

Evaluation of Phenol Red Thread test versus Schirmer test in dry eyes: A comparative study

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ABSTRACT

Background: Dry eye is the most common ocular morbidity found in elderly patients. There is no gold standard/standard test for diagnosing dry eye. **Objectives:** The present study was conducted to compare the potential of Phenol Red Thread (PRT) test versus Schirmer Test in diagnosing dry eye. **Materials and Methods:** The study was conducted on 50 patients, aged 40 years and above. History of dry eye symptoms was taken and the symptoms were graded. Six-questions Bandeen Rosch questionnaire was administered to those having symptoms of dry eye. Patients whose response to any of the questions was often/all the time were included in the study. After performing standard clinical examination, Schirmer and PRT tests were done. **Results:** PRT is equally sensitive in detecting dry eye, and in addition, it has many advantages as compared to Schirmer. PRT is simpler and more comfortable to the patient and can be done in children. It causes less reflex tearing. Most important is the lesser time consumed (15 seconds) in comparison to Schirmer (5 minutes). **Conclusion:** Kappa value between PRT and Schirmer was found to be 0.96 in this study and shows a strong agreement between the two. So, PRT can be considered equally good in detecting dry eye.

Key words: Dry eye, schirmer test, phenol red thread test

INTRODUCTION

Dry eye is defined as a disorder of tear film due to tear deficiency or excessive tear evaporation which causes damage to inter-palpebral ocular surface and is associated with symptoms of ocular discomfort.^[1] There is no gold standard criterion/standard test for dry eye.

Deficiencies in pre-corneal tear film production, quality and replenishment cause dry eye. This can lead to corneal damage and is detrimental to visual performance. Tear film has an estimated thickness of around 4–6 μm . In addition to providing nutrition to cornea, it also protects the ocular surface from

injury and infection. It consists of three layers from anterior to posterior – lipid, aqueous, and mucus layers. Lipid layer is approximately 0.1 nm in thickness and retards the ocular surface water evaporation, preventing the dry eye.^[2] 90% of tear film is due to aqueous layer which is formed by the secretion of lacrimal glands. Measuring about 6.5–7.5 μm , it helps in providing atmospheric nutrition to epithelium.

Dry eye is the most common ocular morbidity found in elderly patients. Prevalence of dry eye is variable due to lack of uniformity in criteria, questionnaire and tests. It ranges from 10.4 to 37%. A study done in USA in 3722 subjects aged 48–91 years, based on symptoms, showed a prevalence of 14.4%,^[3] while another study done at Jaipur by Sahai *et al.* in 200 patients based on questionnaire and tests showed a prevalence of 18.4%.^[4] Both the studies showed that prevalence increased with age and was higher in females. Schein *et al.* in their study on elderly Americans (>65 years), based on questionnaire and tests, found a prevalence of 14.6%.^[5]

Dry eye diagnosis is based on subjective symptoms like ocular discomfort, foreign body sensation, itching, tearing, and photophobia. Various questionnaires used are ocular surface disease index (OSDI), Bandeen Roche^[6] and

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McMonnies.^[7] All these contain some set of questions related to dry eyes. Patients are given four options to answer, i.e. never, rarely, sometimes, often/all the times, and are asked to report the frequency of each symptom. Patients reporting one or more symptoms as often/all the times are considered as symptomatic patients. Various tests include analysis of lacrimal secretion (Schirmer Test, Jones Test), the stability of lacrimal film by tear film break up time (BUT), noninvasive tear break up time (NIBUT), integrity of tear film (using vital stains like fluorescein, Rose Bengal, lissamine green, phenol red), oil gland assessment and meibometry and interferometry of tears.

MATERIALS AND METHODS

The present study was approved by the Institute's Postgraduate Board of Studies and the Institution Ethical Committee. After taking informed consent, patients aged 40 years and above, attending out-patient department, and pre-operative indoor patients at a regional ophthalmology institute of a tertiary care teaching hospital attached to a medical college were enrolled in the study. Patients who had undergone some previous ocular surgeries (cataract, LASIK, etc.), patients on topical medications (beta blockers, brimonidine, artificial tears, aminoglycosides), or systemic medication (amytriptyline, loratidine, diuretics, estrogen supplements, cyclophosphamide) and those seriously ill were not included in the study.

After taking the history of dry eye symptoms (ocular discomfort, foreign body sensation, dryness, itching, photophobia, hyperlacrimation, redness, and burning) and grading their symptoms as mild, moderate and severe according to the grading table, six-question Bandeen Roche questionnaire was administered to the patients who complained of dry eye symptoms. Questions included in the questionnaire were: Do your eyes feel dry, do you ever feel a gritty or sandy sensation in your eyes, do your eyes ever have a burning sensation, are your eyes ever red, do you notice much crusting on your eye lashes, and do your eyes ever get stuck shut in the morning? Of the given four responses, i.e. never, rarely, sometimes, often/all the time, the patients whose response to any of the questions was often/all the times were finally registered for the study. A total of 50 patients were registered for the study.

After doing the standard clinical examination including general physical examination, best corrected visual acuity, intraocular pressure, slit-lamp examination and physical signs of dry eye, dry eye tests were done. Tear film tests were done only in one eye of the subject. Randomization for the selection of eye (right or left) and for the test to be done first out of the two tests [Schirmer and Phenol Red Thread (PRT)], was done

by using randomized card system. Both the tests were done on the same eye, after a gap of 15 minutes, without using any anesthetic agent.

Schirmer test was done by using autoclaved, 35-mm-long and 5-mm-wide Schirmer strip. One millimeter of rounded end of strip was folded and inserted into lower fornix and the patient was asked not to close the eyes, and blink normally. The strip was removed after 5 minutes and the wet portion below the folded end was immediately measured. Results were interpreted as follows: ≤ 5 mm as severe dry eye, ≤ 10 mm as borderline dry eye and > 10 mm as normal tear production.

For PRT test, autoclaved, 75-mm-long phenol-red impregnated thread with 3-mm bent end was placed in lower fornix for 15 seconds. When the phenol red comes in contact with alkaline tears, it changes color from white to yellow-orange, yellow and then to red. The thread was removed after 15 seconds and the red portion was measured from the very tip regardless of the fold. The results were interpreted as follows: wet length < 10 mm as severe dry eye, ≤ 19 mm as borderline dry eye and > 20 mm as normal tear production.

RESULTS

The age of the subjects ranged from 40 to 81 years. Dry eye was present in majority of the subjects. Maximum prevalence of dry eye was observed in the age group of 60–69 years (16, 32%) followed by 50–59 years (15, 30%). Females had higher prevalence (28, 56%) of dry eye than males (22, 44%) as per the questionnaire. The mean age of the study subjects was 56.72 ± 10.54 years.

Foreign body sensation was the universal symptom reported by all the subjects. It was followed by feeling of discomfort/irritation (98%), dryness (6%), redness (74%), photophobia (44%), itching (22%) and hyperlacrimation (16%). Regarding grades of severity, foreign body sensation was the most common symptom (70%), followed by dryness of severe grade (48%) and discomfort/irritation of severe grade (34%) [Table 1].

Severe dry eye was detected by Schirmer test in seven patients (14%), while PRT detected severe dry eye in nine patients (18%). Schirmer test detected borderline dry eye in 25 (50%) patients, while PRT detected this in 22 (44%) patients [Table 2]. Of the patients detected borderline dry eye by Schirmer, 10 (20%) were positive for severe dry eye by PRT, and of those detected borderline dry eye by PRT, nine (18%) were positive for severe dry eye by Schirmer test. Kappa value between PRT and Schirmer test was found to be 0.96, showing a strong agreement between the two tests. Moreover, there was no

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Table 1: Distribution of symptoms of dry eye according to grades of severity

Symptoms	Mild	Moderate	Severe	Total
Foreign body sensation	02	28	70	100
Discomfort/irritation	20	44	34	98
Dryness	06	32	48	86
Redness	18	46	10	74
Photophobia	12	26	06	44
Itching	12	06	04	22
Hyperlacrimation	04	04	08	16

Table 2: Schirmer test versus phenol red thread test

Name of test	Total (%)	Abnormal tear secretion		Normal tear secretion (%)
		Severe dry eye (%)	Borderline dry eye (%)	
Schirmer test	32 (64)	7 (14)	25 (50)	18 (36)
Phenol red thread test	31 (62)	9 (18)	22 (44)	19 (38)

statistically significant difference ($P < 0.05$) between the two tests in diagnosing dry eye.

DISCUSSION

Symptoms of dry eye are relatively common in the ophthalmic practice, especially in elderly population. Dry eye affects the quality of life and may also be sight threatening. Despite many studies on dry eye, there is still lack of uniform criteria for the diagnosis of dry eye. A quartet of diagnostic tests has been universally applied, i.e. to assess symptoms, tear stability, ocular surface staining and reflex tear flow.

This study showed that foreign body sensation was the most common symptom present in all patients, followed by discomfort/irritation in 98% of patients. This is in accordance with the findings of Bandeen Rosche *et al.*,^[6] who found gritty or sandy sensation followed by burning sensation which compelled the patient to seek advice.

Comparatively, few studies have been done on PRT. It was developed to overcome the disadvantages of Schirmer test, including variable results, low sensitivity and failure to measure basal secretions even when used without anesthesia. Although the method of conducting the test is almost similar to Schirmer test, but there are major differences. There is little or no sensation of thread; so, reflex tear secretion is minimal. Test time required per eye is only 15 seconds as compared to 5 minutes for Schirmer test and causes less discomfort to the patient.

A hospital-based cross-sectional study conducted by Sahai *et*

al. in Jaipur found 18.4% prevalence of dry eye, with maximum occurrence among those above 70 years of age (36.1%), followed by patients of 31–40 years (20%). It was more in females (22.8%) than in males (14.9%).^[4] In the present study, maximum prevalence was seen in 60–69 years age group, followed by 50–59 years, with more prevalence in females.

Asbell and Chiang showed that PRT test is more repeatable and statistically reliable, with lesser intra-individual variation than Schirmer test.^[8] The present study showed that PRT is equally sensitive in detecting dry eye as Schirmer test. Although PRT detected dry eye in 62% as compared to 64% by Schirmer, it is more efficient in detecting severe dry eye (18%) as compared to Schirmer (14%). PRT detected dry eye in 20% patients having detected normal/borderline by Schirmer, while Schirmer test detected 18% as dry eye having detected normal/borderline by PRT. So, PRT is almost comparable with Schirmer test, and in addition, it has many advantages as compared to Schirmer. PRT is simpler and more comfortable to the patient and can also be done in children. It causes less reflex tearing. Most important is the lesser time consumed (15 seconds) in comparison to Schirmer (5 minutes).

The Kappa value between PRT and Schirmer was found to be 0.96 in this study and shows a strong agreement between the two, and also, $P < 0.05$ showed that the agreement is statistically significant. So, PRT can be considered as good as Schirmer test in detecting dry eye.

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