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Assessment of Tear Break-Up Time in Eyes with Encroached Pterygium

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ABSTRACT

Original Research Article

Pterygium is a frequent disease of the ocular surface characterised by the proliferation of fibrovascular tissue from the bulbar conjunctiva over the limbus to the corneal surface. In addition to affecting look of the eye and vision, pterygium may also disturb the tear film and lead to ocular surface pain and dry eye symptoms. Tear break-up time (TBUT) is an important clinical parameter for evaluation of tear film stability. The present study measured tear break-up time in encroached pterygium patients and compared the data with the patients without pterygium. The study included 100 subjects; 50 cases with encroached pterygium and 50 controls. The stability of the tear-film was evaluated using the fluorescein tear break-up time test. The data were analysed using SPSS version 25.0. Independent-samples t-test was used to compare TBUT between pterygium and control groups. P-value <0.05 was considered statistically significant. Participants were 20–62 years old, mean age was 33 ± 10.42 years. The mean TBUT was decreased in study subjects with encroached pterygium compared to controls (15.00 ± 5.32 seconds vs 25.56 ± 8.12 seconds). Unstable tear film (TBUT ≤ 10 seconds as assessed in this study) was detected in 32% of eyes with encroached pterygium compared to 10% in the control group. The pterygium group was composed of 64% males and 36% females. An independent-samples t-test revealed a statistically significant drop in TBUT in patients with encroached pterygium compared to controls ($p < 0.05$). Eyes with encroached pterygium had significantly lower tear-film stability than control eyes. The data imply that pterygium may be related with tear film malfunction and greater sensitivity to dry eye symptoms. Increased awareness of pterygium, careful evaluation of the ocular surface and use of lubricating eye drops where clinically warranted may help to enhance ocular comfort in the affected persons.

Keywords: Pterygium, dry eye, ocular surface disease, tear break-up time, tear-film stability, fluorescein.

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INTRODUCTION

Pterygium is a frequent disease of the ocular surface which is characterised by increasing fibrovascular development of conjunctival tissue across the limbus and into the neighbouring cornea. Although pterygium is typically considered a benign condition, it is associated with ocular irritation, redness, foreign-body sensation, visual disruption, and clinically significant corneal involvement and visual impairment in more advanced cases. Pterygium prevalence varies widely among geographical locations and populations, suggesting differences in environmental exposure, demographic features and other potential risk factors [1]. Reported prevalence rates vary from 0.7% to 31% across different populations [1]. The comparatively high prevalence of pterygium in tropical regions has been linked to extended exposure to environmental variables, particularly ultraviolet (UV) radiation [2]. Imo State is located in the southeast of Nigeria and falls within the humid tropical region and has generally high temperatures and high environmental exposure throughout the year. Owerri Municipal has a tropical wet environment. Populations living in tropical climatic circumstances have been reported to have a significantly higher risk of pterygium than populations living outside these locations [3]. These findings highlight the crucial role of environmental exposure, especially UV radiation, in the development and progression of pterygium.

The tear film is a thin coating of fluid covering the corneal and conjunctival surfaces, which plays an important role in preserving the health of the ocular surface and visual function [4]. It ensures a smooth optical surface for clear vision, lubricates the ocular surface, maintains the health and integrity of the corneal and conjunctival epithelium, and participates in the defence of the eye against microbial and environmental insults. Continuous renewal of the tear film also helps to maintain ocular comfort and protect the ocular surface from desiccation and mechanical irritation [6]. Tear film stability is a crucial component of normal ocular surface function. Disruption of the tear film can cause increased evaporation, ocular surface irritation and symptoms of dry eye illness. Tear break-up time (TBUT) is a regularly utilised clinical measurement of tear film

stability. The time delay between a complete blink and the first discontinuity of the fluorescein-stained tear film after instillation of fluorescein is measured. The shorter the TBUT, the more unstable the tear film and the greater likelihood to evaporative or mixed dry eye. The link between pterygium and tear-film instability has become the focus of growing investigation. Pterygium has the ability to change the natural architecture of the ocular surface and disrupt the distribution and stability of the tear film. Tear-film instability has been documented in pterygium [7] and disruptions in tear-film stability have been associated with the growth and progression of pterygium [8].

Thus, patients presenting with pterygium may suffer from ocular discomfort, irritation, redness and dryness. Besides its influence on the ocular surface, pterygium can lead to corneal alterations and optical aberrations that might impact visual function and quality of life [9]. The most common clinical signs are redness, impaired vision, discomfort, and foreign-body sensation [10]. Dry eye-related symptoms have also been described in patients with pterygium [11]. These observations may suggest that a tear film examination could be clinically important in subjects presenting with pterygium, particularly when the lesion has spread onto the cornea. The extent to which a pterygium encroaches on the cornea and alters the ocular surface may determine the degree to which it interferes with tear-film stability. Encroached pterygium can interfere with the smoothness of the ocular surface and can potentially interfere with normal tear-film distribution. This may also enhance tear film instability and predispose those affected to ocular surface discomfort [12]. Therefore, TBUT measurement is a helpful way to study the link between pterygium and tear-film function. In spite of the significant frequency of pterygium among tropical populations including Nigeria, more study of its effect on the tear–film stability among the affected persons is needed. Comparison of TBUT in subjects with encroached pterygium and without pterygium may be informative in providing information regarding the extent of tear-film disturbance associated with the condition. Therefore, the present study was performed to evaluate the tear break-up time in adults with encroached pterygium and to compare the results with persons without pterygium. The study primarily addressed the question of whether tear-film stability is significantly different in eyes with encroached pterygium compared to control eyes.

MATERIAL AND METHODS

Research Area

Owerri Municipal Council is located in Owerri, the capital city of Imo State, southeastern Nigeria. It lies approximately between latitudes 5°29′N and longitude 7°02′E. The Local Government Area occupies an estimated land area of about 58 km² and had a population of 127,213 (62,990 males and 64,223 females) according to the 2006 National Population Census. The area comprises approximately 17,000 households, in addition to numerous commercial establishments and offices. As the state capital, Owerri Municipal has a high concentration of educational institutions, healthcare facilities, business establishments, government ministries, and parastatals.

Ethical Clearance

Ethical approval and administrative authorization for the study were obtained from the Department of Optometry, Imo State University, Owerri, through the Head of Department, Thesis Coordinator, and Project Supervisor. The purpose and procedures of the study were explained to all prospective participants. Written informed consent was obtained from each participant before enrolment. Participation was voluntary, and participants were informed of their right to withdraw from the study at any stage without penalty.

Study Design

This study employed a clinical-based comparative case-control design. It was conducted among adults residing in Owerri Municipal Council. Participants who met the eligibility criteria and provided informed consent were invited to the Optometry Teaching Clinic of Imo State University, Owerri, on designated study days for clinical examination and assessment of tear break-up time (TBUT).

Participants with pterygium constituted the case group, while participants without pterygium constituted the control group. TBUT measurements obtained from the two groups were compared to determine whether the presence of pterygium was associated with altered tear-film stability.

Study Setting

The study was conducted at the Optometry Teaching Clinic, Department of Optometry, Imo State University, Owerri. The study involved the clinical assessment of tear-film stability using tear break-up time (TBUT) in participants with pterygium and comparison with TBUT values obtained from participants without pterygium.

Study Population

The study population comprised adults residing in Owerri Municipal Council, Imo State, Nigeria. Based on the 2006 National Population Census, Owerri Municipal had an estimated population of 127,213, comprising 62,990 males and 64,223 females. The study population consisted of eligible adults with and without pterygium who met the specified inclusion criteria and consented to participate.

Sample Size

A total of 100 participants were recruited for the study. The sample comprised 52 males and 48 females. Fifty participants with pterygium constituted the case group, comprising 32 males and 18 females, while 50

participants without pterygium constituted the control group, comprising 20 males and 30 females.

Sampling Technique

A voluntary response sampling technique was employed. Adults with and without pterygium who met the eligibility criteria and voluntarily consented to participate were recruited into the study. Participants were subsequently categorized into the case group or control group based on the presence or absence of clinically diagnosed pterygium.

Instruments for Data Collection

The following instruments and materials were used for data collection:

1. Illuminated Snellen visual acuity chart.
2. Bright pen torch for external ocular examination.
3. Fluorescein strips.
4. Slit-lamp biomicroscope.
5. Sterile saline solution for removal of residual fluorescein from the ocular surface.
6. Cotton wool.
7. Stopwatch for recording tear break-up time.

Validity and Reliability of the Study

The validity of the study procedures and data collection instruments was ensured through supervision and review by the Project Supervisor and appropriate academic personnel in the Department of Optometry, Imo State University, Owerri. The clinical instruments employed, including the Snellen visual acuity chart and slit-lamp biomicroscope, are standard instruments routinely used for ophthalmic and optometric assessment. The procedures for measuring TBUT were standardized and consistently applied to all participants to enhance the reliability and comparability of the measurements.

Exclusion Criteria

Participants were excluded from the study if they met any of the following criteria:

1. Individuals with a history of previous ocular surgery.
2. Female participants who were menstruating or ovulating during the period of examination.
3. Individuals currently using ocular or systemic medications that could affect tear-film stability, including hormonal contraceptives.
4. Pregnant or breastfeeding women.
5. Individuals with ocular or systemic diseases that could influence tear-film stability, such as diabetes mellitus.
6. Individuals in older age groups with known age-related impairment of tear-film stability.
7. Individuals with active ocular surface infection or inflammation that could interfere with TBUT measurement.

Inclusion Criteria

Participants were eligible for inclusion if they:

1. Were adults residing in Owerri Municipal Council.
2. Had pterygium or were free from pterygium, depending on their assigned study group.
3. Had no condition listed under the exclusion criteria.
4. Were willing to participate in the study.
5. Provided written informed consent before enrolment.

Procedure for Data Collection

Participants who provided informed consent were informed about the purpose and procedures of the study before examination. Relevant demographic information, including age and sex, was obtained using a structured data collection format. A brief medical and ocular history was also taken to identify systemic or ocular conditions that could influence tear-film stability.

Visual acuity was assessed using an illuminated Snellen visual acuity chart. External ocular examination was subsequently performed using a pen torch to identify any obvious ocular abnormalities or surface infections. A slit-lamp biomicroscope was used for detailed examination of the anterior segment and to identify and assess the clinical features of pterygium in participants assigned to the case group.

Measurement of Tear Break-Up Time (TBUT)

Tear break-up time was assessed using fluorescein under slit-lamp biomicroscopic examination. Each participant was comfortably positioned at the slit lamp, and no topical anaesthetic was instilled. A fluorescein strip was gently applied to the lower conjunctival fornix. The participant was then instructed to blink several times to distribute the fluorescein evenly across the ocular surface. After adequate distribution of the fluorescein, the participant was instructed to keep the eyes open without blinking. The tear film was observed under cobalt-blue illumination using the slit-lamp biomicroscope at low magnification with a broad, approximately 2–3 mm, parallelepiped beam. The examiner observed the corneal surface for the first appearance of a dark spot or streak indicating disruption of the fluorescein-stained tear film. The interval, in seconds, between the last blink and the first appearance of a dark spot or streak was recorded as the TBUT. A stopwatch was used to ensure accurate timing. The same procedure was performed for participants in both the pterygium (case) and non-pterygium (control) groups. The recorded TBUT values were subsequently entered into the study database for statistical analysis.

Data Analysis

The data obtained from the study were coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 25.0. Descriptive statistics were used to summarize the data and were

presented in appropriate tables using frequencies, percentages, means, and standard deviations where applicable. The mean TBUT values of participants with pterygium were compared with those of participants without pterygium using the independent-samples *t*-test. Statistical significance was assessed at a 5% level of significance, with a 95% confidence interval. A *p*-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: The age and gender distribution of eyes with encroached pteryguim cases and the control group

Age	Pteryguim group n (%)	Non-pteryguim group n (%)	Total Number of Subject n (%)
20 – 29	13 (26)	34 (68)	47 (47)
30 – 39	17 (34)	10 (20)	27 (27)
40 – 49	9 (18)	2 (4)	11 (11)
50 – 59	7 (14)	4 (8)	11 (11)
> 60	4 (8)	-	4 (4)
Gender			
Male	32 (64%)	20 (40%)	52
Female	18 (36%)	30 (10%)	48
Total	**50**	**50**	**100**

The table above shows that among the study subjects with encroached pteryguim there was more occurrences of pteryguim among the age group of 30 - 39 which was 17 (34%). The total number of males were 32 among the pteryguim group, 20 among the non pteryguim group and a total of 52 males. For the females, there were 18 among the pteryguim group, 30 among the non pteryguim group and a total of 48 females.

Table 2: The distribution of tear break up time among encroached pteryguim and the control group.

TBUT (Secs.)	Pteryguim group n (%)	Non-pteryguim group n (%)
< 10	2 (4)	-
10	16 (32)	7 (14)
> 10	32 (64)	43 (86)

Table 2 shows the values of tear break-up time among the subjects in both groups. Among the pteryguim group, 2 (4%) had TBUT values < 10 secs, 16 (32%) had a TBUT values = 10 secs, and 32 (64%) had TBUT values > 10 seconds. Among the non – pteryguim group, none had TBUT values < 10 secs, 7 (14%) had a TBUT values = 10 secs, and 43 (86%) had TBUT values > 10 seconds.

Table 3: The clinical presentations of Pteryguim among the Pteryguim subjects.

Clinical presentation	N	%
Redness	23	46
Tearing	12	24
Itching	39	78
Sandy sensation	41	82
Inflamed pterygium	25	50
Eye ache	32	64
Blurry vision	16	32
Burning sensation	27	54

Table 3 shows that among the pteryguim group at the point of investigation, 23 subjects experienced redness, 12 had tearing, 39 had itching as symptoms, 41 had foreign body sensations and pteryguim was inflamed in 25 subjects.

DISCUSSION

The purpose of this study was to examine the tear film generation and stability in adult patients with encroached pterygium and without pterygium. A total of 100 subjects were investigated, consisting of 50 participants with pterygium and 50 control participants. The mean age of the subjects in the pterygium group was 38.02 ± 11.60 years and 27.98 ± 9.23 years in the control group. Participants' ages ranged from 20 to 62 years with a mean age of 33.00 ± 10.42 years. The mean tear production was statistically lower in the pterygium group (15.00 ± 5.32) than in the control group (25.56 ± 8.12) ($p < 0.01$). The difference was statistically significant ($p = 0.00001$) and showed decreased tear formation in the pterygium group compared with the control group. This study suggests that pterygium may have a deleterious effect on the quantity and quality of the tear film and may contribute to ocular surface irritation and tear film instability. This conclusion is consistent with the research by [13], which also revealed reduced tear production and signs of tear-film malfunction among patients with pterygium. The present investigation also showed a higher percentage of unstable tear film among those with encroached pterygium. Unstable tear film was defined as a tear break-up time (TBUT) of ≤10 seconds, and was seen in 16 (32%) eyes with encroached pterygium versus 5 (10%) eyes in the control group. These results suggest that the existence of pterygium may be related to a decrease in tear film stability. This observation is similar to that of Balogun et al. (2005) who observed unstable tear film as TBUT < 10 seconds in 12 (16.4%) eyes with

pterygia as compared to 4 (5.4%) in the control group. The decreased TBUT in subjects with pterygium could be due to the structural and physiological consequences of the lesion on the ocular surface.

The growth of pterygium from the conjunctiva onto the cornea may interfere with the normal distribution and preservation of the tear film over the corneal surface. Furthermore, concomitant conjunctival inflammation, hyperaemia and changes to the ocular surface may exacerbate tear-film instability. The lesion may also interfere with the normal function of the meibomian glands, resulting in a reduction in the lipid component of the tear film and an increase in evaporative loss of tears. In their assessment of ocular surface parameters in patients with pterygium, [14] reported alterations in the ocular surface including meibomian gland morphology and function, corneal irregularities, conjunctival hyperaemia and tear-film abnormalities associated with pterygium. Such alterations may have a role in ocular surface symptoms and tear-film malfunction. Hence, the results of the current investigation are consistent with the fact that pterygium might have a significant impact on the ocular surface homeostasis.

In the present study, the participants with pterygium additionally reported ocular symptoms such as tearing, itching, foreign-body impression and ocular redness. These findings are consistent with the well-recognized clinical signs of ocular surface irritation associated with pterygium. Pterygium may be associated with eye discomfort because of persistent exposure of the ocular surface, localised inflammation, disturbance of the normal tear-film distribution and mechanical irritation. These findings are further corroborated by [15], who studied meibomian gland dysfunction and tear function in patients with pterygium. Their investigation showed that meibomian gland function may be affected in patients with pterygium and that these variations were associated with ocular pain and tear film abnormalities. Meibomian gland dysfunction may damage the lipid layer of the tear film resulting in increased evaporation and decreased tear-film stability. This may explain the decreased tear production and higher tear-film instability found in the subjects with pterygium in the present investigation [16].

The present investigation revealed that sex distribution of encroached pterygium was more common in males than in females. Out of 50 patients with encroached pterygium, 32 (64%) were males and 18 (36%) were girls. Males thus formed roughly two-thirds of the pterygium group. This result is consistent with prior research which reported a higher prevalence of pterygium in males, especially in communities with high occupational exposure to sunshine and ultraviolet (UV) radiation.

It has been revealed that pterygium is prevalent in males, which may be related to greater occupational exposure to sunshine and ultraviolet radiation [17]. Similarly, higher prevalence of pterygium reported among males [18] . This may be associated with occupational and environmental exposure to UV radiation as a possible explanation for this sex-related variation. The male predominance in the present study may thus be partly because of occupational exposure as many of the male subjects were outside labourers, and were exposed to sunlight for lengthy hours. The importance of chronic exposure to UV radiation as an environmental risk factor for the development and progression of pterygium is well documented [19].

Another factor that has been connected with the prevalence of pterygium is age. Several studies have indicated increased prevalence of pterygium with increasing age. Other scholars showed a rise in the incidence of pterygium with age [20]. This relationship may be due to cumulative exposure to environmental risk factors, notably UV radiation, and age-related changes in the ocular surface and tear film. While pterygium has been commonly linked with advancing age, the present study revealed a considerably higher prevalence of encroached pterygium among the younger age groups. This finding should be interpreted according to the age profile of the study population, as 74% of the study population were participants aged 20–39 years. Thus, the greater proportion of younger pterygium participants could be explained by the sample distribution, rather than a signal that pterygium is more prevalent in younger adults. The development of pterygium at a relatively young age may also be contributed to occupational exposure to sunshine and other environmental factors notably in people spending considerable amounts of time outside [21].

The results of this study reveal that encroached pterygium is associated with decreased tear production, increased tear-film instability, and ocular surface discomfort. The results also imply that environmental and occupational exposures, especially extended exposure to UV radiation, may have a role in the development of pterygium, especially among outdoor workers. These data emphasise the need for early detection, regular ocular assessment and preventive measures such as proper UV protective eyewear among the individuals who frequently exposed to sunshine.

CONCLUSION

The results of the study showed that the tear production was significantly lower among those with encroached pterygium than among the participants without pterygium. Pterygium patients had a greater tear-film instability frequency as measured by a shortened tear break-up time. Ocular symptoms such as tears, itching, foreign-body sensation and redness show that pterygium may adversely impair ocular surface health and tear-film integrity.

The study also identified a larger percentage of encroached pterygium in males than in females. This could be connected with increased occupational sun exposure and UV radiation, especially in persons with outdoor jobs. Therefore, steps to decrease the length of UV exposure, such as protective eyewear and proper eye. Health education, may be beneficial in reducing the risk and progression of pterygium and its associated tear-film abnormalities.

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