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Comparing The Effects of Lipiflow and IPL Before and After Treatments in Patients with Meibomian Gland Dysfunction

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ABSTRACT

Background: Meibomian Gland Dysfunction (MGD) is a leading cause of evaporative dry eye and ocular surface disease. It results from obstruction or altered secretion of the meibomian glands, causing tear film instability, inflammation, and discomfort. Effective treatment is essential to prevent long-term ocular surface damage. Among the available therapies, Intense Pulsed Light (IPL) and LipiFlow thermal pulsation have shown promising outcomes. This study aimed to compare the clinical efficacy of IPL and LipiFlow in improving tear film stability, lipid layer quality, and meibomian gland structure in patients with MGD over a six-month period.

Materials and Methods: A prospective clinical trial was conducted on 50 patients diagnosed with MGD. All participants underwent baseline assessments including the Ocular Surface Disease Index (OSDI), Tear Break-Up Time (TBUT), Schirmer's Test I (with topical anesthesia), and LipiView imaging. Patients were randomly assigned into two equal groups:

Group 1 (n = 25): Received IPL therapy

Group 2 (n = 25): Received LipiFlow therapy

Results: Both treatment groups showed a significant improvement in TBUT, indicating enhanced tear film stability. A notable reduction in lipid layer thickness (LLT) and meibomian gland dropout was also observed in both groups. However, Schirmer's test values remained largely unchanged in both groups. While both modalities provided comparable clinical outcomes, IPL was found to be more cost-effective, whereas LipiFlow offered greater efficiency in treatment duration and efficacy

Conclusion: IPL and LipiFlow therapies are both effective in the long-term management of MGD, significantly improving tear film parameters and glandular health. While clinical improvements were similar, IPL may be preferred for its cost-efficiency, and LipiFlow for its enhanced treatment performance. Further studies with larger cohorts are needed to validate these findings and support individualized treatment planning.

Keywords: *Meibomian Gland Dysfunction (MGD), Intense Pulsed Light (IPL), LipiFlow Pulsation Therapy, Ocular Surface Disease Index (OSDI), Six-Month Follow-Up.*

1. INTRODUCTION

Dry Eye Disease (DED) is a multifactorial disorder of the ocular surface characterized by a loss of tear film homeostasis and accompanied by a range of ocular symptoms. Key contributing factors include tear film instability and hyperosmolarity, ocular surface inflammation and damage, as well as neurosensory abnormalities. DED is a globally prevalent chronic condition, affecting approximately 5% to 34% of the population worldwide, and between 1 million and 4 million individuals in the United States aged 65 to 84. Its impact extends beyond ocular discomfort, significantly impairing visual performance, daily functioning, workplace productivity, and overall quality of life, thereby posing considerable socio-economic burdens.

With the increasing reliance on visual display units (VDUs) in the modern digital age, the incidence of eye-related disorders, particularly dry eye, has risen substantially. Dry eye can occur due to inadequate tear production by the lacrimal glands or insufficient lipid secretion by the meibomian glands, which is essential for reducing tear evaporation. Among the various subtypes, dry eye associated with Meibomian Gland Dysfunction (MGD) has emerged as a leading cause, especially in Asian populations where the prevalence ranges from 46.2% to 69.3%, compared to 3.5% to 19.9% in white populations. Recent studies also report that the global prevalence of dry eye symptoms can range widely—from 5% up to 50%—depending on geographic and demographic factors.

2. MATERIALS AND METHODS

Study Design:

This prospective clinical study was conducted at Centre for Sight Hospital and involved two parallel treatment groups: one receiving LipiFlow therapy and the other undergoing Intense Pulsed Light (IPL) therapy. A total of 50 patients (100 eyes), including both male and female participants, were enrolled in the study. All participants were aged above 12 years. The duration of the study spanned from December 2023 to December 2024.Patients were included based on specific diagnostic and clinical criteria.

Inclusion criteria consisted of a confirmed diagnosis of Meibomian Gland Dysfunction (MGD) based on clinical signs and symptoms, presence of dry eye symptoms with an Ocular Surface Disease Index (OSDI) score greater than 13, and a Tear Break-Up Time (TBUT) of less than 10 seconds. Additionally, patients who had recently used systemic or topical medications that could affect the ocular surface were excluded. Exclusion criteria also encompassed a history of ocular surgery or trauma within the past six months, active ocular infections or inflammatory ocular diseases, previous treatment with either IPL or LipiFlow therapy within the past year, and any diagnosis of autoimmune diseases such as Sjögren's syndrome or other uncontrolled systemic conditions.

Treatment Protocols: The enrolled participants were divided into two treatment groups. Group A received Intense Pulsed Light (IPL) therapy, consisting of three to four sessions administered over a period of six months. Group B underwent LipiFlow thermal pulsation therapy, in which patients received three sessions, each involving a 12-minute treatment applied to both eyes, also over a six-month duration.

Procedure: Baseline assessments were conducted prior to the initiation of treatment to evaluate the ocular surface condition and meibomian gland function. These included Tear Break-Up Time (TBUT) measured using fluorescein dye, Meibography to assess gland structure and the extent of gland dropout, the Ocular Surface Disease Index (OSDI) score as a patient-reported outcome measure for symptom severity, and Lipid Layer Thickness (LLT), which was measured using interferometry.

Follow-up evaluations were scheduled at 1 month, 3 months, and 6 months after the initiation of treatment. During each follow-up visit, the same assessments performed at baseline (TBUT, Meibography, OSDI score, and LLT) were repeated in order to compare pre-treatment and post-treatment outcomes and evaluate the efficacy of each therapy over time.

3. OBSERVATION & RESULTS

A total of 50 participants were enrolled in the study, with an equal number assigned to two groups—IPL (Group 1) and LipiFlow (Group 2), as shown in Table 1. Each participant underwent a follow-up evaluation six month after receiving their respective treatment (as shown in Figure 1). Pre- and post-treatment parameters were carefully recorded and compared. The data analysis was carried out using a paired t-test with the help of SPSS software to determine the effectiveness of each treatment.

The mean age of participants who received IPL treatment was 60.04 ± 10.25 years, while those who underwent LipiFlow treatment had a mean age of 53.36 ± 11.51 years (as shown in Figure 2).

TBUT (Tear Break-Up Time)

In Group-1, there was a clear improvement in tear film stability after treatment, as seen by the increase in TBUT values for both eyes. The right eye showed a statistically meaningful change ($p = 0.03$), while the left eye showed an even stronger improvement ($p = 0.012$). Similarly, in Group-2, TBUT also improved noticeably after treatment, with the right eye showing a significant change ($p = 0.010$) and the left eye showing a highly significant result ($p = 0.002$), (as shown in Figure 3 and Table 2).

LLT (Lipid Layer Thickness)

There was a noticeable improvement in LLT for patients in both groups, with very strong statistical support ($p < 0.001$). This means that the treatments helped boost lipid production in the eyes, which is essential for maintaining a healthy tear film (as shown in Figure 5 and Table 4).

SCHIRMERS TEST 1

In Group-1, there was some improvement in tear production in the right eye after treatment, but no change was seen in the left eye. For Group-2, the Schirmer test results didn't show any meaningful difference after treatment. While the average Schirmer values did increase slightly in both groups, the change wasn't significant enough to draw strong conclusions (as shown in Figure 4 and Table 3).

MGD DROPOUT

There was a clear and significant reduction in meibomian gland dropout after treatment in both groups, with p-values less than 0.001. This strongly suggests that both IPL and LipiFlow were effective in clearing the blockages in the glands, helping them function better (as shown in Figure 6 and Table 5).

Table 1. Gender Distribution in Group-1 and Group-2

Groups	Gender	Number	Percentage
Group-1	MALE	10	40%
	FEMALE	15	60%
Group-2	MALE	11	44%
	FEMALE	14	56%

Table 2. Pre and Post mean and p-value of TBUT in Group 1 and Group 2

	Group 1			Group 2		
Eye	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	P-Value	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	P- Value
OD	6.6±2.2	9.8±2.13	0.03	6.9±2.55	8.8±1.95	0.010
OS	7.16±2.36	9.9±1.57	0.012	7.04±3.21	9.6±2.68	0.002

Table 3. Pre and Post mean and p-value of Group 1 and Group 2

	Group 1			Group 2		
Eye	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	P-Value	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	P- Value
OD	72.92±20.7	88.2±12.4	>0.001	61±14.8	79.28±15.03	>0.001
OS	74.64±19.8	89.68±11.5	>0.001	62.44±15.2	79.2±12.5	>0.001

Table 4. Pre and Post mean and p-value of Schirmer test 1 in Group 1 and Group 2

	Group 1			Group 2		
Eye	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	P-Value	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	P- Value
OD	17.6±4.4	20.6±3.7	>0.001	16.2±5.1	15.1±4.9	0.129
OS	18.1±4.1	21.1±3.4	>0.001	15.3±4.6	15.3±4.5	0.983

Table 5. Pre and Post mean and p-value of Schirmer test 1 in Group 1 and Group 2

	Group 1			Group 2		
Eye	**Pre-treatment Mean ± SD**	**Post-treatment Mean ± SD**	**P-Value**	**Pre-treatment Mean ± SD**	**Post-treatment Mean ± SD**	**P- Value**
OD	57.0±22.6	34.4±14.9	<0.001	56.6±18.9	34.4±14.9	<0.001
OS	58.4±21.8	33.0±16.7	<0.001	58.4±21.8	33.0±16.73	<0.001

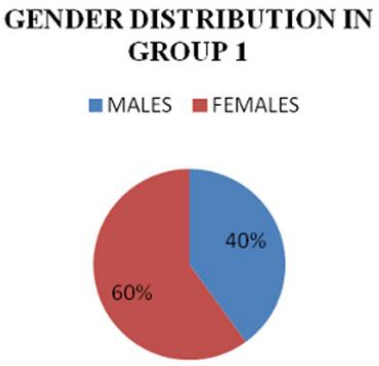

Fig 1. Gender Distribution in Group 1

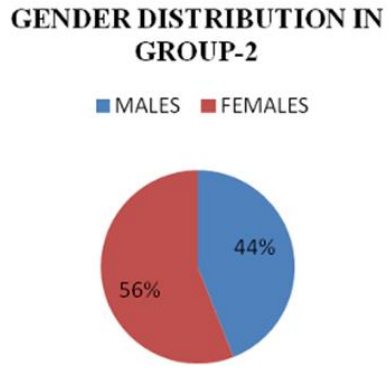

Fig 2. Gender Distribution in Group 2

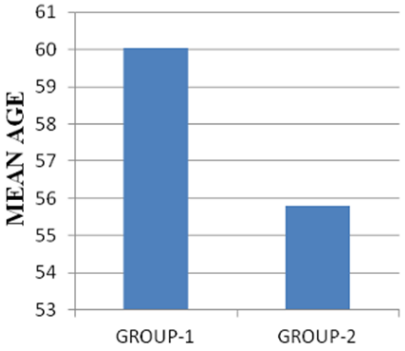

Fig 3. Mean Ages in Group 1 and Group 2.

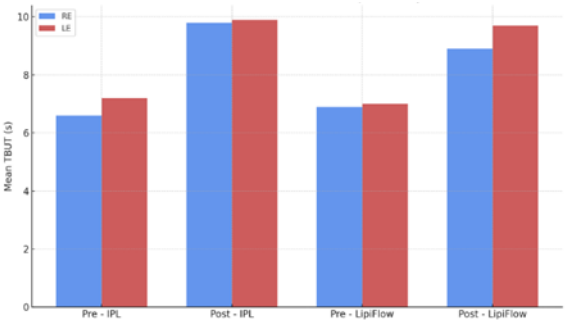

Fig 4. Pre and Post Mean Value of TBUT in Group 1 and Group 2

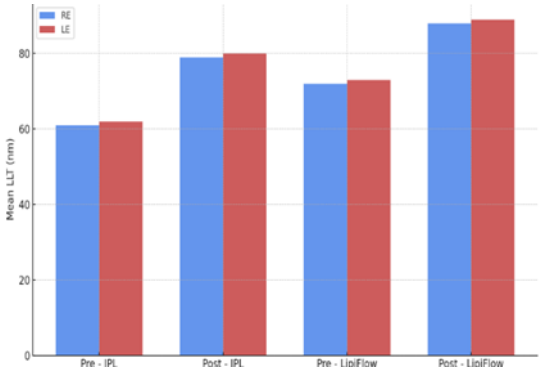

Fig 5. Pre and Post Mean Value of LLT in Group 1 and Group 2

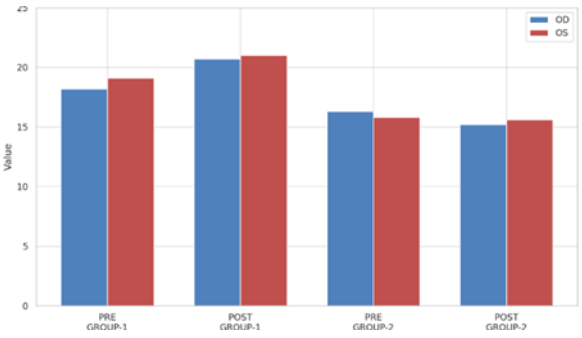

Fig 6. Pre and Post Mean Value of Schirmer in Group 1 and Group 2

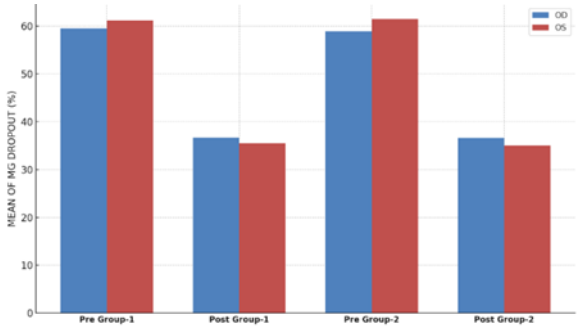

Fig 7. Pre and Post Mean Value of MGD Dropout in Group 1 and Group 2

4. DISCUSSION

Numerous studies have evaluated the individual effectiveness of Intense Pulsed Light (IPL) and LipiFlow therapy in the management of Meibomian Gland Dysfunction (MGD). While both treatments have been shown to provide positive outcomes when assessed separately or against other modalities, limited research exists directly comparing the efficacy of IPL and LipiFlow head-to-head.

In the present study, both IPL (administered in 3–4 sessions over 6 months) and a single session of LipiFlow demonstrated significant clinical improvement in patients with MGD. Improvements were observed in Tear Break-Up Time (TBUT), Lipid Layer Thickness (LLT), and a reduction in meibomian gland dropout. However, no significant change was found in Schirmer test scores, suggesting that neither treatment significantly impacts aqueous tear production.

Previous literature presents mixed findings: some studies reported significant improvement in TBUT following LipiFlow therapy, while others observed minimal to no changes. Similarly, Schirmer values varied across studies, with some indicating an increase and others, including the present study, showing no significant change. Comparable variability was noted in IPL studies—some demonstrated enhanced TBUT and LLT, whereas others did not.

This study supports the clinical effectiveness of both IPL and LipiFlow for improving the lipid component of the tear film. However, cost and accessibility are important factors in determining the suitability of treatment. Given that IPL is more affordable and accessible to a larger segment of the Indian population, it may be a more practical option for patients with financial constraints. On the other hand, LipiFlow, despite being a more expensive single-session procedure, offers time efficiency and similar therapeutic benefits, making it preferable for those who can afford it and seek quicker results.

As this study focused on outcomes over a 6-month follow-up period, future research could explore long-term efficacy over a year or more and include a larger sample size to validate these findings further.

5. CONCLUSION

Both IPL and LipiFlow therapies have shown comparable effectiveness in the management of Meibomian Gland Dysfunction. The primary distinction lies in their practicality—IPL is more cost-effective, making it a suitable choice in settings where patients predominantly come from middle-income backgrounds, such as in many Indian hospitals. In contrast, LipiFlow offers a quicker, single-session treatment option, which may be preferable for patients who can afford the higher cost and are seeking immediate relief.

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