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RESEARCH ARTICLE

Impact of In-Office Dry Eye Therapy on Symptom Relief and Tear Film in Patients with Evaporative Dry Eye Disease in a Primary Optometry Clinic

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Abstract

Evaporative dry eye disease (EDE), commonly associated with meibomian gland dysfunction (MGD), is characterized by tear film instability and visual disturbance. Conventional treatments provide temporary relief without addressing the underlying gland dysfunction. In-office dry eye therapy using controlled heat, Light Emitting Diode (LED+) with vibration has emerged as a potential treatment, though evidence from primary optometry clinics remains limited. This study evaluated the impact of in-office dry eye therapy on both subjective symptoms and objective parameters in patients with evaporative dry eye disease. This prospective pre- and post-interventional study included 49 patients diagnosed with evaporative dry eye disease. Baseline assessment included Tear Film Break-Up Time (TBUT), corneal staining, meibomian gland evaluation, and Ocular Surface Disease Index Questionnaire (OSDI-12) scoring. All patients underwent standardized in-office dry eye therapy, with a follow-up evaluation conducted after one month. Paired t-test was used to analyze the changes in OSDI-12 scores, and the Wilcoxon signed rank test was used to analyze the TBUT score comparison. A statistically significant ($p<0.001$) reduction of the OSDI-12 score was observed following intervention. TBUT values improved significantly post-therapy ($p<0.001$). Corneal staining showed improvement in 75% of patients with EDE, and qualitative improvement in meibomian gland function was noted in the majority of the participants. In-office dry eye therapy was significantly associated with improved tear film stability and reduced symptom severity in patients with evaporative type of dry eye disease.

Keywords: Evaporative dry eye disease, meibomian gland dysfunction, in-office dry eye therapy, tear film stability, OSDI-12, primary optometry clinic

Introduction

Dry eye disease is one of the most common ocular surface disorders, and it is associated with significant ocular surface damage, tear film instability, and ocular surface inflammation (Uchino et al., 2013). This disruption is mostly due to increased tear osmolarity and instability of the tear film, which can trigger inflammation of the ocular surface and alter neurosensory signaling (Craig et al., 2017). Dry eye disease is among the most prevalent ocular conditions observed worldwide by many eye care practitioners, with a growing prevalence ranging from 18.4 to 40.8% (Shirsat et al., 2023). The increased prevalence of dry eye disease is related to a rise in the use of digital devices, environmental pollution, and prolonged exposure to air-conditioned environments, which have contributed to the rising dry eye disease burden, particularly in the urban population (Mandell et al., 2020; K.S Reshma., 2025)

EDE is the most prevalent subtype of dry eye disease, which is primarily associated with meibomian gland dysfunction (MGD) (Sheppard et al., 2023). Meibomian glands play an important role in preserving the stability of the tear film by secreting a lipid layer, thereby reducing evaporation (Sheppard et al., 2023). Dysfunction of these glands leads to altered lipid secretion, increased tear film

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evaporation, and rapid tear film break-up time, resulting in ocular discomfort and visual disturbance. Persistent tear film instability triggers an inflammatory cascade that contributes to ocular surface damage and epithelial compromise (Kaur et al., 2024).

Common clinical symptoms of evaporative dry eye disease include persistent ocular dryness, irritation with foreign body sensation, often accompanied by intermittent blurring of vision. These symptoms may affect daily activities and negatively impact the quality of living (Kaur et al., 2024). Clinical examination of dry eye disease requires both subjective and objective assessment methods. Tear film break-up time (TBUT) is widely used to evaluate the stability of the tear film, and corneal staining helps in assessing the ocular surface integrity (Paugh et al., 2020). The Ocular Surface Disease Index (OSDI-12) questionnaire is a validated tool that quantifies symptom severity and functional limitation linked with dry eye disease. Nevertheless, it is well recognized that symptoms and signs of dry eye do not always correlate, so assessing the clinical parameters and patient- reported outcomes is important.

Conventional treatment of EDE includes using a lubricating eye drop, lid hygiene measures, and warm compresses (Qiao. J et al., 2013). While artificial tears provide only temporary symptomatic relief, they do not address the underlying meibomian gland obstruction. In recent years, in-office dry eye therapy has gained attention as an effective treatment modality that targets the root cause of evaporative dry eye disease. Heat-based therapy with red LED+ and mechanical stimulation is designed to liquify the thickened meibum, improve gland expression, and stabilize the tear film lipid layer function. Compared to home-based treatment, in-office therapy allows controlled heat delivery, standardized application, and better patient compliance (Beining, M. W et al., 2022). Despite an increase in the awareness and availability of in-office dry eye treatment, there are limited published data evaluating their effectiveness in a primary optometry clinic setting, particularly in the Indian context. Most existing studies focus on the tertiary eye care setting, which may not reflect routine clinical practice. Evaluating the impact of in-office dry eye therapy in a primary optometry clinic is important, as optometrists are the first point of contact for patients with dry eye disease.

The study aims to assess the impact of in-office dry eye therapy on tear film parameters and symptom relief in patients with evaporative dry eye disease attending a primary optometry clinic.

Methodology

This study followed a prospective pre-post interventional design and was conducted at MCVI Vision and Eye Care Clinic, Gurugram, over a six-month period from Sep-2024 to Feb-2025. All interventions, examinations, and follow-up assessments were done by a trained optometrist using standardized clinical procedures. A total of 49 participants were enrolled in this study. Participants aged 16 years and above, of both genders, were included. Written informed consent was obtained from the participants before enrolling them in the study.

Patients first underwent a detailed eye examination, including onset and duration of symptoms as well as contributing factors such as digital device use, use of air-conditioning, systemic and ocular history, medication history, and contact lens history. Visual acuity was assessed by using the LogMAR chart. A detailed slit lamp bio-microscopy evaluation was done to see the status of the lid margin, meibomian gland orifice, quality of meibum and its expression, conjunctival hyperaemia, and tear meniscus height. Diagnosis of evaporative dry eye disease was done based on clinical evaluation, tear film assessment, and meibomian gland evaluation.

Inclusion and exclusion criteria of the study:

Inclusion criteria:

- Age greater than 16 years
- TBUT < 10 sec
- Abnormal meibomian gland appearance (thickened meibum, blocked meibomian gland opening, poor expression)
- OSDI-12 score > 13
- Presence of symptoms like dryness, irritation, and fluctuating vision
- Willingness to undergo in-office dry eye therapy

Exclusion criteria

- Ocular infection
- Corneal ulcer or keratitis
- Any recent eye surgery in the last 3 months
- Use of any topical medication other than lubricating eye drops
- Contact lens use within the last 48 hours

During the meibomian gland evaluation, grading was based on secretion quality, meibum expression, gland plugging, and lid margin irregularity.

Meibomian gland dysfunction-related dry eye disease is graded by using these parameters

The following tests were performed before initiation of the therapy.

Tear break-up time (TBUT)

After staining the eye with fluorescein dye, the tear film was assessed under cobalt blue filter, and the time of appearance of the first dry spot was recorded. TBUT score less than 10 sec considered dry eye disease, the average of three measurements was considered (Yazdani, M et al., 2021)

Schirmer's test (Type II)

Schirmer's strips were placed in the lower fornix after instilling the anaesthetic eye drop, and the extent of

wetting was measured after 5 minutes to see the basal tear production (Brott, N. R et al., 2024)

Corneal fluorescein staining

Corneal staining was assessed under the slit lamp with cobalt blue filter, and grading was done to evaluate epithelial integrity

Meibomian gland assessment

Gland expression quality of meibum, lid margin irregularity, and gland obstruction were assessed using a slit-lamp biomicroscope

Ocular Surface Disease Index (OSDI-12)

Patients completed the validated OSDI-12 questionnaire to quantify symptom severity and functional limitation associated with dry eye disease OSDI-12 score >13 is considered dry eye.

In-office dry eye therapy protocol

Patients who met the inclusion criteria and were diagnosed with evaporative dry eye disease were included in the study. After the patient was diagnosed with evaporative dry eye, the procedure began with the application of a heated eye mask over both eyes for 10 minutes to provide uniform warmth and to lead to the liquification of thickened meibum. This was followed by using a dry eye wand device delivering a controlled heat, (42 degree) LED red light, and gentle vibration over both upper and lower eyelids. The device was applied using slow, systematic movement to stimulate the activity of meibomian glands.

Following the wand therapy, manual expression of meibomian glands was performed using a meibum expressor to clear the softened secretion from the gland orifices. In a patient with associated blepharitis, the lid margin with lid lashes was cleaned with a microblepharoexfoliation (MBE) device, followed by wiping with tea tree oil-soaked wet wipes to both upper and lower lids.

After the in-office procedure, all the patients were advised to continue warm compression at home using a gel eye mask once daily for 10 minutes followed by lid massage for a period of one month, and the patients were counselled about the use and compliance with the therapy.

Outcome measures

The main outcome measures were changes in OSDI-12 scores, TBUT scores, and corneal surface staining post-therapy.

Statistical Analysis

For the data analysis process, Jamovi statistical software (version 2.6.13) was used. Descriptive statistics were used to summarize the demographic data. The Shapiro-Wilk test was performed to check the normality and pre-post therapy comparison, a paired t-test was performed for normally distributed data, and a Wilcoxon signed-rank test was performed for not normally distributed data. For categorical variables like corneal staining before and after the dry eye therapy, McNemar's test was used. For all the analyses, a $p < 0.05$ was considered statistically significant.

Result

This study included 49 participants who completed baseline and post-therapy assessments. The study population's mean age was 42.9±16.2 years, ranging from 16 to 75 years. The study samples consisted predominantly of 38 males (79.17%) and 11 females (22.92%). Chi-squared goodness-of-fit test showed a statistically significant difference in gender distribution ($\chi^2 = 30.2$, df = 1, $p < 0.001$).

Change in symptom severity (OSDI-12 score)

Participants' symptom severity was assessed using the OSDI questionnaire. Normality test using the Shapiro-Wilk test confirmed that the score of OSDI-12 was normally distributed ($p > 0.05$), so a paired t-test was used to compare the pre- and post-score. The analysis showed a significant reduction in OSDI-12 score following in-office dry eye therapy ($t=14.7$, $p < 0.001$). The maximum number of participants reported improvement in dry eye symptoms after in-office therapy, including ocular discomfort, dryness, and vision fluctuation after treatment. Figure 1 demonstrates that improvement in the OSDI-12 score post-therapy indicates a reduction in the symptom severity in patients after receiving the in-office dry eye therapy.

Changes in TBUT score

Evaluation of the tear film was done using the TBUT test. Shapiro-Wilk normality testing demonstrated that values of TBUT were not normally distributed ($p < 0.05$), so the Wilcoxon signed-rank test was applied to assess changes between pre- and post-therapy value. There was a significant increase in TBUT value after therapy ($Z= -6.42$, $p < 0.001$), indicating improvement in stability of tear film following in-office treatment. Figure 2 shows a significant upward shift of the TBUT score in the box plot indicate increased stability of the tear film after the therapy

Corneal fluorescein staining

Corneal staining improved significantly in the evaluated cohort. Among the subjects followed by the post-therapy, a majority of participants demonstrated a positive response, with 75% (18/24) showing a significant reduction in staining. Only a small minority (25%, 6/24) remained at the same staining level. This transition toward a healthier corneal surface was statistically significant ($p < 0.001$). Table 2 shows the corneal surface staining changes before and after the in-office dry eye therapy

Meibomian gland and lid findings

Post-therapy slit lamp examination revealed improvement in the meibomian gland expression and meibum quality in the majority of patients. Reduced gland obstruction

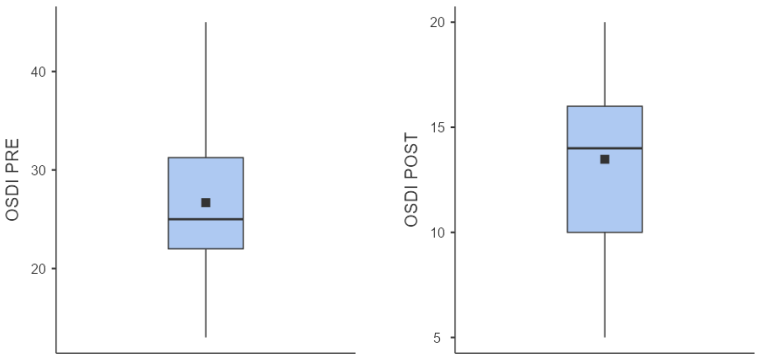

Figure 1: Comparison of the OSDI-12 score before and after in-office dry eye therapy

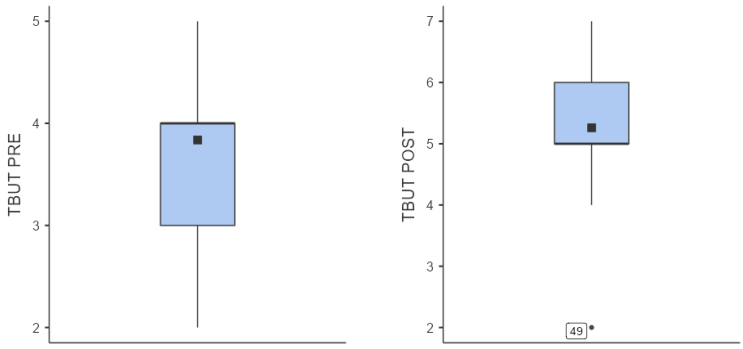

Figure 2: shows a significant upward shift of the TBUT scores in the box plot, indicating increased tear film stability after therapy

and improved ease of meibum expression were observed using combined heat therapy and manual gland expression. Patients with associated blepharitis showed improved lid margin cleanliness after the lid hygiene treatment.

The majority of the participants showed improvement in both subjective and objective dry eye parameters following in-office dry eye therapy. A significant improvement was observed in symptom severity, tear film stability, corneal surface integrity, and meibomian gland function, with no adverse effect throughout the period of the treatment.

Discussion

Dry eye disease, due to excessive evaporation of the tear film, is often associated with meibomian gland dysfunction and represents a significant clinical challenge in routine optometric practice. The present study evaluates the impact of in-office dry eye therapy on tear film stability and symptom relief in patients with evaporative dry eye disease attending a primary optometry clinic. The findings of this study showed a significant improvement in both subjective symptoms and objective parameters following in-office dry eye therapy.

In the present study, symptom severity was assessed by using the OSDI-12 questionnaire, which showed a statistically significant reduction following therapy. Reductions in the OSDI-12 score indicate meaningful symptom relief in terms of ocular discomfort, dryness, visual disturbance, and functional limitation. Improvement in patient-reported outcomes is clinically important as dryness has a substantial impact on daily activity and quality of living (Lim, E.W.L et al., 2023). These study findings are consistent with a previous

Table 1: Comparison of parameters pre and post in-office dry eye therapy in patients with evaporative component of dry eye disease

Parameter	*Pre-therapy (Mean)*	*Post-therapy (Mean)*	*p-value*
OSDI-12 score	26.7	13.5	$p < 0.001$
TBUT score	3.84	5.26	$p < 0.001$

Table 2: Corneal staining pre and post in-office dry eye therapy

Parameter	*Pre-therapy*	*Post-therapy*	*p - value*
Corneal staining	Positive: 42 (85.7%)	Reduced: 18 (75%)	$p < 0.001$
	Negative: 7 (14.3%)	Same: 6 (25%)	

report that has demonstrated a significant symptomatic improvement following heat-based and in-office dry eye therapy (Beining et al., 2022).

The improvement observed in the TBUT score in the current study is comparable to findings reported in earlier studies, which assessed the thermal pulsation system (Meng Z et al., 2023). Previous studies showed that infra-red based thermal therapy improved the stability of tear film in patients with meibomian gland obstruction by liquefying the thickened meibum and enhancing gland function (Antwi A et al., 2024), similarly, the dry eye wand therapy used in the present study, which delivers red LED+ with heat and vibration, contributed to the observed improvement in TBUT value.

Corneal fluorescein staining analysis in the present study further supported the effectiveness of in-office dry eye therapy. Among patients with baseline corneal epithelial involvement, 75% have demonstrated a reduction in corneal staining following therapy, while the remaining patients showed no change. Importantly, there was no worsening of corneal staining. Reduction in corneal staining indicates the improvement in eye surface integrity and is likely secondary to elevated tear film consistency and reduced tear film evaporation. These findings are in line with previous studies reporting reduced staining of the ocular surface after effective treatment of defective meibomian gland (Park Y et al., 2022).

The current study disclosed that there is a qualitative improvement in the expression of the meibomian gland with improved meibum quality after the in-office dry eye treatment. Combined in-office thermal and mechanical therapy likely adds to the liquification of thickened meibum and improves gland clearance. The additional use of lid pro in patients with blepharitis may have further enhanced treatment outcomes by reducing the lid margin inflammation and micro-organism buildup. Similar meibomian gland function improvement has been documented in studies evaluating a complete lid-based treatment protocol (Tao et al., 2023).

The strength of the current study is its setting in a primary optometry clinic, which reflects the real-world clinical practice. Most existing studies on dry eye therapy have been conducted in a tertiary eye care centre using an advanced diagnostic platform. The current study demonstrated that even in the primary optometry clinic, structured in-office dry eye management can lead to significant clinical and symptomatic improvement. These findings show the optometrist's role in early detection and effectively managing the dry eye disease, which is due to evaporation of the tear film.

Despite the significant results, there are certain limitations of this study. The sample size of this study was relatively small, and the follow-up period was limited to one month. A longer follow-up would be helpful to determine the durability of the treatment effect. Adding to this, in this study, lipid layer thickness and meibography were not done, which could provide further insight into the alteration of the meibomian glands.

Further studies with a bigger sample size with longer follow-up durations and inclusion of advanced diagnostic tools are needed to further validate the effectiveness of the in-office dry eye therapy in evaporative dry eye disease.

The current study demonstrated that in-office dry eye therapy is effective in improving tear film, ocular surface health, and severity of symptoms among patients with dry eye disease due to evaporation of tear film. The findings support the integration of a well-structured dry eye therapy protocol in a primary optometry clinic to provide comprehensive care for patients with evaporative dry eye disease.

Conclusion

The present study demonstrated that In-office dry eye therapy is an effective management approach for patients with dry eye due to tear film evaporation in a primary optometry clinic. Significant improvement was observed in both subjective symptoms and objective clinical parameters after therapy. Patient-reported symptom severity assessed with the OSDI-12 score showed a significant reduction after treatment, indicating meaningful symptomatic relief. Tear film stability, evaluated using tear break-up time (TBUT), also improved significantly, reflecting enhanced tear film quality after therapy.

Additionally, there is improvement in the corneal fluorescein staining, and meibomian gland function was observed in the majority of patients, suggesting better ocular surface integrity and gland performance. The combination of controlled heat application, LED+ based therapy, vibration, and manual meibum expression effectively addressed the underlying meibomian gland dysfunction, the key contributing factor to evaporative dry eye disease.

The findings of the study demonstrated the clinical value of a structured dry eye therapy protocol in routine optometric practice. Early diagnosis and targeted intervention in the primary eye care setting can lead to improved patient outcomes with improved quality of life.

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Ethical consideration:

Written informed consent was taken from all the participants before including them in the current study, and this study adheres to the principles of the Declaration of Helsinki

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