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A Retrospective Study of Treatment Outcomes and Prognostic Factors of Intense Pulsed Light Therapy Combined With Meibomian Gland Expression in Patients With Meibomian Gland Dysfunction

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Objectives: To evaluate clinical changes after intense pulsed light and meibomian gland expression (IPL/MGX) treatment in meibomian gland dysfunction (MGD) patients, and to identify ideal candidates, and the therapeutic window, for IPL/MGX.

Methods: This retrospective study reviewed the medical records of 44 MGD patients (44 eyes). The IPL/MGX treatment was applied on the eyelids three times at intervals of 4 weeks. Age, sex, relevant ocular history, Standard Patient Evaluation of Eye Dryness (SPEED), Ocular Surface Disease Index (OSDI), tear break-up time (TBUT), corneal fluorescein staining score (CFSS), meiboscore, meibomian gland loss score (MGLS), meibomian glands yielding secretion score (MGYSS), meibomian glands yielding clear secretion (MGYCS), and meibomian glands yielding liquid secretion (MGYLS) were analyzed.

Results: Standard Patient Evaluation of Eye Dryness, OSDI, TBUT, CFSS, MGYSS, MGYLS, and MGYCS were significantly improved after three IPL/MGX treatments, but the meiboscore and MGLS remained unchanged. In patients who had better treatment outcomes (improvement in MGYSS >7), younger age (36.0, 22.5 vs. 53.0, 25.0 years; $P=0.012$), a longer TBUT (8.0, 4.5 vs. 6.0, 3.0 sec; $P=0.010$), better meiboscore (1.0, 0.5 vs. 2.0, 1.0; $P=0.012$), and less gland loss (19.8%, 20.3% vs. 41.1%, 30.2%; $P=0.008$) before IPL/MGX were noted. Sex, relevant ocular history, SPEED, OSDI, MGYSS, MGYLS, and MGYCS before IPL/MGX showed no significant differences between patients with an improvement in MGYSS >7 versus those with an improvement of ≤ 7. Meibomian glands yielding secretion score changes in patients who had a meiboscore of 0 to 1 and MGYSS of 0 before IPL/MGX (12.0, 10.0) were significantly higher than those who had a meiboscore of 2 to 3 and MGYSS of 0 (6.5, 9.3; $P=0.031$), or a meiboscore of 0 to 1 and MGYSS >0 (5.0, 11.5; $P=0.041$).

Conclusions: Improved dry eye symptoms, TBUT, corneal staining, and meibomian gland secretion were observed in MGD patients after IPL/MGX. Patients in the early stages of MGD maybe benefited most from IPL/MGX treatment.

Key Words: Intense pulsed light—Meibomian gland dysfunction—Meibomian gland secretion function.

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Meibomian gland dysfunction (MGD) is a common ocular surface condition and the leading cause of dry eye.[1] The lipid-rich secretion of the meibomian gland, called meibum, comprised neutral lipids (wax esters, cholesteryl esters, and triacylglycerols, etc.) and polar compounds (free fatty acids and phospholipids, etc.).[2] Once the gland orifices have been obstructed, the components of the meibum thereof change, and the phase transition (from gel to liquid crystalline) temperature of the meibum increases,[3] which leads to dysfunction of meibomian gland secretion.[4] Physical therapies and approaches, such as a warm compress, ensuring good eyelid hygiene, and meibomian gland expression (MGX) are used to facilitate the secretion of lipid products at the ocular surface by unclogging gland orifices and "softening" the meibum.[5] However, poor compliance to physical therapies limits their application; they are usually time-consuming, and some can be uncomfortable.

In 2005, Toyos reported dry eye symptom relief in facial rosacea patients after intense pulsed light (IPL) treatment.[6] Putative mechanisms underlying the effects of IPL treatment on dry eye include a thermal effect that facilitates meibomian gland secretion by softening meibum, ablation of telangiectasia to decrease the levels of inflammatory factors released from the area around the glands, and a reduction in the amounts of bacteria and other microorganisms on the eyelids.[7,8] For many years, researchers (including our group) have used IPL therapy to treat MGD and dry eye patients. Results have indicated that IPL with/without MGX was safe and efficacious

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for relieving dry eye symptoms[9–17] and improve meibomian gland secretion function[11,15,17] and inflammation,[7,9,17,18] thickening the tear film lipid layer,[9,13] and increasing the tear break-up time (TBUT).[9–17] In 2017, a report from the Tear Film and Ocular Surface Society International Dry Eye Workshop II (TFOS DEWS II) listed IPL among the physical therapy options for dry eye patients.[19]

Although studies have shown that IPL is an effective therapy, a retrospective study by Vegunta et al.[11] reported that a few refractory cases did not respond to this treatment. Few studies have reported on the severity of the disease or the treatment opportunities for patients, and there are currently no clinical guidelines for IPL. Therefore, we retrospectively reviewed the medical records of MGD patients treated by IPL combined with MGX (IPL/MGX) to evaluate the effect of this treatment on dry eye symptoms, clinical signs, and meibomian gland secretion. Furthermore, to identify ideal candidates, and the therapeutic window, for IPL/MGX, we analyzed clinical parameters that might affect the treatment outcomes.

METHODS

The Ethics Committee of Peking University First Hospital approved this study. The medical records of consecutive MGD patients seen at the Ophthalmology Department of Peking University First Hospital from March to July in 2016 were analyzed. Patients who (1) showed MG orifice obstructions under slit-lamp examination; (2) had a meibomian gland yielding secretion score $\leq$12 in the lower lid[20]; and (3) a Standard Patient Evaluation of Eye Dryness (SPEED) score $\geq$6 were diagnosed with MGD.[18] IPL/MGX was performed in patients who were unsatisfied or showed poor compliance with traditional treatments, such as artificial tears, warm compress, MGX, or local/systematic antibiotics. Patients who met the following inclusion criteria were enrolled: (1) aged >18 years and (2) completion of three consecutive IPL/MGX treatments at 4-week intervals. Those who had (1) missing meibomian gland evaluation results before or after IPL/MGX treatment or (2) systemic diseases that may lead to dry eye disease were excluded.

Patients underwent Fitzpatrick[21] skin typing before treatment according to sun sensitivity and skin appearance. Those with a Fitzpatrick skin type of five or six were excluded because they may have suffered melanin damage and loss of pigment in the areas being treated. Before IPL treatment, patients were asked to clean their faces to remove any make-up. Topical anesthetic cream (compound lidocaine cream; Ziguang Pharmaceutical, Beijing, China) was then applied to the treatment zone for 30 min. After removing the anesthetic cream, a drop of 0.4% oxybuprocaine hydrochloride (Benoxil; Santen Pharmaceutical, Osaka, Japan) was instilled into the conjunctival sac two times, with a 5-min interval. Ultrasound gel was then applied to the area to be treated. The clinician placed a Jaeger lid plate (Suzhou Mingren Medical Equipment, Suzhou, China) within the conjunctival sac for protection of the cornea and sclera. The IPL (M22; Lumeni, Yokneam, Israel) fluence was set to 14 to 16 J/cm^2, depending on the Fitzpatrick skin type. For types I and II, the fluence was 16 J/cm^2; for type III, the fluence was 15 J/cm^2; and for type IV, the fluence was 14 J/cm^2. A series of 12 overlapping IPL pulses were then applied around the periocular areas on the upper and lower eyelids.[15] Once the IPL treatment was completed and the ultrasound gel had been removed, an ophthalmologist performed MGX using an Arita Meibomian Gland Compressor (Katena Products, Denville, NJ).

Demographic characteristics, as well as the dry eye–related ocular history, SPEED score,[22] Ocular Surface Disease Index (OSDI),[23] TBUT, corneal fluorescein staining score (CFSS), and meibomian gland evaluation results were reviewed. The OSDI was divided into four levels[24]: normal (score of 0–12), mild dry eye (score of 13–22), moderate dry eye (score of 23–32), and severe dry eye (score of 33–100). The TBUT and CFSS were measured using moist fluorescein sodium strips (Jingming New Technological Development, Tianjin, China). The strip was wetted with saline to dissolved fluorescein and then gently taped to the lower palpebral conjunctiva. After the patient had blinked a few times, the TBUT was measured using a cobalt blue filter. The average of TBUT was calculated from three repeated measurements. The cornea was divided into four quadrants. Each quadrant was graded on a scale of 0 to 3, as follows[25]: 0, no punctate staining; 1, 1 to 30 punctate lesions; 2, >30 punctate lesions but no confluent lesions; and 3, confluent lesions or an ulcer. The total CFSS score of all four quadrants ranged from 0 to 12.

Meibomian gland secretion function was measured using a meibomian gland evaluator (Tear Science, Morrisville, NC) according to the Lane protocol.[20] Fifteen glands on the lower eyelids were evaluated. For each gland, the secretion was graded first (0, no secretion; 1, inspissated/toothpaste consistency; 2, cloudy liquid secretion; and 3, clear liquid secretion). Then, three meibomian gland assessment parameters were calculated[20,26]: the sum of the grades for all 15 glands was defined as the meibomian glands yielding secretion score (MGYSS, range: 0–45); the number of glands yielding clear secretions (grade 3) was defined as the meibomian glands yielding clear secretion (MGYCS, range: 0–15); and the number of glands secreting any liquids (grades 2 and 3) was defined as the meibomian glands yielding liquid secretion (MGYLS, range: 0–15). Meibography (Topcon, Tokyo, Japan) was performed as described by Arita et al.[27] In the lower eyelid, the extent of meibomian gland loss was recorded as the meiboscore: 0, no loss; 1, gland loss of less than one-third; 2, gland loss of between one- and two-thirds; and 3, gland loss of more than two-thirds. Objective assessment of the meibomian gland loss area in the lower eyelid was conducted using ImageJ software (National Institute of Health, Bethesda, MD) and the protocol of Pult and Riede-Pult.[28] The percentage of meibomian loss relative to the total area of the lower eyelids was given by the meibomian gland loss score (MGLS).

Comparisons of SPEED, OSID, TBUT, CFSS, meiboscore, MGLS, MGYSS, MGYLS, and MGYCS, before versus after the IPL/MGX, were conducted first. Then, according to changes in the MGYSS (ΔMGYSS) of each patient at the end of the third treatment, they were divided into a responsive group (ΔMGYSS ranking in the top 50% among all patients) and nonresponsive group (ΔMGYSS ranking in the bottom 50% among all patients). Age, sex, SPEED, OSID, TBUT, meiboscore, MGLS, MGYSS, MGYLS, and MGYCS before the treatment were compared between the two groups to identify possible clinical parameters that may have affected the treatment outcomes.

Statistical Analysis

All statistical analyses were performed using SPSS statistical software for Windows (version 24.0; IBM Corp., Armonk, NY).

The normality of the data was analyzed using the Shapiro–Wilk test. Descriptive statistics are presented the (median, interquartile range). Standard Patient Evaluation of Eye Dryness, OSDI, TUBT, CFSS, MGYSS, MGYLS, and MGYCS before and after IPL/MGX were analyzed with the pairwise Wilcoxon test. The Mann–Whitney *U* test and chi-square test were used for prognosis subgroup analyses. The statistical significance was set at $\alpha=0.05$.

RESULTS

Forty-four patients (44 eyes) were enrolled in the study. The average patient age was (45.4, 31.5) years (range: 23–86 years). Twelve males (27.3%) and 32 females (72.7%) were included in the study. Each patient received three IPL/MGX treatments at an interval of 4 weeks.

At the end of the third IPL/MGX treatment, the TBUT, CFSS, MGYSS, MGYLS, and MGYCS were significantly improved, while the meiboscore and MGLS showed no change (Table 1). The SPEED score had significantly decreased relative to baseline, from (18.5, 6.0) to (6.0, 6.75) ($P<0.001$, pairwise Wilcoxon test). Twenty-nine (65.9%) patients had a decrease in SPEED score ≥50%, while the score remained the same, or increased, in only four (9.1%) patients after treatment. The SPEED score in the remaining 11 (25.0%) patients decreased by 1% to 49%. Similar results were also found for the OSDI. Before IPL/MGX, the median OSDI was (22.0, 16.75), and 33 (75.0%) patients had severe dry eye symptoms (score of 33–100). After IPL/MGX, the OSDI significantly decreased, to (5.5, 11.75) ($P<0.001$, pairwise Wilcoxon test). None of the patients had severe dry eye symptoms, and 21 (47.7%) were classified as normal (score of 0–12; Fig. 1).

The median ΔMGYSS among all patients was 7. Forty-four patients were divided into two groups: a responsive group (ΔMGYSS >7, n=21) and a nonresponsive group (ΔMGYSS ≤7, n=23). The changes in TBUT, meiboscore, MGLS, MGYSS, MGYLS, and MGYCS after IPL/MGX of the responsive and nonresponsive groups are listed in Table 2.

Age, sex, SPEED, OSDI, TBUT, meiboscore, MGLS, MGYSS, MGYLS, and MGYCS before treatment were compared between the responsive and nonresponsive groups. Figure 2 shows that patients who were younger (36.0, 22.5 vs. 53.0, 25.0 years of age; $P=0.012$, Mann–Whitney *U* test) had a longer TBUT (8.0, 4.5 vs. 6.0, 3.0 sec; $P=0.010$, Mann–Whitney *U* test), better meiboscore in the lower eyelid (1.0, 0.5 vs. 2.0, 1.0; $P=0.012$, Mann–Whitney *U* test), and less MGLS (19.8%, 20.3% vs. 41.1%, 30.2%; $P=0.008$, Mann–Whitney *U* test) before receiving IPL/MGX exhibited significantly better treatment outcomes than the other patients (ΔMGYSS >7).

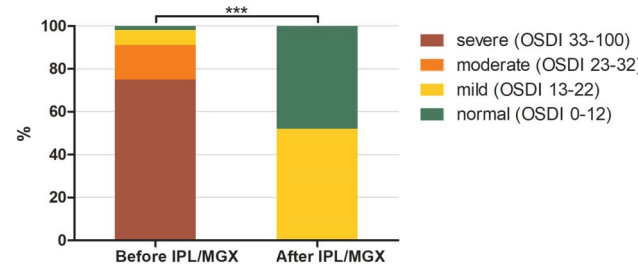

FIG. 1. Ocular Surface Disease Index frequencies before and after IPL/MGX. Before IPL/MGX: Severe, 33 (75.0%); moderate, 7 (15.9%); mild, 3 (6.8%); normal, 1 (2.3%). After IPL/MGX: Severe, none; moderate, none; mild, 23 (52.3%); normal, 21 (47.7%). ***$P<0.001$, pairwise Wilcoxon test.

Six males and 15 females were classified into the responsive group. The nonresponsive group included 6 males and 17 females. No significant difference in sex distribution was found between the groups ($P=0.853$, χ^2 test). Although dry eye symptom (SPEED and OSDI) and meibomian gland secretion (MGYSS, MGYLS, and MGYCS) were worse in the responsive group, no statistically significant difference was found between the groups (Fig. 3).

Dry eye and MGD-related history data are provided in Table 3. In the nonresponsive group (ΔMGYSS ≤7), more patients had rosacea, eyeliner tattoo, and previous surgeries that might lead to dry eye or MGD, but the differences were not significant compared with the responsive group (ΔMGYSS >7).

To further analyze the effects of meibomian gland structure and function on IPL/MGX treatment outcomes, all 44 patients were divided into four groups according to the MGYSS and meiboscore in the lower eyelids before IPL/MGX: 1, MGYSS=0 and meiboscore=0 to 1; 2, MGYSS=0 and meiboscore=2 to 3; 3, MGYSS >0 and meiboscore=0 to 1; and 4, MGYSS >0 and meiboscore=2 to 3. Changes in the MGYSS after IPL/MGX treatment in all four of these groups are listed in Table 4. Patients with a MGYSS of 0 and meiboscore of 0 to 1 before treatment showed the greatest improvement.

DISCUSSION

In the current study, we reviewed the medical records of MGD patients who underwent three IPL treatments combined with MGX

TABLE 1. *Changes of Clinical Signs Before and After IPL/MGX Treatment*

	Before IPL/MGX	After IPL/MGX	P^a
TBUT	8.0, 5.0	10.0, 3.0	<0.001
CFSS	0.0, 2.0	0.0, 0.0	0.002
Meiboscore	1.0, 1.0	1.0, 1.0	1.000
MGLS	26.3%, 29.7%	25.8%, 26.8%	0.327
MGYSS	0.0, 4.0	9.0, 7.75	<0.001
MGYLS	0.0, 2.0	4.0, 3.0	<0.001
MGYCS	0.0, 0.0	1.0, 2.0	<0.001

[a]Pairwise Wilcoxon test.

CFSS, corneal fluorescein staining score; MGLS, meibomian gland loss score; MGYCS, meibomian glands yielding clear secretion; MGYLS, meibomian glands yielding liquid secretion; MGYSS, meibomian glands yielding secretion score; TBUT, tear break-up time.

TABLE 2. *The Changes in TBUT, Meiboscore, MGLS, MGYSS, MGYLS, and MGYCS After IPL/MGX of the Responsive and Nonresponsive Groups*

	Responsive Group	Nonresponsive Group	P^a
ΔSPEED	−9.0, −8.0	−11.0, −8.0	0.741
ΔOSDI	−10.0, −14.0	−11.0, −18.0	0.962
ΔTBUT	2.0, 4.0	4.0, 5.0	0.195
ΔMeiboscore	0.0, 0.0	0.0, 0.0	1.000
ΔMGLS	−0.8%, 6.3%	−0.6%, 4.7%	0.698
ΔMGYSS	12.0, 5.0	4.0, 4.0	<0.001
ΔMGYLS	6.0, 2.5	2.0, 1.0	<0.001
ΔMGYCS	2.0, 2.5	0.0, 0.0	<0.001

[a]Mann–Whitney *U* test.

MGLS, meibomian gland loss score; MGYCS, meibomian glands yielding clear secretion; MGYLS, meibomian glands yielding liquid secretion; MGYSS, meibomian glands yielding secretion score; OSDI, Ocular Surface Disease Index; SPEED, Standard Patient Evaluation of Eye Dryness; TBUT, tear break-up time.

on the eyelids. The results showed that improved TBUT, corneal staining, dry eye symptoms, and meibomian gland secretion function were associated with IPL/MGX treatment. More importantly, the analysis showed that younger age, longer TBUT, and better meibomian gland structure before IPL/MGX were associated with greater benefits of treatment.

There are several established physical therapies and approaches for treating ductal obstruction to improve meibomian gland secretion function.[19] As a prospective physical treatment, IPL, with or without MGX, has been compared with other physical therapies, such as warm compress[7] and MGX.[13–15,18] The results showed that IPL and IPL/MGX are effective not only in improving the meibum grade,[14] meibum quality,[15,18] lipid layer grade,[13,14] and TBUT,[13–15,18] but also in decreasing inflammation around glands[7] and eyelid abnormalities.[14] IPL has multiple mechanisms of action with respect to the treatment of MGD (such as softening the meibum and reducing inflammation).[8] It is not difficult to understand the above studies showed that IPL was more effective than a warm compress or MGX alone.

Traditional physical therapies such as MGX and warm compress were shown to be an effective MGD treatment in most former studies.[19] Interestingly, in other studies, when they served as control comparing with novel therapies, their treatment outcome seemed to be unsatisfactory.[14,15] These studies did not combine MGX with a daily warm compress,[15] or provide no details of compliance of the patients.[14] By contrast, in another study on IPL,[7] a daily warm compress and lid massage protocol in the control group were described in detail, and compliance was strictly enforced. Improvement of dry eye symptoms and meibomian gland secretion function were observed. The authors posited that both compliance and an appropriate methodology are crucial for ensuring good treatment outcomes when using a traditional warm compress and various physical therapies. However, it should be noted that the expectations of unblinded patients and examiners may bias comparisons of a novel therapy to traditional therapies. Most previous studies on IPL treatment of MGD/dry eyes did not compare IPL with other thermal devices or medication treatments; studies addressing this are therefore needed in the future.

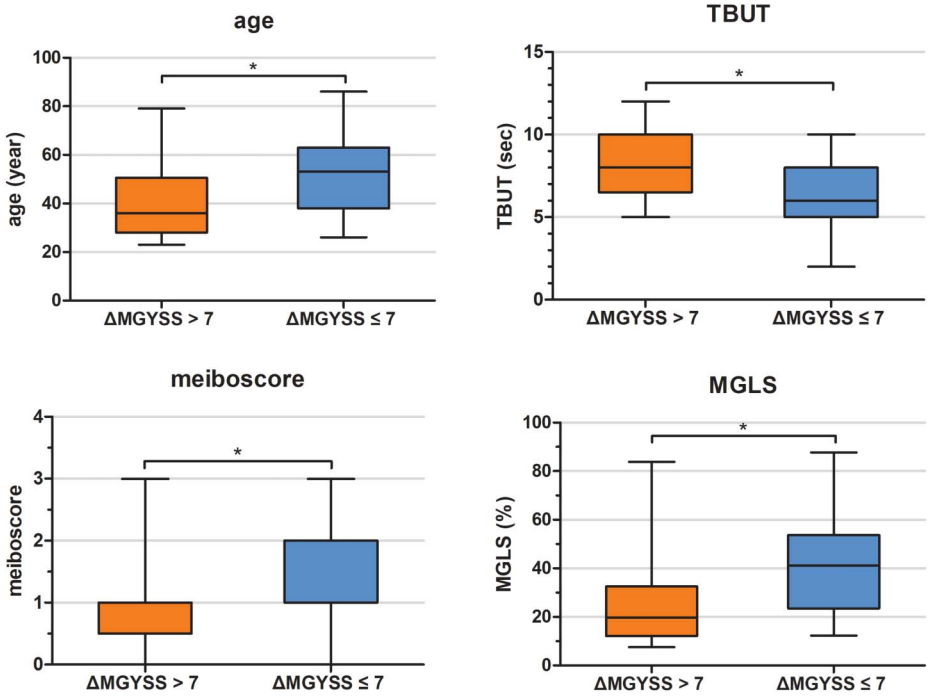

FIG. 2. Distribution of age, TBUT, meiboscore, and MGLS in the lower eyelids before IPL/MGX between groups. ΔMGYSS >7, MGYSS changes larger than 7 after IPL/MGX. ΔMGYSS ≤7, MGYSS changes no more than 7 after IPL/MGX. *Significant difference at $P<0.050$, Mann–Whitney *U* test. MGLS, meibomian gland loss score; MGYSS, meibomian glands yielding secretion score; TBUT, tear break-up time.

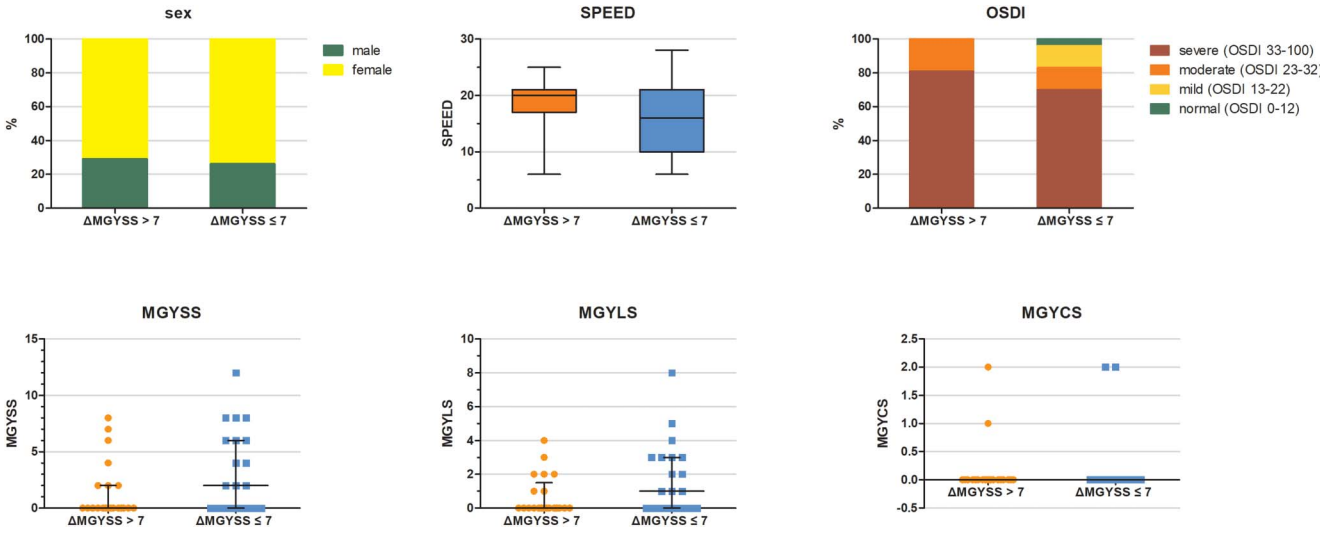

FIG. 3. Distribution of sex, SPEED, OSDI, and meibomian gland secretion parameters before IPL/MGX between groups. No significant differences were found in sex (P=0.853, χ^2 test), SPEED (20.0, 4.0 vs. 16.0, 11.0; P=0.147, Mann–Whitney U test), OSDI (56.3, 33.2 vs. 41.7, 33.3; P=0.196, Mann–Whitney U test), MGYSS (0.0, 2.0 vs. 2.0, 6.0; P=0.152, Mann–Whitney U test), MGYLS (0.0, 1.5 vs. 1.0, 3.0; P=0.144, Mann–Whitney U test), and MGYCS (0.0, 0.0 vs. 0.0, 0.0; P=0.962, Mann–Whitney U test). ΔMGYSS >7, MGYSS changes larger than 7 after IPL/MGX. ΔMGYSS ≤7, MGYSS changes no more than 7 after IPL/MGX. MGYSS, meibomian glands yielding secretion score; MGYLS, meibomian glands yielding liquid secretion; MGYCS, meibomian glands yielding clear secretion; OSDI, Ocular Surface Disease Index; SPEED, Standard Patient Evaluation of Eye Dryness.

In the 2017 TFOS DEWSII report, IPL was listed as an alternative physical therapy for dry eye, but no indications or proper treatment opportunities were proposed.[19] As mentioned above, improved meibomian gland secretion function is the basis of MGD treatment. We therefore considered changes in MGYSS after IPL/MGX as the main treatment outcome. We compared demographic and clinical characteristics and relevant dry eye/MGD ocular history data between responsive patients (ΔMGYSS >7) and nonresponsive patients (ΔMGYSS ≤7). The results showed that age, TBUT, and the extent of glands dropout, but not sex, dry eye symptoms, or gland secretion function, may affect treatment outcomes. Patients with a younger age, longer TBUT, and more meibomian glands seemed to benefit most from IPL/MGX treatment. It is reasonable to assume that these patients had a relatively normal meibomian gland structure and were in the early stages of MGD. Once the obstruction and inflammation were resolved, the secretion function was recovered.

Meibomian gland dysfunction may manifest only as impairment in meibomian gland secretion function during the early stages. However, with disease progression, the acini and gland ducts become dilated and infiltrated with inflammatory cells, which may eventually result in structural changes, known as gland dropout.[29] Cases with no obvious inflammation, relatively normal meibography, but poor gland secretion function under diagnostic expression (meibomian gland evaluator expression) were termed as nonobvious obstructive MGD (NOMGD) by Blackie et al.[30] Although our study did not record eyelid inflammation, we did enroll patients with normal meibography (meiboscore of 0–1) but poor gland secretion (MGYSS of 0); these patients benefited most from IPL/MGX. Because NOMGD may be a precursor of obvious MGD,[30] IPL/MGX in the early stages of MGD may be helpful to prevent its progression to the acini dropout.

Although the results of this study were almost all positive, there were two females and one male who did not respond to IPL/MGX (ΔMGYSS ≤0) treatment. The younger female nonresponder had minor conjunctiva exposure when closing the eyes. The older female received an eyeliner tattoo when she was younger. The male patient had severe rosacea without any previous treatment. Vegunta et al.[11] reported that IPL nonresponders in their study included those showing incomplete blinking, as well as contact lens wearers and laser in situ keratomileusis patients. They hypothesized that these nonresponders may have had more pronounced gland dropout or atrophy, which could have resulted in treatment failure. Considering our results together those of Vegunta et al.,[11]

TABLE 3. *Dry Eye and MGD-Related History of Patients*

	Responsive Group	Nonresponsive Group	P^a
Rosacea (n, %)	5, 23.8%	8, 34.8%	0.426
Eyeliner tattoo (n, %)	1, 4.8%	5, 21.7	0.101
Cornea refractive laser surgery (n, %)	1, 4.8%	3, 13.4%	0.340
Blepharoplasty (n, %)	1, 4.8%	1, 4.3%	0.947

[a]Chi-square test.

MGD, meibomian gland dysfunction.

TABLE 4. *Cross Comparison of MGYSS Changes at the End of the Study*

	Lower Eyelids, before IPL/MGX		
	Meiboscore 0–1	Meiboscore 2–3	P^a
MGYSS =0 before IPL/MGX, (median, IQR), n (%)	(12.0, 10.0), 15 (34.1%)	(6.5, 9.3), 10 (22.7%)	0.031
MGYSS >0 before IPL/MGX, (median, IQR), n (%)	(5.0, 11.5), 13 (29.5%)	(2.5, 9.0), 6 (13.6%)	0.323
P^a	0.041	0.181	

[a]Mann–Whitney *U* test.

IQR, interquartile range; MGYSS, meibomian glands yielding secretion score.

we hypothesize that the extent of meibomian glands dropout may be a critical factor in IPL/MGX treatment outcomes because the number of meibomian glands is correlated with age, TBUT, and the MGD progression. Thus, patients in the early stages of MGD could be ideal candidates for IPL/MGX therapy, although further studies are needed to validate this hypothesis.

There were some limitations to our study. First, it used a retrospective design. The expectations of patients and examiners regarding a novel therapy may constitute a bias when reporting symptoms and evaluating clinical signs. Randomized controlled clinical trials or well-designed cohort studies are needed to compare IPL with other therapies for MGD and dry eye, and to identify ideal candidates for IPL and the optimal therapeutic window. Furthermore, most of our patients were female, which may reduce the representativeness of our findings. In addition, the relatively small sample size limited our ability to perform subgroup analyses. Future studies should include larger samples, compare the effects of different protocols, obtain detailed medical records of patients, and explore the mechanisms underlying the effects of IPL treatment on MGD. Long-term studies on IPL treatment outcomes in MGD or dry eye patients are also needed.

CONCLUSION

Improved dry eye symptoms, TBUT, corneal staining, and meibomian gland secretion were observed in MGD patients after IPL/MGX. Patients in the early stages of MGD maybe benefited most from IPL/MGX treatment.

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