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Testing The Efficacy Of Meibomian Gland Massager In Managing Meibomian Gland Dysfunction

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Abstract
Background: Meibomian Gland Dysfunction (MGD) is the primary cause of evaporative dry eye. Conventional treatment methods suffer from poor compliance and inconsistent outcomes. This study evaluates the efficacy of a custom-designed Meibomian Gland Massager (MGM) in improving clinical and symptomatic parameters in patients with MGD.
Methods: A prospective interventional study was conducted among 106 patients with clinically diagnosed MGD. Participants underwent two weekly sessions using the MGM device, which delivers controlled heat and vibration to the eyelids. Objective parameters (Tear Break-Up Time [TBUT], Schirmer's test) and subjective symptoms (Ocular Surface Disease Index [OSDI]) were assessed at baseline, 1 week, and 2 weeks.
Results: TBUT increased significantly from a mean of 5.92s to 14.92s ($p < 0.001$). Schirmer's test improved from 6.81 mm to 17.12 mm (RE) and 5.81 mm to 18.14 mm (LE). OSDI scores decreased from 21.14 to 7.53. The device was well-tolerated, with minimal adverse effects.
Conclusion: The MGM is a promising, affordable, and effective intervention for MGD. It improves both objective signs and subjective symptoms, offering a standardizable and patient-compliant alternative to conventional therapies.
Keywords: *Meibomian Gland Dysfunction, Dry Eye, Thermal Therapy, Tear Break-Up Time, Schirmer Test, OSDI, Eyelid Massage*

INTRODUCTION

Meibomian Gland Dysfunction (MGD) is a chronic abnormality of the meibomian glands, which contributes significantly to the pathogenesis of evaporative dry eye disease (DED) (1). It affects up to 70% of the aging population and is considered the most common cause of DED worldwide (2,3). MGD results in altered meibum secretion and quality, leading to tear film instability, ocular surface inflammation, and discomfort (4).

Standard MGD treatments include warm compresses, lid scrubs, meibomian gland expression, and artificial tears (5,6). However, these methods require strict compliance and yield inconsistent results. Office-based therapies such as LipiFlow, iLux, and TearCare have shown promise but remain costly and less accessible (7–9).

The aim of this study was to evaluate the efficacy of a novel, portable Meibomian Gland Massager (MGM) that provides controlled heating and mechanical vibration to express meibum and restore glandular function. This device was designed to provide standardized, repeatable therapy without the need for extensive user training or cost-prohibitive equipment.

MATERIALS AND METHODS

Phase I: Device Development

Objective: To design and prototype a smart meibomian gland massager to alleviate dry eye symptoms through controlled massage and warmth.

Design and Prototyping:

1. **Silicone Frame:** A flexible silicone frame is created for comfort and durability.
2. **Vibrating Massager:** Small vibrators are integrated into the inner surface, designed to produce gentle massage for stimulating the meibomian glands.

3. **Heating Elements:** Heating elements are embedded within the device to provide controlled warmth, optimized for promoting meibum secretion without causing discomfort. A precise temperature ranging from 32°C to 35°C is maintained.
4. **Rechargeable Battery:** A compact rechargeable battery is incorporated for portability and convenience, allowing for extended use without reliance on external power sources.

Meibomian Gland Massaging device

Phase II: Clinical Trial

Objective: To evaluate the efficacy, safety and usability of the smart meibomian gland massager in alleviating dry eye symptoms by controlled clinical trial.

Study Design:

This is an Interventional study

Place of Study:

This study was done in the Department of Ophthalmology, Saveetha Medical College, Chennai, India

Patient Selection: Adults aged 18-75 years with a diagnosis of dry eye syndrome (DEWS score ≥6) and signs of meibomian gland dysfunction.

Sample size and Study Population: A total of 106 patients diagnosed with Meibomian gland Dysfunction, attending the department of Ophthalmology at Saveetha Medical College and Hospital, Chennai were recruited for the study considering the inclusion and exclusion criteria.

INCLUSION CRITERIA:

- Patients attending ophthalmology OPD in Saveetha medical college aged above 18 years of age
- Patients with meibomian gland dysfunction who provided consent.

EXCLUSION CRITERIA:

1. Ocular surface disorders
2. Autoimmune diseases
3. Incomplete data
4. Pregnant women
5. Diabetic patients
6. Patients with autoimmune disorders.
7. Previous ocular trauma
8. Patients with ocular infections
9. Patients on topical immunosuppressants
10. Patients on medications that may cause dry eye

Ethical considerations:

Permission from ethical committee attached to Saveetha Medical College, Chennai, Tamil Nadu was taken before starting the study.

METHODOLOGY:

- Patients diagnosed with Meibomian gland Dysfunction, attending the department of Ophthalmology at Saveetha Medical College fulfilling the inclusion criteria were recruited for the study.
- All patients were explained about the procedure and informed consent was taken.
- Patient particulars like history of present illness were noted in detail.

- Past history, previous comorbidities like hospital admissions, hypertension, diabetes mellitus, tuberculosis, vascular disorders and history of trauma were taken into account.
- Slit lamp examination was done and parameters such as Tear Film Breakup Time (TBUT), Schirmer's test (ST1), and Ocular Surface Disease Index (OSDI) scoring were assessed before the intervention.
- Massage therapy was given once a week for a period of 2 weeks.
- Parameters were assessed before, after 1 week and after 2 weeks of massage therapy.

Outcome measures:

1. Tear Break-Up Time (TBUT)
2. Schirmer's I Test (without anesthesia)
3. Ocular Surface Disease Index (OSDI) questionnaire

Statistical Analysis:

Data were analyzed using SPSS v26. Paired t-test was used to compare pre- and post-treatment values. A p-value <0.05 was considered statistically significant.

RESULTS

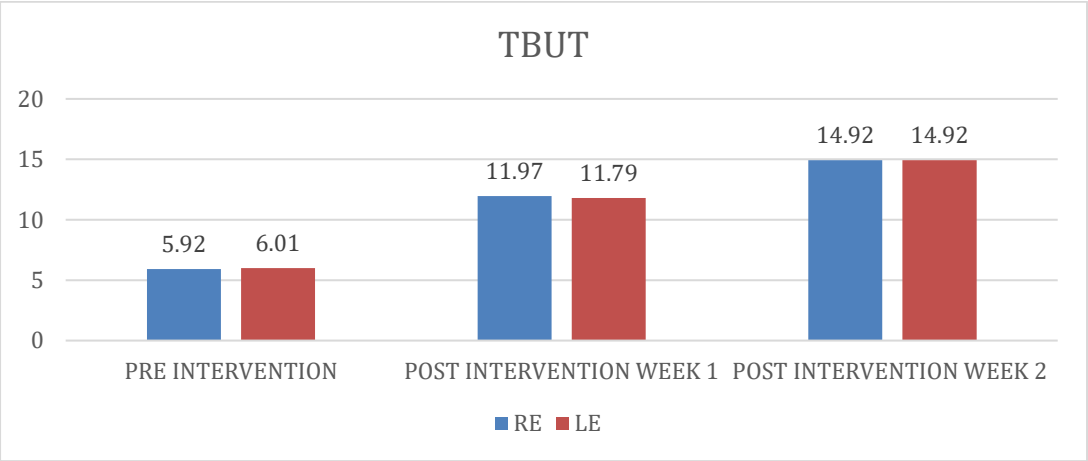
Demographics: Of 106 patients, 55 (51.89%) were male and 51 (48.11%) were female. The average age was 34.4 years.

TBUT: Increased significantly from 5.92 ± 1.02 s at baseline to 12.32 ± 1.27 s at 1 week and 14.92 ± 1.18 s at 2 weeks ($p < 0.001$).

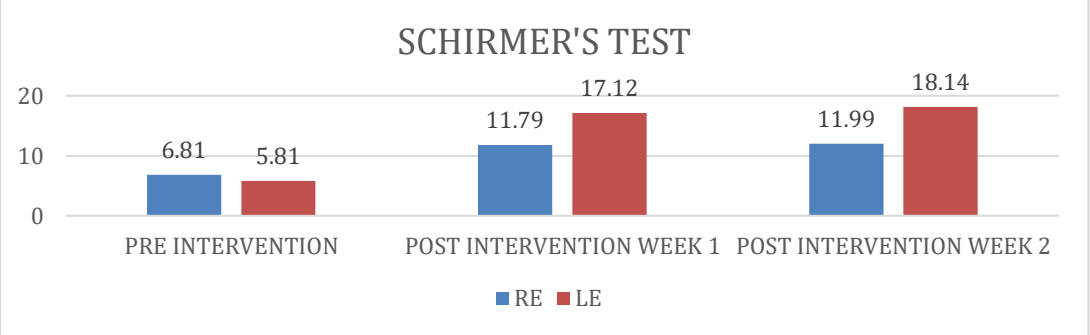
Schirmer's Test: Mean values improved from 6.81 mm to 17.12 mm (RE) and 5.81 mm to 18.14 mm (LE) by week 2 ($p < 0.001$).

OSDI: Mean scores decreased from 21.14 (moderate symptoms) to 10.87 at 1 week and 7.53 (mild/none) at 2 weeks.

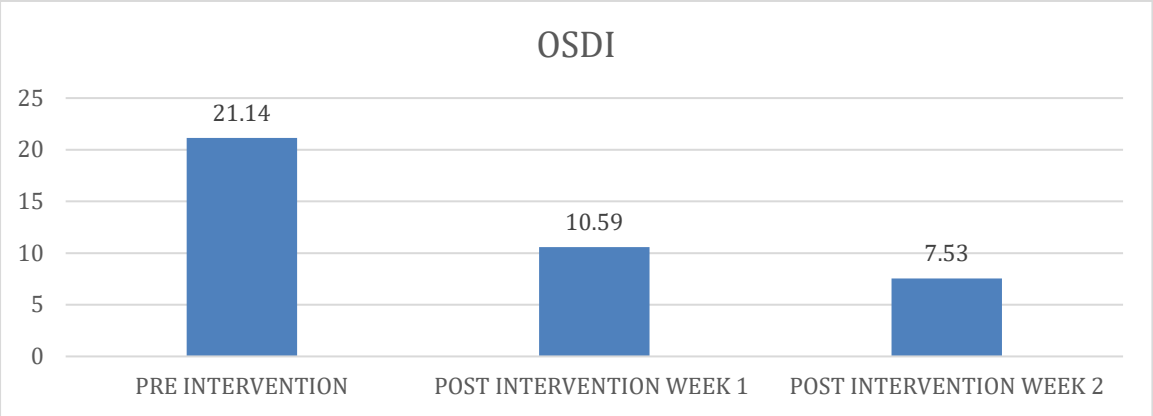
No serious adverse events were reported. Two patients reported mild lid tingling which resolved spontaneously.



Graph 1 gives a summary of the TBUT values before intervention, at 1 week and at 2 weeks after intervention in right and left eye. This shows that at the end of 2 weeks of massage therapy there's a significant improvement in the TBUT in both eyes.



Graph 2 gives a summary of the Schirmer's test score before intervention, at 1 week and at 2 weeks after massage therapy in right and left eyes. This shows a significant improvement in the Schirmer's test score at the end of 2 weeks of massage therapy in both eyes.



Graph 3 gives a summary of OSDI scores before intervention, at 1 week and at 2 weeks following the massage therapy. There is a significant reduction in the ODSI scores at the end of 2 weeks which suggests that massage therapy provides immediate comfort, symptomatic relief and a sense of improved ocular health in all patients.

DISCUSSION

Our results demonstrate significant improvement in both objective tear film parameters and subjective symptoms after use of the MGM device. Thermal therapy improves meibum fluidity, and mechanical massage facilitates gland expression—both key mechanisms in MGD treatment (10,11).

Previous studies support these findings. Wang et al. (12) reported significant TBUT improvement with similar vibrational heat therapy. Han et al. (13) observed reduced OSDI and improved tear film with thermal massage. Although LipiFlow and TearCare also offer comparable results, the cost and accessibility remain limiting factors (14,15).

The novelty of our device lies in its affordability, ease of use, and potential for home-based care. Consistent treatment application by MGM helps overcome the compliance issues seen in manual compress therapies (16).

Limitations of this study include the short duration of follow-up and lack of a control group. Long-term efficacy and comparative studies with standard treatments are warranted.

CONCLUSION

The Meibomian Gland Massager is an effective and well-tolerated tool for treating MGD. It significantly improves tear film stability and patient comfort. Given its simplicity and affordability, this device may become a valuable addition to the standard MGD treatment regimen.

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