SHORT COMMUNICATION

Assessment of tear film parameters in females with refractive errors using a single device: An observational study

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Abstract

This observational study aimed to evaluate the use of a single portable device to assess the non-invasive tear break-up time (NITBUT), tear meniscus height (TMH), and lipid layer patterns (LLP) in young females with refractive errors (REs). The study was conducted at the College of Applied Medical Science (Female campus), Riyadh, Saudi Arabia between January 5, 2021 to May 15, 2021. Forty young females, with mean age of 23.0± 4.3 years with REs (−2.53 ± 2.05 D) and 40 females, mean age 23.8± 4.5 years with healthy eyes were recruited. The tests were administered in the following order: Ocular Surface Disease Index (OSDI), followed by NITBUT, TMH, and LLP. Significant differences (via Mann–Whitney U test) were noted in the median ocular surface disease index (OSDI; $p<0.001$), NITBUT ($p=0.035$), TMH ($p=0.009$), and LLP ($p<0.001$) scores between the study and control groups. Females with REs have significantly lower lipid layer, TMH, and NITBUT scores than those with healthy eyes.

Keywords: Dry eye syndromes, Risk factors, Refractive errors, Eye abnormalities, tears.

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Introduction

The status of the tear film is essential to maintain vision and keep the ocular surface healthy. The tear film is responsible for the lubrication of the surface and keeping it moist and smooth.[1] Disturbance in tear film function leads to problems in vision and ocular surface diseases (e.g. dry eye). Dry eye is a common syndrome that results if homeostasis of the tear film is lost.[2] Dysfunction in the meibomian gland causes alteration in the lipid content within the tear film. The disturbance in the thickness of the layer leads to a high rate of tear evaporation and, therefore, causes an evaporative dry eye.[3] The shortage in tear secretion from the lacrimal glands leads to hyposecretory dry eye.[3] A significant proportion (up to 30%) of the world population suffers from dry eye.

Risk factors for dry eye include aging, systemic disorders (e.g. diabetes and thyroid), smoking, contact lens wearing, vitamin (A and D) deficiency, a high body mass index, refractive errors (RE), and others.[4] The diagnosis of dry eye is complex since several tests are needed to assess different parameters of the tear film.[5,6] Recently, a single non-invasive device (e.g. EASYTEAR View+) was used to assess dry eye.[6]

The REs result from light not being focused on the retina. The most common REs include astigmatism, hyperopia, and myopia. The REs are associated with several ocular surface conditions, including dry eye.[7] No single device or test is useful in detecting eye dryness; therefore, a combination of tests and devices are used. Thus, the current work aimed to assess the non-invasive tear breakup time (NITBUT), tear meniscus height (TMH), and lipid layer patterns (LLP) in subjects with REs using a single non-invasive device. In addition, to determine whether the data for the parameters evaluated, support those reported cases using different devices.

Subjects / Methods and Results

This observational study was conducted at the College of Applied Medical Science (Female campus), Riyadh, Saudi Arabia. The data was collected between January 5, 2021 to May 15, 2021. The subjects were recruited from the Clinics of the College of Applied Medical Sciences. Forty young females, with mean age of 23.0±4.3 years, with REs (−2.53±2.05 D) were recruited. For comparison, 40 females, with mean age of 23.8±4.5 years with healthy eyes were included in the study as a control group. The exclusion criteria were smokers, contact lens wearers, and those who had diabetes, thyroid, ocular surgery, vitamin A or D deficiency, and a high cholesterol level (<200 mg/dL is considered as a normal). The medical record of each subject was checked. The order of assessment was the use of Ocular Surface Disease Index (OSDI), followed by NITBUT, TMH, and LLP tests. The evaluation using EASYTEAR View+ was performed on the right eye of each subject. There was a five-minute interval between the consecutive tests. Each

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participant signed a written informed consent form before the measurements.

EASYTEAR View+(EASYTEAR S.R.L., Via Maioliche, Trento, Italy) was used to measure the NITBUT, TMH, and LLP. The measurements of the NITBUT and TMH were carried out three times by the same examiners with two two-minute gaps between the consecutive tests.

The OSDI is a fast method to assess ocular inflammation and irritation due to dry eye. Each participant completed the OSDI, and a score was given. Dry eye was diagnosed with a score of >13.

NITBUT is the duration between the appearance of the first dry spot in the tear film and the next blink. The measurement of NITBUT provides essential information about the tear film stability. Dry eye was defined if the NITBUT was of less than 10 seconds.[1,8]

TMH is the height in millimetres of the triangular cross-section between the cornea and the margin of the lower lid. Dry eye was defined for a TMH of less than 0.2mm.

LLP has been classified into five grades (A, B, C, D, or E). The lipid layer thickness (LLT) was arranged from the highest (grade E; LLT=90 to 140 nm) to the lowest (grade A; LLT=13

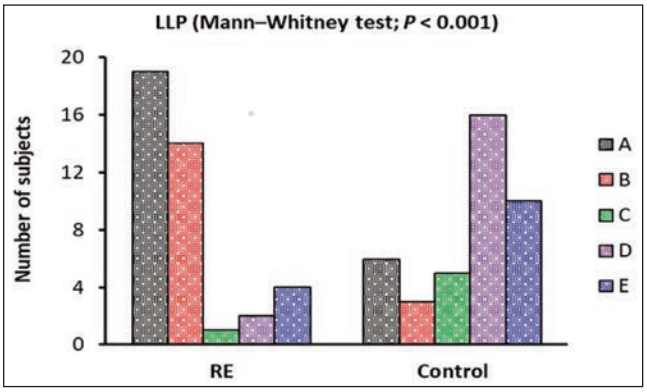

Figure-2: LLP representation in females with REs (study study) and healthy eyes (control group).

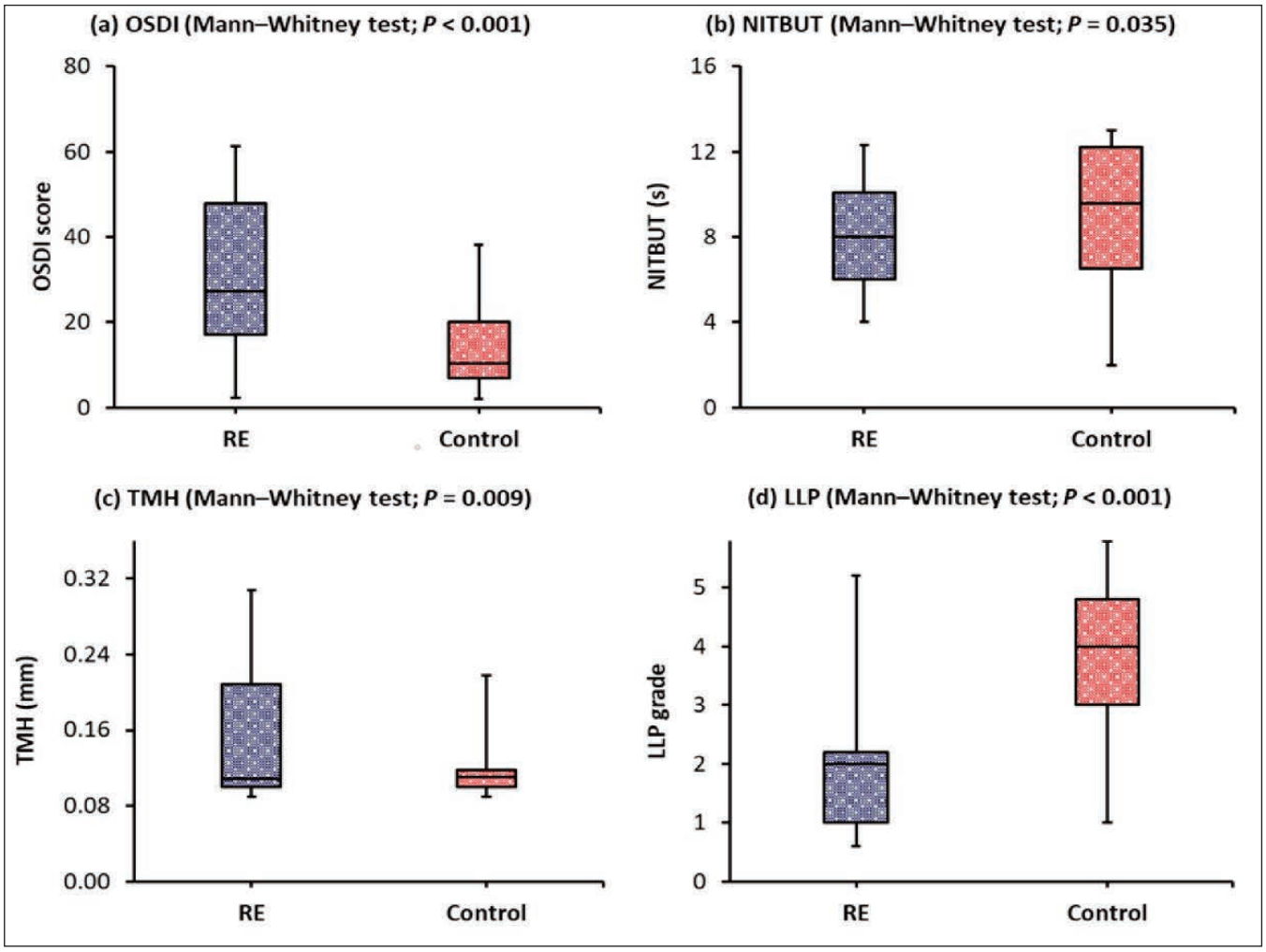

Figure-1: Side-by-side boxplots of the scores from (a): OSDI, (b): NITBUT, (c): TMH, and (d): LLP in females with REs (study group) and healthy eyes (control group).
OSDI: Ocular Surface Disease Index; NITBUT: non-invasive tear breakup time; TMH: tear meniscus height; LLP: lipid layer patterns

to 15 nm). Numbers (1, 2, 3, 4, and 5) were used instead of grades (A, B, C, D, and E, respectively) for appropriate statistical analysis to be carried out as previously reported.[6]

The data was analysed using statistical software (SPSS version 22; IBM Software, Armonk, NY, USA). The normality of the data was tested using the Kolmogorov–Smirnov test. The data obtained from both the groups were analysed using the Mann–Whitney U test. The Spearman rank correlation coefficient (r) was used to test the correlation between the scores of different parameters.

The scores were not normally distributed ($p< 0.05$), so the median (interquartile range; IQR) was used to measure central tendency. Significant (Mann–Whitney U test; $p<0.001$) differences were observed in the median scores of the OSDI ($p<0.001$), NITBUT ($p=0.035$), TMH ($p=0.009$), and LLP ($p<0.001$) between the study (subjects with REs) and control (healthy eye subjects) groups. The side-by-side boxplots for different scores in both the groups are shown in Figure 1.

The analysis of LLP showed that grade A or 1 (grey appearance; LLT=13–15nm) was predominant in females with REs (the study group). At the same time, grade D or 4 (dense white-blue layer; ~80nm) was typical in females with healthy eyes (the control group). The LLP grades for subjects in both the groups are given in Figure 2.

For the study group, the OSDI has moderate negative correlations (Spearman rank correlation coefficient; *r*) with the NITBUT ($r = -0.474$, $p = 0.002$) and TMH ($r=-0.428$, $p=0.006$) scores. In addition, the NITBUT score was strongly correlated ($r=0.539$, $p<0.001$) with the TMH score. For females with healthy eyes, OSDI has a strong negative correlation with NITBUT score ($r=-0.553$, $p=<0.001$) and a medium negative correlation with TMH ($r=-0.456$, $p=0.003$) score. Also, NITBUT score was strongly correlated ($r=0.756$, $p<0.001$) with TMH score.

The study group subjects were classified based on the degree of REs into mild (n=26; −0.25 to −3.00 D) and moderate (n=14; −3.10 to −6.00 D) REs sub-groups. No significant difference in age was noted between subjects with mild or moderate REs. The median LLP grade was significantly lower ($p=0.033$) in subjects with mild REs than those with moderate REs. Significant differences ($p<0.001$) were noted in the median OSDI, NITBUT, TMH, and LLP scores between the control group and subjects with mild and moderate REs. No significant ($p>0.05$) differences were observed in the OSDI, NITBUT, TMH, and LLP scores between the mild and moderate REs groups.

The results of this study revealed an association between REs and dry eye, which agrees with the results of previous reports. For example, a study conducted on 25 subjects with myopia, 25 with hyperopia, and 25 with healthy eyes showed that the median OSDI and TER scores were significantly higher ($p<0.001$) in individuals with REs compared with those in the control group.[5] Based on the OSDI scores, the prevalence of dry eye in subjects with REs was 24–36%, while based on TER, dry eye was observed in 48–56% of the subjects with REs.[5] Another study on 50 females with REs showed that the NITBUT was significantly ($p<0.001$) longer in healthy subjects compared with those who have myopia (n=46) and hyperopia (n=36).[7] Subjects with REs show a high prevalence of dry eye.[9] REs could cause changes in the anterior cornea surface, leading to dry eye symptoms.[10]

Conclusion

Females with refractive errors have significantly lower NITBUT, TMH, and LLT than those with healthy eyes. The results agree with previous reports using different devices. The EASYTEAR View+ can be used as a single device to assess various tear parameters.

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Author Contribution:

MAA, GAREH: Data conceptualization, methodology, validation, investigation, curation, writing original draft, review, editing, visualization, funding acquisition.
SAA: Data validation, curation, writing original draft, review, editing, visualization.
MAB, MSA: Data validation, formal analysis, writing original draft, review, editing, visualization.