

THE REPEATABILITY OF TEAR FILM MEASUREMENTS IN SUBJECTS WITH DRY EYE

INTRODUCTION

- In patients with dry eye disease, there is considerable variability in both objective measures of tear volume and tear function, and in subjective symptom reports.[1] This is challenging not only in the diagnosis of disease, but in understanding response to treatment and the natural history of the condition
- Variability in subject populations and methods used to evaluate and report repeatability of tear film measurements makes it challenging to compare different measurement techniques. Therefore, it is desirable to investigate the repeatability of various tear film assessment techniques in a single cohort of symptomatic dry eye subjects

AIM

To investigate the repeatability of tear film measurements in a symptomatic dry eye population, and to determine associations between tear film evaporation rate and other tear parameters.

METHODS

- Forty non-contact lens wearers with symptoms of dry eye (Ocular Surface Disease Index [OSDI] score >18)[2] were enrolled
- Subjects attended up to four visits. Tear film characteristics measured included:
 - Absolute tear evaporation rate (TER: grams/square metre/hour [gm²h]) measured with a modified VapoMeter (Delfin Technologies)[3] (Figure 1);
 - Fluorescein tear film break-up time (TBUT: sec): average of three measurements;
 - Lipid layer thickness (LLT: nm) with a LipiView (TearScience);
 - Un-anesthetized Schirmer I tear volume (TV: mm).
- Measurements were obtained for each eye, but data for the right eye only were used for the analysis

DATA ANALYSIS

Coefficient of repeatability (COR, 1.96*within-subjects standard deviation was estimated for tear parameters. Associations were determined using either Pearson or Spearman Rank correlation tests. Variables associated at p<0.2 were included in a stepwise ANOVA regression analysis to establish tear parameters which best predicted tear evaporation rate

Tear Film Measurements

- Fourteen males and 26 females with average age 40.1 ± 19.8 years and OSDI score 40.2 ± 14.5 were enrolled
- The averages for TER, TBUT, LLT and TV, the corresponding COR, and the proportion of the COR relative to the measurement averages are shown in Table 1

Associations

- Tear evaporation rate was moderately negatively associated with TBUT (r=-0.32, p<0.05) (Figure 2), LLT (r=-0.32, p = 0.05) (Figure 3) and positively associated with OSDI score (r=0.38, P<0.02) (Figure 4)



Figure 1: Modified VapoMeter

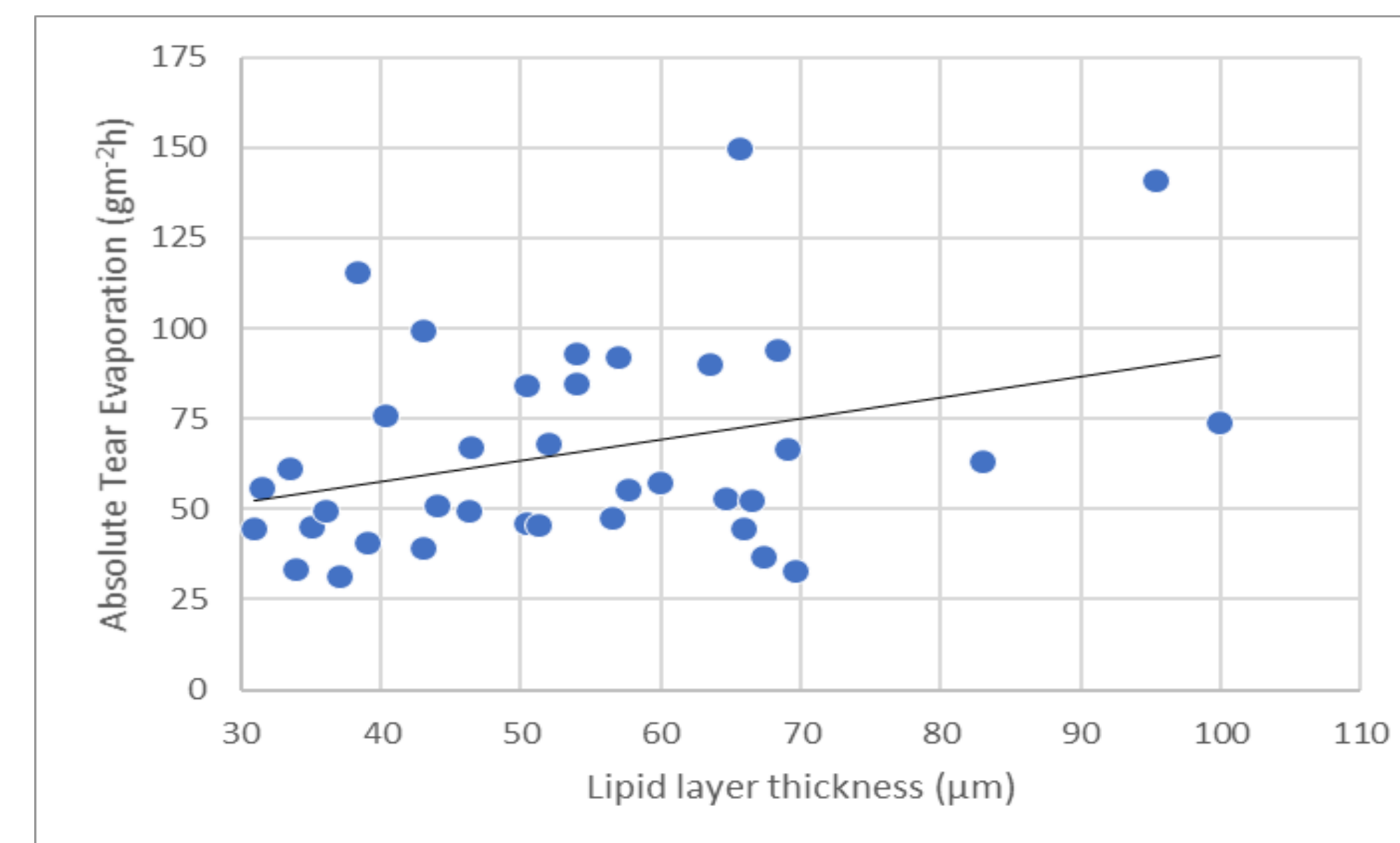


Figure 3: Association between TER and LLT (r=-0.32, p=0.05)

- In the ANOVA regression model, tear evaporation rate was best predicted by OSDI and LLT (ANOVA, F=4.94, p=0.01) (Tables 2a, 2b and 2c)

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.47	0.23	0.18	30.38

Table 2a: ANOVA model summary (Predictors: (Constant), OSDI, LLT)

RESULTS

Table 1: Average tear film measurements, coefficients of repeatability and proportion of COR relative to the average

	Average ± SD	COR	COR / Average (%)
TER (gm ² h)	69.9 ± 31.4	42.4	60.7
TBUT (s)	6.3 ± 1.7	3.1	49.2
Average LLT (nm)	57.7 ± 16.8	19.1	33.1
TV (mm)	16.8 ± 10.8	11.2	66.7

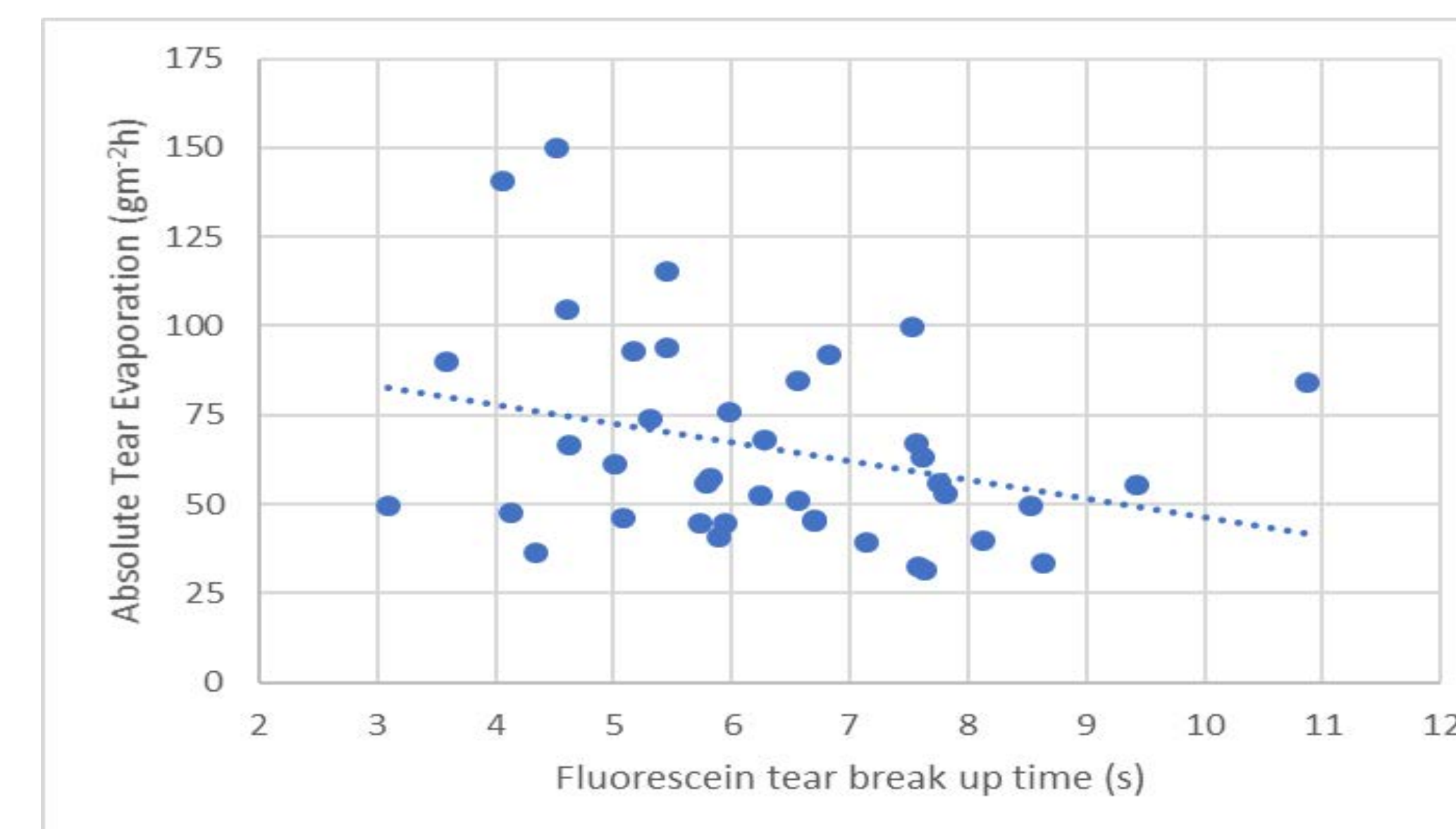


Figure 2: Association between TER and TBUT (r=-0.32, p<0.05)

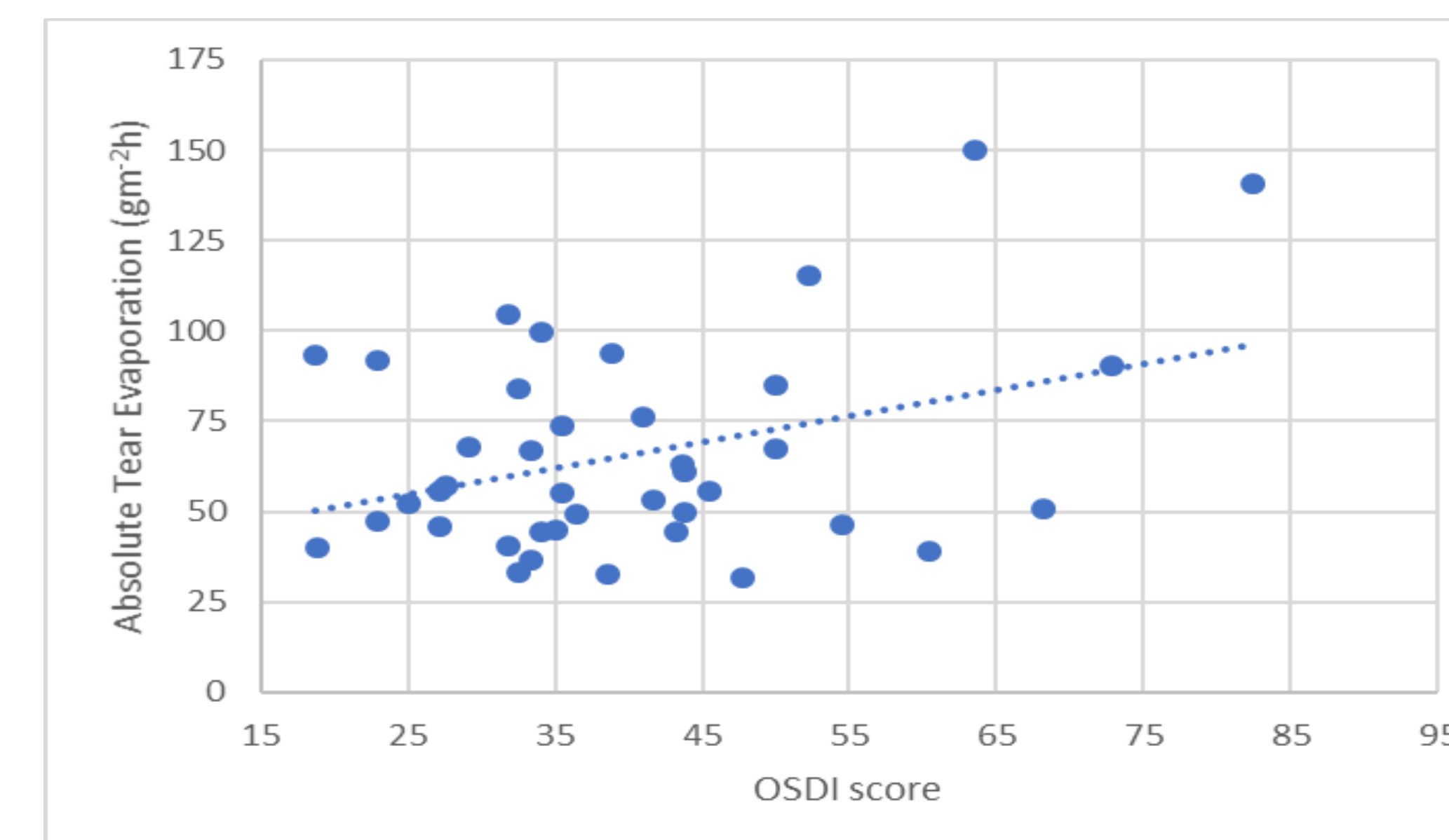


Figure 4: Association between TER and OSDI (r=0.38, p<0.02)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	9114.74	2	4557.37	4.94	0.01
Residual	31371.27	34	922.68		
Total	40486.01	36			

Table 2b: ANOVA regression model (Dependent variable: TER, Predictors: OSDI and LLT)

	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	4.53	20.86		0.22	
LLT	0.54	0.30	0.27	1.78	0.08
OSDI	0.81	0.35	0.35	2.31	0.03

Table 2c: Regression model coefficients

DISCUSSION AND CONCLUSIONS

- In this population of symptomatic dry eye subjects, when the COR was considered as a proportion compared to the measurement average, LLT was the most repeatable measurement, followed by TBUT and then TER
- The repeatability of LLT measurement in this dry eye population was marginally poorer compared to a non-dry eye population (COR 19.1 vs. 13-16 respectively)[4], whereas repeatability of TER measurements was comparable to a normal population (COR 42.4 vs. 49 respectively)[3]
- Tear volume was the least repeatable measurement, which differs to previous reports of marginally better repeatability for TV (Schirmer without anesthetic) compared to TBUT in dry eye patients, when expressed as the average range/dynamic range between the maximum and minimum values for each test (19.8 ± 17.0% vs. 22.3 ± 17.6% respectively)[1]
- The coefficient of variation for average non-invasive tear break-up time (NITBUT) was similar in dry eye subjects compared to healthy subjects (17.3-18.7% vs. 17.4-19.1%), whereas tear meniscus height was more repeatable in dry eye subjects (16.0-16.1% vs. 18.9-19.8%)[5]
- This study found significant associations between TER and TBUT, LLT and OSDI score, whereas previously, no significant correlation was found between LLT and TBUT in a non-dry eye population[4]
- Alves et. al. reported that the best combination of diagnostic tests for dry eye disease were OSDI, TBUT and Schirmer test without anesthesia.[6]
- However, the TFOS DEWS II consensus process proposed the diagnosis and monitoring of dry eye should include symptomatology and one clinical sign: NITBUT, tear osmolarity or ocular surface staining[7]
- In this population of symptomatic dry eye subjects, LLT and TBUT were the most repeatable tear parameters. In regression analysis, TER was best predicted by OSDI score and LLT
- A study limitation is that OSDI score was only measured once at the first visit to determine eligibility to participate
- Tear film measurements such as TER may be useful for the diagnosis of dry eye disease. The utility of TER in monitoring dry eye management options requires further investigation

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DISCLOSURES

This study was sponsored by Allergan Australia Pty Ltd. All authors met the ICMJE authorship criteria. Neither honoraria nor payments were made for authorship