

## Correlation of dry eye status with the duration of diabetes and the severity of diabetic retinopathy in type 2 diabetes mellitus patients

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### Abstract

**Purpose:** To correlate dry eye status with the duration for which the patient has been diagnosed with type 2 diabetes and severity of retinopathy.

**Materials and Methods:** A prospective study was done involving 384 patients aged above 45 years with Type 2 Diabetes Mellitus of duration more than 5 years. A detailed history was taken and ocular and systemic examination was done. Diabetic retinopathy changes graded according to ETDRS classification. Dry eye status was evaluated with TBUT, Schirmer's test, Fluorescein and issamine green staining of ocular surface and graded as mild, moderate and severe dry eye. Diagnosis was established by positivity of one or more of the tests.

**Results:** The prevalence of dry eye among the diabetics was found to be 19%. Out of them, 93.15% had mild dry eye and 6.85% had moderate dry eye. The prevalence of mild dry eye was 42.86% in those who had DM for more than 20 years duration. The prevalence of mild dry eye among PDR was found to be 66.67%.

**Conclusion:** There was statistically significant positive correlation between the dry eye and duration of diabetes and severity of retinopathy. Early treatment of dry eye should be initiated in dry eye positive individuals in order to prevent potential corneal complications.

**Keywords:** Dry eye, Diabetes, Diabetic retinopathy, Schirmer test.

### Introduction

Dry eye is defined according to Dry eye workshop (DEWS) Definition (2007) as a multifactorial disease of the tear film and ocular surface resulting in symptoms of visual disturbance, discomfort, tear film instability, increased osmolarity of tear film and ocular surface inflammation.<sup>1</sup> The reduced corneal sensitivity favors the occurrence of dry eye syndrome (DES) by reducing the blink rate, by decreasing the reflex-induced lacrimal secretion and increasing evaporative tear loss.<sup>2</sup>

Many theories explain the connection between dry eye and diabetes. Hyperglycemia and microvascular damage to the corneal nerves can block the feedback mechanism which controls secretion of tears. When the ocular surface innervation is disrupted; tears are not secreted properly by the lacrimal gland. Hyperglycemia triggers inflammatory alterations, thus reducing tear secretion. Inflammation is not only a cause, but also a consequence of dry eye. Inflammation results in aqueous deficient dry eye or lacrimal insufficiency.<sup>3</sup>

The various complications include recurrent erosions, persistent epithelial defect, punctate keratopathy, increased risk of microbial keratitis, delayed wound healing, neurotrophic keratopathy and corneal scarring leading to permanent vision impairment. The ocular complications among diabetics include cataract, glaucoma and retinopathy. Recently, dry eye has been reported. Early diagnosis and treatment reduces the complications. The aim of our study was to correlate dry eye status with the duration for which the patient has been diagnosed with type 2 diabetes and the severity of diabetic retinopathy (DR).

A study conducted by Sahai et al, out of 500 patients, 92 (18.4%) had dry eye with higher prevalence in females.<sup>4</sup> In a study by Seifart et al, 52.8% of diabetics complained of dry eye symptoms, as against 9.3% of the controls.<sup>5</sup> In a study by Kesarwani et al abnormal schirmer's, TBUT, Rose Bengal staining, impression cytology scores was noted in type 2 diabetes.<sup>6</sup> Hom and De Land showed 52.9% of diabetics had self-reported dry eye. They also found that the severity of dry eye correlated with the severity of DR.<sup>7</sup> In a study by Hasan et al, mild dry eyes was most common among diabetics (20%). There was no significant association of age, sex and duration of diabetes with the dry eye incidence.<sup>8</sup> Mehmet Citirik et al, suggested that there might be an association between the impression cytology grading scores and the severity of DR.<sup>9</sup> In a study done by Tanushree et al, dry eye was reported in 36% of diabetics. Further dry eye was more frequent in patients with longer duration and in patients with DR.<sup>10</sup> In a study by Suzuki et al osmolarity of tears was found to correlate with dry eye severity.<sup>11</sup>

### Materials and Methods

A prospective study was done involving 384 patients aged above 45 years with type 2 diabetes mellitus of duration more than 5 years attending our outpatient and in-patient department between the time period from Oct 2015 to June 2017. All type 2 diabetes mellitus patients above the age of 45 years, including new and review cases were included in the study. Cases excluded were patients with type 1 diabetes mellitus and other unspecified cases, Contact lens users, patients who have undergone Pterygium excision, Cataract surgery, Keratoplasty, Glaucoma

surgeries, patients who have undergone LASIK surgery, on medications such as antiglaucoma medications, antihistamines, tricyclic antidepressants, oral contraceptives and diuretics, patients with features clinically suggestive of Sjogren’s syndrome, Rheumatoid arthritis, Parkinson, Lupus, Hypothyroidism, patients on haemodialysis, with chronic lid abnormalities like blepharitis, meibomitis, lagophthalmos, ectropion, trichiasis, blistering mucocutaneous disorders, ocular chemical injuries in the past.

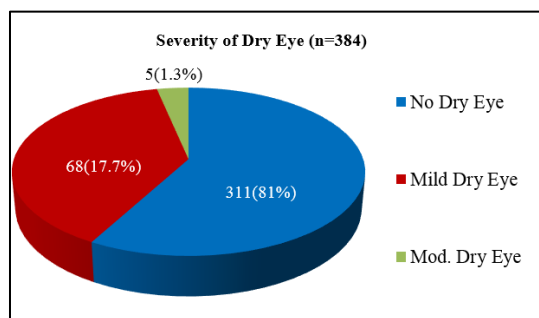
**Methods:** Informed written consent was taken from all the patients. Ethical clearance was obtained. A detailed history regarding age, sex, ocular symptoms, and duration of type 2 diabetes mellitus and presence of other diseases was obtained. Detailed ocular and systemic examination was done. All type 2 diabetes mellitus patients were analyzed for dry eye status and presence of diabetic retinopathy changes. Dry eye status was confirmed by TBUT, Schirmer’s 1 test and ocular surface dye staining pattern with fluorescein and issamine green strips. Diagnosis is established by positivity of one or more of the tests in one eye and / or both eyes. The worse eye grading of any of the above test mentioned was considered for statistical purposes when different grading was seen in each eye in an individual.

The grading system has been followed in our study in accordance with DEWS 2007 report, study done by Thampi et al and Hasan et al<sup>1,12,8</sup> with certain modifications (Table 1). Fundus evaluation was done by indirect ophthalmoscopy and slit lamp biomicroscopy using 78D lens after pupillary dilation. DR was graded accordingly to ETDRS criteria. When the grading was different in two eyes of the individual, the higher grade/ the worse eye grading was taken for statistical purpose. The data was analysed using SPSS version 16.0. All the data was analyzed using descriptive statistics and Chi square test.

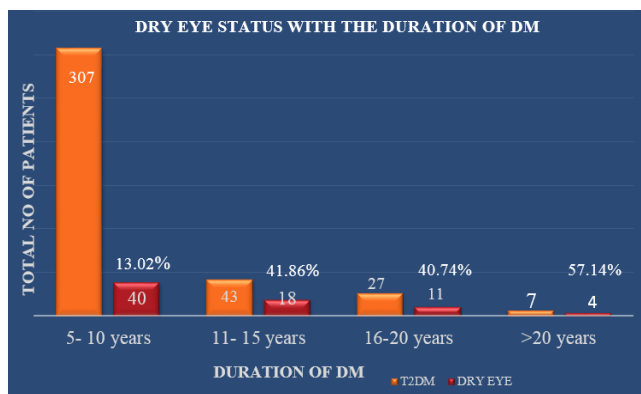
**Results**

In our study mean age was 60.20 ± 6.985 years and mean duration of type 2 DM was 9.12 ± 4.667 years. Out of 384, 272 (70.8%) were males and 112 (29.2%) were females. Around 94% of the patients had TBUT > 10 seconds. Schirmer’s 1 test values were < 10mm in all dry eye positive cases (Table 2). None of them showed positive staining when tested with fluorescein and issamine green strip. Prevalence of dry eye among type 2 diabetes mellitus patients was found to be 19% (73) of the total. Out of the dry eye tested positive, 93.15% (68) had mild dry eye and 6.85% (5) had moderate dry eye (Fig. 1). The prevalence of dry eye was found to increase with increase in the duration of diabetes (Fig. 2). According to Likelihood ratio, significant correlation was noted between dry eye disease and duration of diabetes mellitus (p <0.001). The prevalence of mild dry eye was 12.37% (38) in those with 5-10 years of having had type 2 DM; 39.53% (17) in 11-15 years of duration of DM; 37.03% (10) in those with 16-20 years of DM and 42.86% (3) in those who had DM for longer than 20 years. The prevalence of moderate dry eye was 0.65% (2) in those with 5-10 years of DM; 2.32% (1) in 11-15

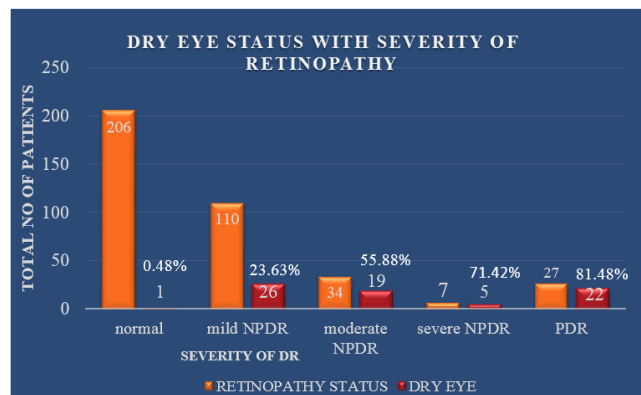
years of duration of DM; 3.7% (1) in those with 16-20 years of duration and 14.29% (1) had moderate dry eye with more than 20 years of DM. The prevalence of dry eye was found to increase as the severity of retinopathy increase (Fig. 3). According to Likelihood ratio, significant correlation was noted between dry eye disease and retinopathy (p <0.001). Out of 110 with mild NPDR, 26 (23.64%) had mild dry eye. Out of 34 who had moderate NPDR, 18 (52.94%) had mild dry eye; 1 (2.94%) had moderate dry eye. Out of 7 with severe NPDR, mild dry eye was seen in 5 (71.43%). Out of 27 PDR patients, mild dry eye was seen in 18 (66.67%) and moderate dry eye was seen in 4 (14.81%).



**Fig. 1: Distribution of severity of dry eye**



**Fig. 2: Correlation of dry eye status with the duration of DM**



**Fig. 3: Correlation of dry eye status with severity of retinopathy**

**Table 1: Grading of dry eye**

Grading of Dry Eye	TBUT (seconds)	Schirmer's 1 Test (reading in mm; wetting noted after 5min)	Fluorescein Staining Pattern	Issamine staining Pattern(interpalpebral area; scores of 0-3 for each zone with maximum score-9, score of >3 – dry eye)
No dry eye	>10	≥ 10	Negative	Negative
Mild	8-10	6 – 9	<1 quadrant of staining of the cornea	Scores of 4 and 5
Moderate	5 – 7	3 – 5	> 1 quadrant	Scores of 6 and 7
Severe	< 5	≤ 2	Diffuse corneal staining and often conjunctival too	Scores of 8 and 9

**Table 2: Schirmer 1 Test**

Grades of Dry Eye	Right eye		Left eye	
	Frequency	Percent	Frequency	Percent
No dry eye	327	85.2	349	90.9
Mild dry eye	53	13.8	34	8.9
Moderate dry eye	4	1.0	1	0.2
Severe dry eye	0	0	0	0
Total	384	100.0	384	100

## Discussion

India being known as the diabetic capital of the World, regular monitoring and good glycemic control is important. In our study prevalence of dry eye in type 2 diabetes cases examined was 19%. Moss et al showed 18.1% of diabetics had dry eye.<sup>13</sup> In a study conducted by Sahai et al on type 2 diabetics, 18.4% had dry eye.<sup>4</sup> Nepp et al found 43% to have dry eye.<sup>14</sup>

In our study we found that the prevalence of mild dry eye was 12.37% (38) in those with 5-10 years of DM; 39.53% (17) in 11-15 years of duration of DM; 37.03% (10) in those with 16-20 years of DM and 42.86% (3) in those who had DM for longer than 20 years. The prevalence of moderate dry eye was 0.65% (2) in those with 5-10 years of DM; 2.32% (1) in 11-15 years of duration of DM; 3.7% (1) in those with 16-20 years of duration and 14.29% (1) had moderate dry eye with more than 20 years of DM. In a study by Manaviat et al, prevalence of dry eye syndrome in diabetics was 54.3%. Significant association was noted between dry eye syndrome and duration of diabetes and was more frequent in diabetics with DR.<sup>15</sup> In a study by Pradeep et al, prevalence of dry eye was 32% among type 2 diabetics and showed the prevalence being high in older age groups and with >10 years of duration of diabetes mellitus.<sup>16</sup>

In our study, the prevalence of mild DE among mild, moderate, severe NPDR and PDR was found to be 23.64%, 52.94%, 71.43% and 66.67% respectively. The prevalence of dry eye was found to be more as the severity of retinopathy increases. Moderate dry eye was seen in one patient with moderate NPDR and 4 (14.81%) patients with PDR. In a study by Najafi et al, significant correlation was found between dry eye disease and diabetic retinopathy

( $p=0.01$ ).<sup>17</sup> Ling Yu et al, Hongbin et al, Raman et al in their study suggested that the tear functions are worse in diabetic patients. Moreover, patients with PDR are more predisposed to impaired tear functions.<sup>18-20</sup>

## Conclusion

This study proves that there exists a significant association between diabetes mellitus and dry eye. There was statistically significant positive correlation between the duration of diabetes and severity of retinopathy to dry eye. Early diagnosis and timely treatment of diabetes and its control can improve the quality of life. Early treatment of dry eye should be initiated in dry eye positive individuals in order to prevent potential corneal complications. Close monitoring of diabetic patients and good blood sugar regulation is important for prevention of dry eye and diabetic retinopathy.

**Conflict of Interest:** None.

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