Original Research Article

EJO European Journal of Ophthalmology

Intense regulated pulse light for the meibomian gland dysfunction

European Journal of Ophthalmology
1–4

DOI: 10.1177/1120672118817687
journals.sagepub.com/home/ejo
SAGE

Emine Esra Karaca, Özlem Evren Kemer and Dilay Özek

Abstract

Purpose: To assess the effect of intense regulated pulse light (E-Eye; E-Swin, France) on the treatment of meibomian gland dysfunction.

Setting: Health Sciences University, Ankara Numune Training and Research Hospital, Department of Ophthalmology.

Methods: A total of 26 patients underwent intense pulsed light treatment (E-Eye; E-Swin), with homogeneously sequenced five light pulses delivered to one eye at 1, 15, and 45 days following baseline evaluation. At each visit, subjective clinical parameters (ocular surface disease index questionnaire and standard patient evaluation of eye dryness questionnaire) and objective clinical parameters (Schirmer I test scores, tear break-up times, Oxford grading, lid margin abnormality score, secretion quality and expressibility degree) were recorded. The subjective and objective parameters at Days 15 and 45 were compared with baseline values.

Results: Patients underwent three sessions of intense pulsed light treatment. Schirmer test and tear break-up time improved significantly from baseline to Day (D) 45 (8.53 ± 4.31 mm vs 12.6 ± 3.14 mm, 4.53 ± 1.33 sn vs 11.07 ± 2.87 sn, $p = 0.003$ and $p < 0.001$). Ocular surface disease index and standard patient evaluation of eye dryness scores improved from baseline to D15 and baseline to D45 (all with $p < 0.05$). All the subjects reported reduced symptoms by D45. There were no cases of adverse ocular effects. There was no significant change in Oxford grading, lid margin abnormality score, secretion quality, and expressibility degree.

Conclusions: Intense regulated pulse light seems a safe treatment procedure for meibomian gland dysfunction, improving tear film quality and reducing symptoms of dry eye.

Keywords

Dry eye, intense regulated pulse light, meibomian gland disease

Date received: 19 March 2018; accepted: 13 November 2018

Introduction

Dry eye disease (DED) is one of the most common ocular disorders that can considerably impact patients' quality of life.[1] DED includes instability and hyperosmolarity of the tear film as well as inflammation of the ocular surface and the lacrimal glands.[2,3] DED is divided into two major types: aqueous deficient and evaporative dry eye. Actually, both mechanisms are frequently present in most of the individuals.[4]

Evaporative DED is caused by meibomian gland dysfunction (MGD). MGD is a chronic, diffuse abnormality of the meibomian glands, commonly characterized by terminal duct obstruction and/or qualitative/quantitative changes in the glandular secretion.[5] The severity of MGD depends on the degree of abnormal lid margin findings of vascularity, plugging of gland orifices, lid margin irregularity, lid margin thickening, gland dropout, and expressed secretions.[6] MGD affects tear film stability and results in symptoms of eye irritation.[7] Current strategies for the management of MGD include tear supplementation with lubricants, tear retention, tear stimulation, topical or systemic anti-inflammatory therapy, and environmental approaches.[8] Despite these treatment options, MGD management is quite difficult to handle and alternative options are investigated.

Department of Ophthalmology, Health Sciences University, Ankara Numune Training and Research Hospital, Ankara, Turkey

Corresponding author:
Emine Esra Karaca, Department of Ophthalmology, Health Sciences University, Ankara Numune Training and Research Hospital, Ankara 06100, Turkey.
Email: emineesra@yahoo.com

Intense pulsed light (IPL) therapy is a new treatment strategy for treatment of MGD by inducing the restoration of the normal activity of the meibomian glands.[9] In fact, IPL has been used for treating the patients with facial telangiectasias and erythema for a long time.[10,11] IPL treatment reduces the telangiectasias and erythema of rosacea and also resulted in improvement in ocular surface health.[12] This surprised improvement in turn has led to assumption of IPL to be a potential therapy for MGD patients. The aim of this study was to investigate the effect of IPL in treatment-naïve patients with MGD.

Methods

The study was performed in adherence to the tenets of the Declaration of Helsinki and approved by the local ethics committee. In all, 26 patients with mild to moderate signs of MGD[6] were enrolled in this study. The age of subjects ranged between 27 and 67. The exclusion criteria were contact lens wearing, history of any other ocular disease or surgery, atopy and allergic diseases, pregnancy, any systemic or inflammatory disease, and any medical treatments. Furthermore, patients without minimum follow-up of 6 months were also excluded.

The reports of the patients who had MGD and treated by IPL between January 2017 and March 2017 were reviewed. The clinical charts of patients were evaluated for age, sex, best corrected visual acuity, Schirmer I test scores, tear break-up times (TBUT), Oxford grading, lid margin abnormality score, secretion quality, and expressibility degree. Symptoms were assessed with ocular surface disease index (OSDI) and standard patient evaluation of eye dryness (SPEED) questionnaires.[13] All the patients were examined by the same experienced ophthalmologist. The treating physician scored fluorescein staining of ocular surface (Oxford grading) on a scale of 0–5, with 0 being absent and 5 being the most severe. Meibomian gland secretion quality and expressibility were scored on a 0–3 scale: 0 representing normal oil and 3 representing no oil flow with digital pressure along lid margin. In addition, lid margins were observed and each parameter (irregularity of lid margin, vascular congestion over lid margin, obstruction of the meibomian gland orifices, anatomic displacement of gray line) gained 1 point in case of its presence.

IPL treatment was administered to the skin area just below the lower eyelid on Day (D) 1, D15, and D45 as per manufacturer's recommendations. Eye mask was adjusted on patients' eyes, followed by gel application on the cheekbone and temporal areas. A series of five flashes were applied under each eye (Figure 1). The power of the flash delivered was set to be as its maximum in all cases. All IPL treatments were done using E-Eye (E-Swin, France). Post-IPL scores at D1, D15, D45, and D180 were compared with baseline (BL) scores.

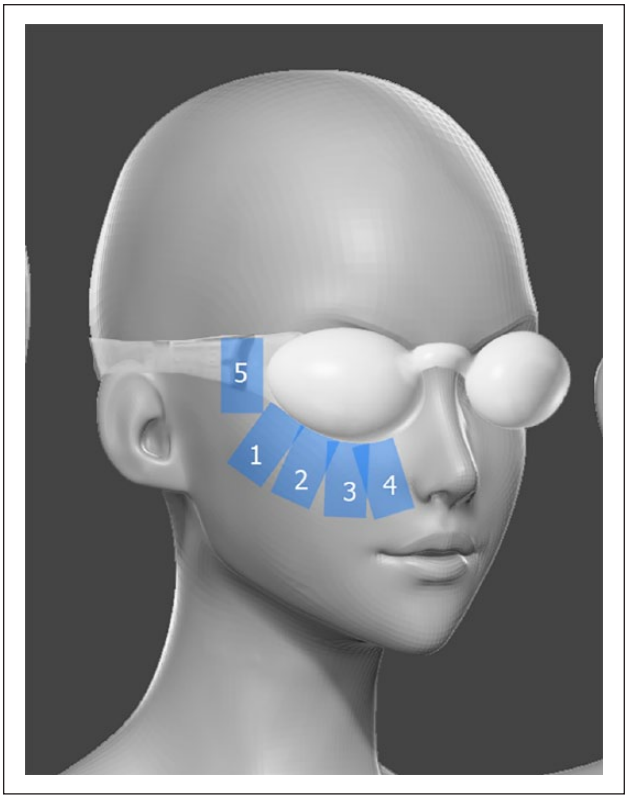

Figure 1. Schematic design of IPL application regions.

Statistical analysis

Statistical analysis was performed by using the software SPSS 20.0. Continuous data are given as mean ± SD or median (minimum to maximum), and categorical variables are given as number of cases and percentages (%). Significance of the difference between mean values and medians for groups was tested by Kruskal–Wallis test. For comparing time-dependent clinical measurements during follow-up time, Wilcoxon signed-rank test was used. Categorical variables were compared by Spearman's rho test. The criterion for statistical significance was $p < 0.05$.

Results

In all, 26 patients with mild-to-moderate MGD underwent IPL therapy. Mean age was 51.6 ± 13 years. There were seven males and five females.

Schirmer test and tear break-up time improved significantly from BL to Day (D) 45 (8.53 ± 4.31 mm vs 12.6 ± 3.14 mm, 4.53 ± 1.33 sn vs 11.07 ± 2.87 sn, $p = 0.003$ and $p < 0.001$). OSDI and SPEED scores improved from BL to D15 and BL to D45 (all with $p < 0.05$). All the subjects reported reduced symptoms by D45. No significant deterioration at Schirmer test, tear break-up time, OSDI, and SPEED scores at sixth month was seen (Table 1). There were no cases of adverse ocular

Table 1. Ophthalmologic characteristics of subjects at BL, D1, D15, and D45.

Parameters	Baseline (BL)	Day 1	Day 15	Day 45	Day 180	p value
Schirmer I	8.5 ± 4.3*	11.6 ± 4.1	12.1 ± 3.6	12.6 ± 3.1*	11.1 ± 3.7	0.003
TBUT	4.5 ± 1.3	5.4 ± 1.7	7.3 ± 2.9	11.1 ± 2.8	10.6 ± 2.6	<0.001
LMAS	2.84 ± 0.55	2.72 ± 0.57	2.69 ± 0.63	2.38 ± 0.65	2.41 ± 0.64	0.822
OSDI score	26.4 ± 3.8**,***	26.3 ± 2.7	28.3 ± 3.6**	33.0 ± 4.5***	30.2 ± 3.8	<0.001
SPEED score	20.6 ± 5**,***	10.3 ± 5.2	6.9 ± 5.8**	6.9 ± 5.8***	8.3 ± 4.7	<0.001

TBUT: tear break-up time, LMAS: lid margin abnormality score, OSDI: ocular surface disease index; SPEED: standard patient evaluation of eye dryness.
*Statistically significant difference between BL and D45 ($p = 0.003$; according to post hoc analysis).
**Statistically significant difference between BL and D15 ($p < 0.001$).
***Statistically significant difference between BL and D45 ($p < 0.001$; according to post hoc analysis).

effects. There was no significant change in Oxford grading, lid margin abnormality score, secretion quality, and expressibility degree.

Discussion

Our study found that three sessions of IPL improved dry eye outcomes (irritation symptom, TBUT, and Schirmer improvements). IPL is a relatively novel treatment option for patients with MGD. As such, there are limited data on its efficacy at the moment. The outcomes of IPL treatment in this study are similar to recent studies. Gupta et al.[14] reported a multicenter study with 100 patients. They showed significant decrease in scoring of lid margin edema, facial telangiectasia, lid margin vascularity, meibum viscosity, and OSDI score. In addition, they showed significant increase in oil flow score and TBUT. Similarly, Craig et al.[12] reported a prospective, placebo-controlled study of 28 patients. They showed significant improvement in tear film quality, tested by TBUT and lipid layer grading, as well as decrease in SPEED score. In another study, Rong et al.[15] provided a sham treatment to one eyelid and IPL to the other at 44 patients. They reported improvement of meibomian gland yielding secretion score, TBUT, SPEED, and cornea fluorescein staining scores in the study eyes compared to the BL. Toyos et al.[16] conducted a study involving 91 patients presenting with severe dry eye. They applied a series of monthly treatments until there was adequate improvement in dry eye syndrome symptoms by physician judgment or until patient discontinuation. Finally, improvement in dry eye tear break-up time was found for 68 of 78 patients (87%) with seven treatment visits and four maintenance visits on average (medians), and 93% of patients reported post-treatment satisfaction with degree of dry eye syndrome symptoms. In our study, we also showed significant improvements in Schirmer test, TBUT, OSDI, and SPEED scores. However, our study is different from previous studies because we did not apply traditional IPL to patients. We did use intense regulated pulse light technology, of which energy and spectrum are determined precisely to stimulate the meibomian glands.

Even the mechanism of IPL has not been completely understood, and we assume that the mechanism of action is neurological. The flash application to lower eyelid and temporal region stimulates two branches of the parasympathetic nerve, and this stimulation leads to the meibomian glands returning to their normal activity. This improvement starts within hours after treatment. Of the 26 patients, 20 have reported the symptomatic relief on the same day, and rest of the patients have relieved after second treatment. The complete success of the treatment is assumed to depend on compliance with three sessions (days 0, 15, and 45); however, fourth session may be required in some of the patients (day 75). We followed these patients for 6 months, and none of them needed the fourth treatment.

Two other mechanisms of action of IPL may be local warming effect at the level of meibomian glands, which aids the meibum expression and reduction of chronic inflammation via reduction of eyelid margin telangiectasias.[12,14] In dermatology practice, IPL is a choice of treatment for rosacea and telangiectasias. IPL leads to photothermolysis at a wavelength of 500–1200 nm and selectively destroys blood vessels by targeting chromophores within the vessels.[11] Vascular destruction probably leads to reduction of inflammatory markers. Liu et al. investigated the change of inflammatory markers in tears of DED subjects due to MGD. They found that interleukin (IL)-17A, IL-6, and prostaglandin E2 (PGE2) were decreased significantly after IPL treatment on lower eyelid. In addition, they suggested that the reduction of inflammatory factors was related to the improvement of clinical symptoms and signs.[17] Otherwise, Mark et al.[18] found 29% decrease in the telangiectasias and 21% decrease in the erythema. Taub[19] showed that 83% of rosacea patients had reduced redness, 75% noted reduced flushing, and 64% noted fewer acneiform breakouts. In our study, we did not find significant decrease in scoring of lid margin abnormality. This is probably due to small sample size.

Nowadays, IPL is assumed to affect the parasitic and bacterial growth.[20] *Demodex folliculorum* and *Demodex*

brevis are potential causes of ocular inflammatory diseases.[21] Rosacea, skin phenotype, sunlight, alcohol, and smoking are some of the risk factors that may lead to ocular demodicosis.[22] Demodicosis may prevent resolution of blepharitis because demodex mites are resistant to a wide range of antiseptic agents. The pigmented exoskeleton of Demodex probably absorbs IPL energy, and IPL treatment induces coagulation and necrosis of mites.[20,23] Eradication of Demodex through IPL may break the chronic inflammation and improve the response of patients with MGD.

The major limitations of this study were the small sample size, short-term follow-up time, lack of control group, and high cost of IPL. In addition, severe dry eye patients were not involved in the study.

In conclusion, IPL seems to be an effective treatment in MGD. Although the sample size of this study is quite small, the treatment gives valuable results for evaporative dry eye. However, for proposing IPL as a standard treatment modality in patients with MGD, further randomized prospective studies with a larger sample size are required.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

1. Pflugfelder SC. Prevalence, burden, and pharmacoeconomics of dry eye disease. *Am J Manage Care* 2008; 14(Suppl. 3): S102–S106.
2. Sullivan BD, Whitmer D, Nichols KK, et al. An objective approach to dry eye disease severity. *Invest Ophthalmol Vis Sci* 2010; 51(12): 6125–6130.
3. Mantelli F, Massaro-Giordano M, Macchi I, et al. The cellular mechanisms of dry eye: from pathogenesis to treatment. *J Cell Physiol* 2013; 228(12): 2253–2256.
4. Wozniak PA, Schmidl D, Bata AM, et al. Effect of different lubricant eye gels on tear film thickness as measured with ultrahigh-resolution optical coherence tomography. *Acta Ophthalmol* 2017; 95(4): e307–e313.
5. Nelson JD, Shimazaki J, Benitez-del-Castillo JM, et al. The international workshop on meibomian gland dysfunction: report of the definition and classification subcommittee. *Invest Ophthalmol Vis Sci* 2011; 52(4): 1930–1937.
6. Tomlinson A, Bron AJ, Korb DR, et al. The international workshop on meibomian gland dysfunction: report of the diagnosis subcommittee. *Invest Ophthalmol Vis Sci* 2011; 52(4): 2006–2049.
7. Nichols KK, Foulks GN, Bron AJ, et al. The international workshop on meibomian gland dysfunction: executive summary. *Invest Ophthalmol Vis Sci* 2011; 52(4): 1922–1929.
8. Thode AR and Latkany RA. Current and emerging therapeutic strategies for the treatment of meibomian gland dysfunction (MGD). *Drugs* 2015; 75(11): 1177–1185.
9. Vora GK and Gupta PK. Intense pulsed light therapy for the treatment of evaporative dry eye disease. *Curr Opin Ophthalmol* 2015; 26(4): 314–318.
10. Papageorgiou P, Clayton W, Norwood S, et al. Treatment of rosacea with intense pulsed light: significant improvement and long-lasting results. *Br J Dermatol* 2008; 159(3): 628–632.
11. Kassir R, Kolluru A and Kassir M. Intense pulsed light for the treatment of rosacea and telangiectasias. *J Cosmet Laser Ther* 2011; 13(5): 216–222.
12. Craig JP, Chen YH and Turnbull PR. Prospective trial of intense pulsed light for the treatment of meibomian gland dysfunction. *Invest Ophthalmol Vis Sci* 2015; 56(3): 1965–1970.
13. Asiedu K, Kyei S, Mensah SN, et al. Ocular surface disease index (OSDI) versus the standard patient evaluation of eye dryness (SPEED): a study of a nonclinical sample. *Cornea* 2016; 35(2): 175–180.
14. Gupta PK, Vora GK, Matossian C, et al. Outcomes of intense pulsed light therapy for treatment of evaporative dry eye disease. *Can J Ophthalmol* 2016; 51(4): 249–253.
15. Rong B, Tang Y, Tu P, et al. Intense pulsed light applied directly on eyelids combined with meibomian gland expression to treat meibomian gland dysfunction. *Photomed Laser Surg* 2018; 36: 326–332.
16. Toyos R, McGill W and Briscoe D. Intense pulsed light treatment for dry eye disease due to meibomian gland dysfunction: a 3-year retrospective study. *Photomed Laser Surg* 2015; 33(1): 41–46.
17. Liu R, Rong B, Tu P, et al. Analysis of cytokine levels in tears and clinical correlations after intense pulsed light treating meibomian gland dysfunction. *Am J Ophthalmol* 2017; 183: 81–90.
18. Mark KA, Sparacio RM, Voigt A, et al. Objective and quantitative improvement of rosacea-associated erythema after intense pulsed light treatment. *Dermatol Surg* 2003; 29(6): 600–604.
19. Taub AF. Treatment of rosacea with intense pulsed light. *J Drug Dermatol* 2003; 2(3): 254–259.
20. Prieto VG, Sadick NS, Lloreta J, et al. Effects of intense pulsed light on sun-damaged human skin, routine, and ultrastructural analysis. *Laser Surg Med* 2002; 30(2): 82–85.
21. Luo X, Li J, Chen C, et al. Ocular demodicosis as a potential cause of ocular surface inflammation. *Cornea* 2017; 36(Suppl. 1): S9–S14.
22. Bernstein JE. Rosacea flushing. *Int J Dermatol* 1982; 21(1): 24.
23. Dell SJ. Intense pulsed light for evaporative dry eye disease. *Clin Ophthalmol* 2017; 11: 1167–1173.