Comparison of Tear Film Layer Analysis Using Lipiview and iTrace Prime in Dry Eye Disease Patients

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ABSTRACT

Comparison of Tear Film Layer Analysis Using Lipiview and iTrace Prime in Dry Eye Disease Patients

Purpose : This study compares the widely used LipiView analysis for diagnosing Dry Eye Disease (DED) with the recently used iTrace Prime, focusing on the Tear Film Index (TFI) among other metrics for tear film layer analysis.

Method : A retrospective study was conducted. 67 patients included in the study had tear film analyzed using two methods. LipiView measures lipid layer thickness (LLT) and the number of eye blinks. iTrace Prime assesses tear film quality by providing the TFI and Topo break-up time.

Result : The study involved 129 eyes from 67 patients. Statistically significant positive correlations were observed between LLT and TFI ($r = 0.200$, $p < .05$). Total blinks and TFI revealed a negative correlation ($r = -0.178$, $p < .01$). The strongest correlation observed in this study was between Topo BUT and TFI ($r = 0.617$, $p < .001$).

Conclusion : Both LipiView and iTrace Prime provide different insights into the tear film characteristics of DED patients. This difference necessitates careful consideration, as it might complicate correlations between the two. Therefore, a multifaceted approach to diagnosing DED is recommended, utilizing the complementary strengths of both devices.

Key words : dry eye disease, lipiview, tear film index, itrace prime

I. INTRODUCTION

Dry eye disease (DED), characterized by insufficient tear production or excessive tear evaporation, leads to a myriad of symptoms, including ocular discomfort and visual disturbance, affecting millions worldwide. [1-3] DED presents a significant clinical challenge due to its multifactorial nature, leading to tear film instability, hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities. [4] Initial evaluations through careful history taking and physical examination, including slit lamp examination with and without different stains to assess eyelid margins, conjunctiva, and cornea are essential but often insufficient for comprehensive diagnosis and staging in many patients. [5,6]

Given the limitations of conventional diagnostic methods in providing a diagnosis of DED, there is a growing reliance on additional diagnostic tests. Recent advancements in diagnostic technologies, such as meniscometry, optical coherence tomography, tear film stability analysis, interferometry, tear osmolarity, the tear film normalization test, ocular surface thermography, and tear biomarkers, facilitate a better understanding of DED. [6] Among these technologies, the LipiView Ocular Surface Interferometer (TearScience Inc., Morrisville, NC, USA) has become a fundamental tool in the diagnosis and evaluation of DED. [7] LipiView facilitates the direct visualization and measurement of the lipid layer thickness (LLT) of the tear film, providing information on tear film stability and quality. [8] Additionally, during the 20-second examination for measuring LLT and the number of eye blinks, the subjects naturally blink, allowing for the measurement of both partial and total blinking frequencies. [9] The correlation between LLT measurements obtained via LipiView and dry eye symptoms supports the instrument's utility in aiding

the assessment of tear film health. [10,11]

iTrace Prime has introduced a new metric in tear film analysis, the Tear Film Index(TFI), which assesses the quality of the tear film by analyzing the contrast sensitivity, shape, and continuity of Placido discs. [12] This innovation offers a quantitative measure of tear film quality, enhancing the ability to diagnose and understand the complexities of DED from a new perspective. This index, ranges from 0 to 10. It offers a quantitative assessment of tear film quality, with higher scores indicating better tear film stability. The iTrace Prime can also perform corneal aberration analysis. Studies have shown that higher-order aberrations (HOAs) are significantly elevated in eyes with dry eye disease compared to normal eyes. [13,14]

This study aims to compare the effectiveness of tear film analysis using the widely adopted LipiView with the newer iTrace Prime, particularly focusing on the use of the TFI and other parameters provided by these technologies. By comparing these diagnostic tools, this study seeks to evaluate their utility in clinical practice, potentially improving the diagnosis and management of patients with DED.

II. MATERIALS AND METHODS

2.1. Subjects

This study was conducted through a retrospective analysis of medical records from patients diagnosed with DED at Severance Hospital Ophthalmology Department between January 2022 and October 2023. DED diagnosis was based on the patient's subjective complaints of dry eye symptoms and objective findings from slit lamp examination,

including corneal status. Additionally, Topo Break-Up Time (BUT) of less than 10 seconds was used as a criterion for diagnosing DED. Patients included in this study were those who underwent tear film analysis using both the LipiView and the iTrace Prime. The inclusion criteria were strictly adhered to, ensuring that only those patients who did not meet any of the exclusion criteria were selected for the final study group. The study was conducted in accordance with the tenets of the Declaration of Helsinki, and the study protocol was approved by the Institutional Review Board of Severance Hospital.

2.2 Exclusion Criteria

Patients were excluded from the study based on the following criteria:

1. Presence of ophthalmic autoimmune diseases or systemic diseases.
2. History of ocular surgery or trauma, excluding simple cataract surgery.
3. Coexisting ophthalmic conditions such as uveitis and glaucoma, other than dry eye and simple cataract.
4. Active ophthalmic inflammatory diseases.
5. Undergoing any ocular surgery, including simple cataract surgery, within one year prior to the examination date.

2.3 Outcome measures

Retrospective data collection included patient age, gender, ophthalmic history, and basic information regarding the eyes examined. Diagnostic procedures for DED, such as slit lamp

biomicroscopy, were conducted following standard outpatient protocols. Measurements obtained from the LipiView included the thickness of the tear lipid layer and the number of blinks and incomplete blinks. From the iTrace Prime, the TFI and Topo BUT were recorded for comparative analysis. TFI was measured over the entire corneal surface. Tear index 0-4mm was obtained from the area within 4mm of the central cornea, while Tear index 4-8mm was measured from the outer corneal area excluding the central portion. The Topo BUT was measured using corneal topography and can also be obtained from iTrace Prime, allowing for comparative analysis. In addition, iTrace allows for the analysis of corneal higher-order aberrations. The types of aberrations quantified in this study include coma, spherical, and trefoil aberrations. Therefore, we compared corneal aberrations with other indicators. These procedures are in accordance with the standard guidelines for clinical evaluation and diagnosis in ophthalmology.

2.4 Statistical analysis

Statistical analyses were performed using SPSS for Windows (SPSS Inc., Chicago, IL, USA). To compare the clinical outcomes between iTrace Prime and LipiView, Pearson's correlation coefficient was calculated. A p-value of less than 0.05 was considered statistically significant, indicating a meaningful relationship between the outcomes of the two diagnostic tools.

III. RESULTS

The basic patient characteristics included 129 eyes from 67 patients, with a gender

distribution of 20 males to 47 females. The mean age of the participants was 59.16 ± 17.45 years.

The LipiView revealed an average LLT of 84.44 ± 19.51 nm. Partial and total blinks were observed at average rates of 4.61 ± 4.45 and 7.78 ± 5.39 times, respectively, with a recorded partial blinking rate of 0.58 ± 0.35. The iTrace Prime, introducing the TFI and measuring Topo BUT, showed an average Topo BUT of 8.04 ± 3.20 seconds. The TFI was found to average at 8.93 ± 0.82. In the corneal section extending from the center to 4mm, the tear index 0-4mm showed an average value of 8.58 ± 0.98. Moving to the 4-8mm zone, covering the mid-peripheral corneal area, the Tear Index 4-8mm was found to average 8.80 ± 1.12. Among the corneal HOAs aberrations, the mean coma aberration was 0.24 ± 0.26, the spherical aberration was 0.12 ± 0.16, and the trefoil aberration was 0.23 ± 0.56 (Table 1).

Table 1. Baseline characteristics of LipiView and iTrace Prime figures

Characteristics	
LipiView	
Lipid layer thickness (nm)	84.44 ± 19.51
Partial blinking (n)	4.61 ± 4.45
Total blinking (n)	7.78 ± 5.39
Partial blinking rate	0.58 ± 0.35

iTrace Prime	
Topo break up time (s)	8.04 ± 3.20
Tear film index	8.93 ± 0.82
Tear index 0-4mm	8.58 ± 0.98
Tear index 4-8mm	8.80 ± 1.12
Coma (RMS)	0.24 ± 0.26
Spherical (RMS)	0.12 ± 0.16
Trefoil (RMS)	0.23 ± 0.56

RMS = Root Mean Square

The LLT measurements showed a statistically significant positive correlation with the TFI ($r = 0.200$, $p < .05$) and Tear Index 0-4mm ($r = 0.202$, $p < .05$). Total blinks showed a significant negative correlation with TFI ($r = -0.178$, $p < .01$), Tear Index 0-4mm ($r = -0.235$, $p < .01$), and Tear Index 4-8mm ($r = -0.192$, $p < .05$). We also investigated the relationships between Topo BUT measured by iTrace Prime and TFI, Tear index 0-4mm, and Tear index 4-8mm. The highest correlation was observed between Topo BUT and TFI, with a correlation coefficient of 0.617. Topo BUT and Tear index 4-8mm also showed a high correlation, with a coefficient of 0.517. In contrast, Tear index 0-4mm exhibited a relatively lower correlation with Topo BUT, with a coefficient of 0.358 (Table 2).

iTrace Prime allows for the measurement of corneal aberrations. We compared corneal aberrations with tear indicators and blink counts using Pearson's correlation. Statistically significant values were found between Topo BUT and trefoil aberrations, with a coefficient of -0.209. Furthermore, Tear index 0-4mm and coma aberrations showed a statistically significant coefficient of -0.246 (Table 3).

Table 2. Results of Pearson's correlation between tear indicators and blinks

	Topo BUT	TFI	TI 0-4mm	TI 4-8mm
Lipid layer thickness	.039	.200*	.202*	.149
Partial blinks	-.111	-.060	-.006	-.076
Total blinks	-.133	-.178*	-.235†	-.192*
Partial blink ratio	-.69	.099	.099	.106
Topo BUT	1	.617§	.358§	.517§

Topo BUT = Topo Break-Up Time ; TFI = Tear Film Index ; TI = Tear Index

* indicates p<.05, † indicates p<.01, § indicates p<.001

Table 3. Results of Pearson's correlation of tear indicators and blinks with corneal HOAs aberrations

	Coma	Spherical	Trefoil

Lipid layer thickness	-.111	-.053	-.110
Partial blinks	.064	.051	-.025
Total blinks	-.029	-.054	-.093
Topo BUT	-.004	.030	-.209*
TFI	-.078	.010	-.074
TI 0-4mm	-.246†	-.096	-.150
TI 4-8mm	-.121	-.061	-.085

Topo BUT = Topo Break-Up Time ; TFI = Tear Film Index ; TI = Tear Index

* indicates p<.05, † indicates p<.01, § indicates p<.001

IV. DISCUSSION

In this study, we compared the measurements of the LipiView Ocular Surface Interferometer and the iTrace Prime in analyzing the tear film layer in patients with DED. The use of LipiView provided insightful data on the LLT and blinks, which is related to tear film stability. On the other hand, the iTrace Prime introduced a novel TFI and Topo BUT, offering an innovative approach to evaluating tear film quality.

The Pearson correlation analysis results from this study indicate that LipiView's LLT is positively correlated with both iTrace Prime's TFI and Tear Index 0-4mm. The correlation

coefficient between LLT and TFI is 0.200, and between LLT and Tear Index 0-4mm is 0.202. Although these coefficients are not particularly high, they align with previous research suggesting that lower LLT values are associated with tear film instability and DED symptoms. [8,15,16] In contrast, Lee et al. reported cases of patients with thick LLT but short TBUT and severe dry eye symptoms, suggesting that LLT alone should not be considered in isolation. Instead, other dry eye parameters should also be considered. [17] Some studies have shown a positive correlation between TBUT and LLT in patients with dry eye and obstructive MGD. [18,19] However, this study did not demonstrate a correlation between Topo BUT and LLT.

Additionally, iTrace Prime's TFI demonstrated a negative correlation with the total blinks by LipiView. Specifically, the correlation coefficient between total blinks and TFI was -0.178, indicating a weak correlation. Furthermore, the correlation coefficient between Tear Index 0-4mm and total blinks was -0.235, suggesting a slightly higher correlation. In contrast, the correlation coefficient between Tear Index 4-8mm and total blinks was -0.192. These results imply a more pronounced relationship in the central corneal area compared to the peripheral corneal area.

Several studies showing a correlation between incomplete blinking and DED highlight the relationship between blinking mechanics and ocular surface health. [20,21] In the study by Pult et al., the concept of an almost complete blink was introduced to illustrate its relationship with DED. [22] In our study, the relationship between partial blinks and TFI did not yield statistically significant results. Based on Jeon et al.'s study, which established a correlation between the PBR and DED, and Chou et al's study revealing the relationship between LLT and PBR in DED, this study investigated the association with iTrace Prime's TFI. [23,24] However, no significant correlation was found in our research. Nevertheless, the

statistically significant negative correlation observed between total blinks and TFI suggests that while there may not be a causal relationship, there is likely an influential relationship between total blinks and TFI. Following the diagnosis of DED using basic tests, considering the number of total blinks when using TFI measurements may offer insights into the severity of DED. This becomes especially relevant when comparing TFI values among individual DED patients, where taking the total blinks into account may prove beneficial.

The iTrace Prime can also measure HOAs. We utilized this capability to compare the HOAs with the tear metrics and blinks we have analyzed so far. Our results showed that while there were significant associations between Topo BUT and trefoil aberration, and between Tear Index 0-4mm and coma aberration, the correlation coefficients were not substantial. Given that significant correlations were observed in only one of the HOAs, the findings may not hold strong clinical significance. Previous studies have indicated that HOAs are significantly elevated in eyes with dry eye disease compared to normal eyes. [13,14] However, our study focuses solely on dry eye patients, which introduces a difference in context.

Previous studies compared LipiView with other diagnostic devices in patients with DED. Study conducted by Lee et al. aimed to compare LLT, meibomian gland dropouts, and blinking patterns between LipiView II and IDRA Ocular Surface Analyzer. [25] Markoulli et al.'s study compared measurements taken with the Tearscope-Plus to those taken with the LipiView for LLT. [26] These studies encountered straightforward comparisons on the same metric of LLT. However, this study diverges by contrasting LLT measurements from LipiView with TFI quantified by analyzing the Placido disc with iTrace Prime. This difference necessitates careful consideration, as it might complicate correlations between

the two.

Limitations of this study include its retrospective design. Additionally, conducting research with a larger sample size across multiple centers could provide better results. Furthermore, having access to subjective symptom assessments, such as the Ocular Surface Disease Index, would have enabled a better depiction of the relationship with the TFI.

De Luca et al.'s study discussed high-tech devices for DED diagnosis, including the DEvice Hygrometer, IDRA, Tearcheck, Keratograph 5M, Cornea Dome Lens Imaging System, I-PEN Osmolarity System, LipiView II interferometer, LacryDiag Ocular Surface Analyzer, Tearscope-Plus, and Cobra HD Camera.[27] However, previous studies have not addressed the iTrace Prime, and there are currently no publications focusing on this device. Therefore, our study represents the first comprehensive examination of its kind. It introduces the TFI as a new measure for assessing DED, establishing a basis for future research. If the iTrace Prime becomes more widely used as a supplementary tool for DED diagnosis, it will be important to compare TFI values with other diagnostic metrics. This study lays the groundwork for further use and study of the iTrace Prime in understanding DED. Given the iTrace Prime's recent introduction, it holds potential for not only diagnosing DED but also for evaluating treatment efficacy through TFI follow-up.

V. CONCLUSION

This study compares the LipiView and the iTrace Prime in analyzing the tear film layer in patients with DED. LipiView provides valuable data on LLT and blink patterns, while the iTrace Prime introduces the TFI and Topo BUT as innovative metrics for evaluating tear film quality.

The findings show statistically significant correlations between LLT and both TFI and Tear Index 0-4mm, indicating that these measurements can aid in the diagnosis of DED. Also, there is a statistically significant negative correlation between total blinks and each of TFI, Tear Index 0-4mm, and Tear Index 4-8mm. This indicates that total blink counts should be taken into account when analyzing TFI.

Despite these correlations, both LipiView and iTrace Prime provide different insights into the tear film characteristics of DED patients. This difference necessitates careful consideration, as it might complicate correlations between the two. Therefore, a multifaceted approach to diagnosing DED is recommended, utilizing the complementary strengths of both devices.

References

1. Rhee MK, Mah FS. Inflammation in Dry Eye Disease: How Do We Break the Cycle? Ophthalmology 2017;124:S14-S9.
2. Zemanová M. DRY EYE DISEASE. A REVIEW. Ceska a Slovenska Oftalmologie: Casopis Ceske Oftalmologicke Spolecnosti a Slovenske Oftalmologicke Spolecnosti 2021;77:107–19-–19.
3. Rouen PA, White ML. Dry eye disease: prevalence, assessment, and management. Home healthcare now 2018;36:74-83.
4. Craig JP, Nichols KK, Akpek EK, Caffery B, Dua HS, Joo CK, et al. TFOS DEWS II Definition and Classification Report. Ocul Surf 2017;15:276-83.
5. Di Cello L, Pellegrini M, Vagge A, Borselli M, Ferro Desideri L, Scorcia V, et al. Advances in the Noninvasive Diagnosis of Dry Eye Disease. Applied Sciences 2021;11.
6. Zeev MS, Miller DD, Latkany R. Diagnosis of dry eye disease and emerging technologies. Clin Ophthalmol 2014;8:581-90.
7. Ren Y, Wen H, Bai F, Huang B, Wang Z, Zhang S, et al. Comparison of deep learning-assisted blinking analysis system and Lipiview interferometer in dry eye patients: a cross-sectional study. Eye Vis (Lond) 2024;11:7.
8. Finis D, Pischel N, Schrader S, Geerling G. Evaluation of lipid layer thickness measurement of the tear film as a diagnostic tool for Meibomian gland dysfunction. Cornea 2013;32:1549-53.
9. Kim TH, Han KE. Clinical Characteristics of Corneal Hyperalgesia in Patients with Dry Eye Symptoms. Journal of the Korean Ophthalmological Society

2021;62:21-8.

10. Sullivan BD, Crews LA, Messmer EM, Foulks GN, Nichols KK, Baenninger P, et al. Correlations between commonly used objective signs and symptoms for the diagnosis of dry eye disease: clinical implications. Acta Ophthalmol 2014;92:161-6.
11. Kim RY, Na KS, Park YL, Kim HS. Correlation Analysis of Tear Film Lipid Layer Thickness and Ocular Surface Disease Index. Journal of the Korean Ophthalmological Society 2017;58.
12. Kundu G, Shetty R, Khamar P, Gupta S, Mullick R, Ganesan VL, D'Souza S. Impact of tear optics on the repeatability of Pentacam AXL wave and iTrace in measuring anterior segment parameters and aberrations. Indian J Ophthalmol 2022;70:1150-7.
13. Montés-Micó R, Cáliz A, Alió JL. Wavefront analysis of higher order aberrations in dry eye patients. J Refract Surg 2004;20:243-7.
14. Denoyer A, Rabut G, Baudouin C. Tear film aberration dynamics and vision-related quality of life in patients with dry eye disease. Ophthalmology 2012;119:1811-8.
15. Hwang HS, Kim EC, Kim MS. Novel tear interferometer made of paper for lipid layer evaluation. Cornea 2014;33:826-31.
16. Blackie CA, Solomon JD, Scaffidi RC, Greiner JV, Lemp MA, Korb DR. The relationship between dry eye symptoms and lipid layer thickness. Cornea 2009;28:789-94.
17. Lee Y, Hyon JY, Jeon HS. Characteristics of dry eye patients with thick tear film lipid layers evaluated by a LipiView II interferometer. Graefes Arch Clin Exp

Ophthalmol 2021;259:1235-41.

18. Eom Y, Lee JS, Kang SY, Kim HM, Song JS. Correlation between quantitative measurements of tear film lipid layer thickness and meibomian gland loss in patients with obstructive meibomian gland dysfunction and normal controls. Am J Ophthalmol 2013;155:1104-10.e2.
19. Isreb MA, Greiner JV, Korb DR, Glonek T, Mody SS, Finnemore VM, Reddy CV. Correlation of lipid layer thickness measurements with fluorescein tear film break-up time and Schirmer's test. Eye (Lond) 2003;17:79-83.
20. Wang MTM, Tien L, Han A, Lee JM, Kim D, Markoulli M, Craig JP. Impact of blinking on ocular surface and tear film parameters. Ocul Surf 2018;16:424-9.
21. Jie Y, Sella R, Feng J, Gomez ML, Afshari NA. Evaluation of incomplete blinking as a measurement of dry eye disease. Ocul Surf 2019;17:440-6.
22. Pult H, Riede-Pult BH, Murphy PJ. The relation between blinking and conjunctival folds and dry eye symptoms. Optometry and Vision Science 2013;90:1034-9.
23. Jeon YJ, Song MY, Kim KY, Hwang KY, Kwon YA, Koh K. Relationship between the partial blink rate and ocular surface parameters. Int Ophthalmol 2021;41:2601-8.
24. Chou YB, Fan NW, Lin PY. Value of lipid layer thickness and blinking pattern in approaching patients with dry eye symptoms. Can J Ophthalmol 2019;54:735-40.
25. Lee JM, Jeon YJ, Kim KY, Hwang KY, Kwon YA, Koh K. Ocular surface analysis: A comparison between the LipiView((R)) II and IDRA((R)). Eur J Ophthalmol 2021;31:2300-6.
26. Markoulli M, Duong TB, Lin M, Papas E. Imaging the Tear Film: A Comparison

Between the Subjective Keeler Tearscope-Plus and the Objective Oculus(R) Keratograph 5M and LipiView(R) Interferometer. Curr Eye Res 2018;43:155-62.

27. De Luca A, Ferraro A, De Gregorio C, Laborante M, Coassin M, Sgrulletta R, Di Zazzo A. Promising High-Tech Devices in Dry Eye Disease Diagnosis. Life (Basel) 2023;13.

Abstract in Korean

건성안 환자에서 Lipiview와 iTrace Prime을 이용한 눈물층 분석 비교

목적 : 본 연구는 건성안 진단에 널리 사용되는 LipiView와 Tear Film Index (TFI) 등 다른 건성안 관련 지표들을 가진 iTrace Prime를 비교한다.
방법 : 후향적 연구로 진행되었으며 67명의 환자들을 두 장비를 이용하여 눈물막을 분석하였다. LipiView는 눈물 지질층의 두께 (LLT)와 눈 깜빡임 횟수를 측정하고, iTrace Prime은 Tear Film Index 와 Topo break up time을 측정하여 평가한다.
결과 : 67명의 환자로부터 총 129안이 연구에 포함되었다. LLT와 TFI 사이에 통계적으로 유의한 양의 상관관계를 보였다 ($r = 0.200$, $p < .05$). 총 깜빡임 수와 TFI 사이에는 음의 상관관계가 나타났다 ($r = -0.178$, $p < .01$). 이 연구에서 관찰된 가장 강한 상관관계는 Topo BUT와 TFI 사이에서 보였다 ($r = 0.617$, $p < .001$).
결론 : 건성안을 측정하는 장비인 LipiView 와 iTrace Prime은 서로 눈물막을 측정하는 바가 다르다. 이 차이는 둘 사이의 상관관계가 관련을 보이기 어려울 수 있음을 고려해야 할 것이다. 따라서 두 장치의 상호 보완적인 강점을 활용한 다각적인 접근이 건성안 진단에 권장된다.

핵심되는 말 : 건성안, lipiview, tear film index, itrace prime