease contributes to progressive disruption of tear film homeostasis and ocular surface integrity. Long-term hyperglycemia may induce microvascular damage, autonomic neuropathy and reduced lacrimal gland function, thereby increasing susceptibility to dry eye disease. The statistically significant relationship identified in the current study indicates that duration of diabetes is an important determinant of ocular surface health. Individuals with increased HbA1c levels exhibited a significantly greater occurrence of moderate to severe dry eye disease in comparison to those with improved glycemic management. This finding is supported by the recommendations outlined by the American Diabetes Association **[15],** which recognize chronic hyperglycemia as a major contributor to diabetic complications affecting multiple organ systems, including ocular tissues **[16]**. Poor glycemic management leads to inflammatory changes; oxidative stress and neural dysfunction that negatively impact tear production and the stability of the ocular surface. Consequently, achieving effective management of blood sugar levels could be essential in lowering the likelihood and intensity of dry eye disease in individuals with diabetes. Overall, the findings of the present study highlight the significance of regular eye examinations for individuals with Type II diabetes mellitus. Prompt recognition of dry eye disease via symptom evaluation and clinical examination can enable swift action and enhance patient comfort, visual performance and overall well-being. The notable connections identified between the length of diabetes and blood sugar regulation emphasize the importance of thorough management approaches to avert complications related to the eye's surface.

Conclusion:

Dry eye disease was prevalent in 43.6% of individuals with type II diabetes mellitus, with burning sensation, redness and watering being the most common symptoms. Longer diabetes duration and inadequate glycemic control were associated with increased prevalence and severity of dry eye disease. Routine ocular surface assessment and optimal glycemic control may help reduce dry eye complications and preserve ocular health in individuals with diabetes.

Ethical status:

Before starting the study, approval from the Institutional Ethics Committee was secured. Participant information was kept confidential during the entire study and all individuals were made aware of the study's purpose and procedures prior to their enrollment.

Conflict of interest:

No! Conflict of interest is found elsewhere considering this work**.**

Source of funding:

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