

Original Article

Combined meibomian gland massage and acupuncture enhances tear film and ocular surface health in meibomian gland dysfunction

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Abstract: Objectives: To evaluate the efficacy of meibomian gland massage combined with pressing acupuncture in patients with meibomian gland dysfunction (MGD) and to compare outcomes with massage alone. Methods: A retrospective analysis was performed on 220 MGD patients (440 eyes) treated at Xi'an Aier Eye Hospital between August 2021 and August 2023. Patients were assigned to two groups: the Massage Group (n = 119), which received standard meibomian gland massage, and the Acupuncture Group (n = 101), which received massage plus pressing acupuncture. Clinical outcomes included Tear Break-Up Time (TBUT), Schirmer Test (SIT), corneal fluorescein staining, meibomian gland expressibility and dropout scores, subjective symptom scores, Meibomian Gland Yields and Secretion Score (MGYSS), Eyelid Margin Abnormality Score (EMAS), overall efficacy, and adverse reactions. Results: Both groups showed improved tear function, but the Acupuncture Group demonstrated superior post-treatment outcomes, including SIT (P = 0.036), TBUT (P = 0.023), expressibility (P = 0.038), dropout scores (P = 0.009), subjective symptom scores (P = 0.004), MGYSS (P = 0.019), EMAS (P = 0.003), and total clinical effectiveness rate (P < 0.001). Corneal staining also improved more significantly in the Acupuncture Group (P = 0.013). The incidence of adverse reactions was comparable between groups. Conclusions: Meibomian gland massage combined with pressing acupuncture provides significantly greater improvements in tear film stability, glandular function, and ocular surface health compared with massage alone, without increasing adverse reactions.

Keywords: Meibomian gland dysfunction, acupuncture, meibomian gland massage, dry eye disease, tear film stability, ocular surface inflammation

Introduction

Meibomian gland dysfunction (MGD) is a prevalent chronic condition characterized by obstruction of the meibomian glands and alterations in the quality and quantity of glandular secretions [1, 2]. It is the leading cause of evaporative dry eye disease (DED), frequently associated with ocular discomfort and visual instability. The etiology of MGD is multifactorial; gland obstruction, inflammation, and microbial factors can impair the lipid layer of the tear film. Effective management requires addressing these underlying mechanisms to alleviate symptoms, preserve ocular surface integrity, and prevent long-term damage [3-5].

Conventional treatments for MGD primarily focus on symptomatic relief through pharmaco-

logical agents or eyelid hygiene. Antibiotics and anti-inflammatory drugs may provide benefits but do not directly resolve gland obstruction, and their adverse effects limit long-term application [6]. Physical therapies, including warm compresses and eyelid massage, are commonly recommended to relieve ductal obstruction, restore meibum secretion, and stabilize the tear film lipid layer. However, many patients achieve only partial improvement, underscoring the need for more effective therapeutic strategies [7-9].

In recent years, complementary medicine, particularly traditional Chinese medicine, has attracted increasing attention in ocular surface disease management. Acupuncture, involving the insertion of fine needles at specific acupoints, has shown potential as an adjunctive

treatment for MGD and other ocular disorders. Its therapeutic effects may be mediated through modulation of neural pathways, enhanced local blood circulation, and anti-inflammatory mechanisms. These potential benefits have prompted interest in combining acupuncture with standard physical therapies to optimize outcomes in MGD management [10, 11]. Accordingly, this study aimed to evaluate the efficacy of meibomian gland massage combined with pressing acupuncture in patients with MGD, focusing on clinical outcomes related to tear film stability and ocular surface health.

Materials and methods

Case selection

A retrospective analysis was conducted on 220 patients (440 eyes) with MGD treated at Xi'an Aier Eye Hospital between August 2021 and August 2023. Patients were divided into two groups according to treatment modality: the Massage Group (n = 119), which received conventional meibomian gland massage alone, and the Acupuncture Group (n = 101), which received a combination of meibomian gland massage and acupuncture point pressing. The study protocol was approved by the Institutional Review Board and Ethics Committee of Xi'an Aier Eye Hospital.

Inclusion criteria

Eligible patients met the diagnostic criteria for MGD [12], with symptoms such as ocular dryness, foreign body sensation, burning, or fluctuating vision. Clinical signs included eyelid margin abnormalities (e.g., redness, swelling, scales, or purulent discharge at the lash base) and slit-lamp evidence of meibomian gland obstruction or abnormal secretion in both eyes. Additional criteria included: no ocular surgery within the past six months; meibomian gland expressibility score of 1-3; and meibomian gland dropout score of 1-3.

Exclusion criteria

Exclusion criteria were as follows: other ocular diseases (e.g., conjunctivitis, corneal disorders); eyelid malformations due to trauma, scarring, or other lesions; fever, severe cardiovascular/cerebrovascular disease, or infectious

disease; autoimmune disorders; malignant tumors; systemic conditions such as diabetes, severe cardiovascular disease, or arthritis; acute glaucomatous attacks or retinal hemorrhage; hepatic or renal insufficiency; inability to adhere to treatment or complete examinations; pregnancy or lactation; and psychiatric disorders.

Intervention

Massage group: Patients first applied a steam eye mask (Yunnan Baiyao Group Co., Ltd., Kunming, China) for 20 minutes to warm the eyelids. Two drops of proparacaine hydrochloride ophthalmic solution (Santen Pharmaceutical Co., Ltd., Japan) were then instilled into the conjunctival sac for topical anesthesia. The periocular skin was disinfected with 75% alcohol. Sterile meibomian gland massage forceps (MG-100, Shanghai Medical Instruments Co., Ltd.) were used to apply controlled pressure from the posterior tarsal plate margin toward the eyelid margin to express glandular secretions.

All procedures were performed by the same experienced clinician to ensure consistency. Gentle, moderate pressure was applied to avoid damage to the eyelid or conjunctiva. After massage, gland orifices were cleaned with a saline-soaked cotton swab, and the conjunctival sac was irrigated with physiological saline for 3 seconds to remove debris. Finally, one additional drop of proparacaine hydrochloride was instilled for topical anesthesia. This protocol was administered three times weekly, with each session lasting 10 minutes, for a total duration of four weeks.

In this study, conventional meibomian gland massage was chosen as the sole intervention for the control group to isolate the therapeutic contribution of acupuncture point pressing. Previous studies have demonstrated that massage alone significantly alleviates MGD signs and symptoms [13]. By excluding adjunctive therapies such as artificial tears or lubricants, potential confounding factors were minimized, enabling a clearer assessment of the incremental benefits of combined treatment.

Acupuncture group: In addition to the meibomian gland massage protocol described above, patients in the Acupuncture Group received

adjunctive acupuncture treatment 10 minutes after massage. Patients were seated with their chins stabilized on the rest of a slit-lamp microscope (model S390L, Shanghai MediWorks Precision Instruments Co., Ltd.). Under topical anesthesia and slit-lamp visualization, sterile acupuncture needles (0.16 mm × 7 mm; Yun-long Medical Instruments Co., Ltd., Wujiang, Jiangsu) were inserted into selected acupoints at a depth of 1-2 mm. The targeted points included Jingming, Cuanzhu, Sizhukuang, Tongziliao, Taiyang, Hegu, Taichong, Fengchi, and Baihui. Following induction of the characteristic sensation, needles were retained for 30 minutes. Acupuncture sessions were performed three times per week for four consecutive weeks.

Data collection

Primary outcome: Treatment efficacy was evaluated using subjective symptom scores. Marked efficacy was defined as a > 70% reduction in symptom scores compared with baseline, effective response as a 30-70% reduction, and ineffective response as < 30% reduction. The overall clinical effectiveness rate was calculated as the proportion of patients achieving marked efficacy or effective response.

Secondary outcomes: Tear Break-Up Time (TBUT): A fluorescein strip (Haag-Streit AG, Koeniz, Switzerland) moistened with 0.9% sodium chloride was applied to the bulbar conjunctiva. After 3-5 seconds of eye closure, patients opened their eyes, and TBUT was measured under slit-lamp observation as the interval from eye opening to the first appearance of a black spot on the cornea. The procedure was repeated three times, and the average value was calculated. A TBUT > 10 s was considered normal. Inter-observer reliability for TBUT assessment has been reported at 0.78 [14].

Schirmer Test (SIT): A standard filter paper strip (Alcon Laboratories, Inc., Fort Worth, TX, USA) was folded at the 5-mm mark and inserted into the lower conjunctival sac at the medial canthus. After 5 minutes with eyes gently closed, the strip was removed, and the wetted length was measured (excluding the initial 2 minutes). The average of both eyes was calculated.

Corneal Fluorescein Staining (FLS): Sodium fluorescein was instilled, and the cornea was examined under cobalt blue light. Staining severity was graded as none (0), mild (1), moderate (2), or severe (3). Decreases in score indicated improvement. Reliability for FLS has been reported at 0.98 [15].

Meibomian Gland Expressibility Score: Graded as 0 (normal), 1 (membranous material at gland orifices), 2 (blocked and elevated openings), or 3 (severe obstruction with dense lipid plugs) [16].

Meibomian Gland Dropout Score: Scored as 0 (no dropout), 1 ($\leq 1/3$ area lost), 2 ($1/3$ - $2/3$ area lost), or 3 ($> 2/3$ area lost). Scores from the upper and lower eyelids were summed and averaged [17].

Subjective Symptom Score: Based on the “Guiding Principles for Clinical Research of New Traditional Chinese Medicine” [18], five symptoms (dryness, foreign body sensation, burning, photophobia, fatigue) were rated 0 (none) to 3 (severe). Scores were summed, with higher totals indicating greater severity.

Meibomian Gland Yields and Secretion Score (MGYSS): Secretions were graded as 0 (clear), 1 (cloudy), 2 (cloudy with particles), or 3 (toothpaste-like). Higher scores indicated worse dysfunction [19].

Eyelid Margin Abnormality Score (EMAS): Evaluated under slit lamp for smoothness of margin, presence of neovascularization, orifice obstruction, and abnormal fluorescein line displacement. Each item was scored as 1 (present) or 0 (absent), with total scores ranging from 0 to 4. Higher scores indicated more severe abnormalities [15, 19].

Statistical analysis

All statistical analyses were performed using SPSS 29.0 software (SPSS Inc., Chicago, IL, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD) and compared between groups using independent t-tests. Categorical variables were expressed as counts (percentages) and analyzed using chi-square tests (χ^2). All tests were two-tailed, and $P < 0.05$ was considered statistically significant.

Table 1. Baseline demographics prior to treatment

Parameter	Massage group (n = 119)	Acupuncture group (n = 101)	t/ χ^2	P
Age (years)	47.25 $\pm$ 5.27	46.78 $\pm$ 5.34	0.653	0.514
Disease duration (years)	12.33 $\pm$ 2.42	12.45 $\pm$ 2.50	0.363	0.717
Male/Female [n (%)]	64/55	45/56	1.861	0.173
BMI $\geq$ 24 kg/m ²	41 (34.45)	32 (31.68)	0.189	0.664
Long-term smoking [n (%)]	53 (44.54)	53 (52.48)	1.379	0.240
Prolonged use of electronic devices [n (%)]	66 (55.46)	68 (67.33)	3.230	0.072
Wearing contact lenses [n (%)]	22 (18.49)	18 (17.82)	0.016	0.899
Chronic blepharitis [n (%)]	32 (26.89)	24 (23.76)	0.282	0.596
MRSE (D)	-3.36 $\pm$ 1.09	-3.56 $\pm$ 1.18	-1.275	0.204
Central corneal thickness (μ m)	548.48 $\pm$ 35.10	554.27 $\pm$ 25.78	1.408	0.161
Pupil diameter (mm)	3.01 $\pm$ 0.53	3.07 $\pm$ 0.69	0.698	0.486

BMI: body mass index; MRSE: manifest refractive spherical equivalen.

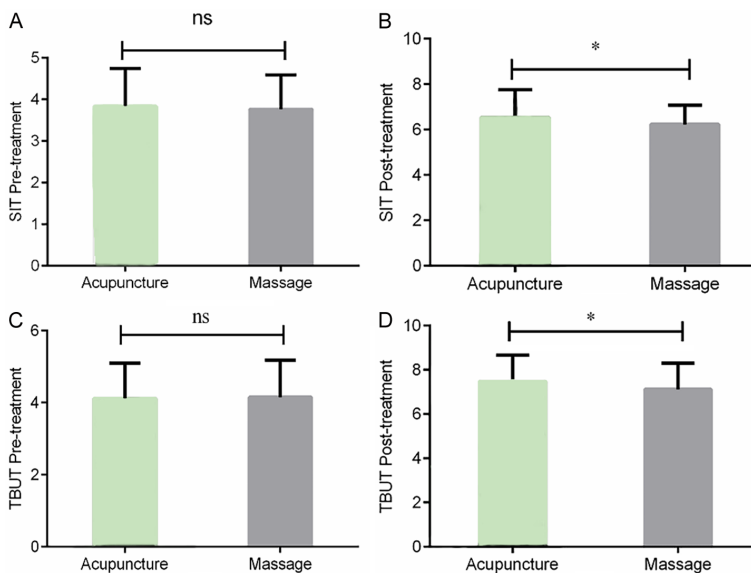


Figure 1. Comparison of SIT and TBUT scores. A. SIT Pre-treatment; B. SIT Post-treatment; C. TBUT Pre-treatment; D. TBUT Post-treatment. SIT: Schirmer Test; TBUT: Tear Break-Up Time. No statistically significant difference; *: P < 0.05.

Results

Baseline demographics

No significant differences were found between the Massage and Acupuncture groups in age, disease duration, gender distribution, BMI $\geq$ 24 kg/m², long-term smoking, prolonged use of electronic devices, contact lens wear, chronic blepharitis prevalence, manifest refractive spherical equivalent (MRSE), central corneal thickness, or pupil diameter (all P > 0.05). These results indicate that baseline character-

istics were well balanced between groups (**Table 1**).

SIT and TBUT scores

Before treatment, SIT (P = 0.558) and TBUT (P = 0.828) did not differ significantly between groups. After treatment, both SIT and TBUT improved significantly, with the Acupuncture Group showing greater improvements than the Massage Group (SIT: P = 0.036; TBUT: P = 0.023) (**Figure 1**).

Meibomian gland expressibility scores

At baseline, no significant differences were observed in expressibility score distributions between groups for scores of 1 (P = 0.226), 2 (P = 0.812), and 3 (P = 0.443) (**Table 2**).

After treatment, significant between-group differences were detected for 0 points (χ^2 = 5.419, P = 0.02), 1 point (χ^2 = 4.325, P = 0.038), 2 points (χ^2 = 6.285, P = 0.012), and 3 points (χ^2 = 5.258, P = 0.022).

Meibomian gland dropout scores

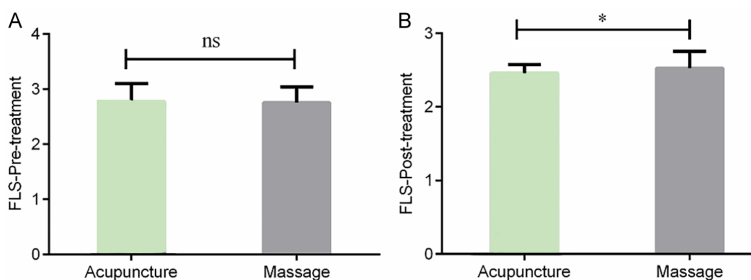
Baseline dropout score distributions were similar between groups (scores of 1: P = 0.138; 2: P = 0.920; 3: P = 0.566) (**Table 3**). Post-treatment, significant differences were observed for 0

Table 2. Meibomian gland expressibility scores

	Massage group (n = 119)	Acupuncture group (n = 101)	χ^2	P
Pre-Treatment				
1 point [n (%)]	4 (3.36)	7 (6.93)	1.465	0.226
2 points [n (%)]	57 (47.90)	50 (49.5)	0.056	0.812
3 points [n (%)]	58 (48.74)	44 (43.56)	0.588	0.443
Post-Treatment				
0 points [n (%)]	15 (12.61)	25 (24.75)	5.419	0.020
1 point [n (%)]	60 (50.42)	65 (64.36)	4.325	0.038
2 points [n (%)]	36 (30.25)	16 (15.84)	6.285	0.012
3 points [n (%)]	8 (6.72)	0 (0.00)	5.258	0.022

Table 3. Meibomian gland dropout scores

	Massage group (n = 119)	Acupuncture group (n = 101)	χ^2	P
Pre-Treatment				
1 point [n (%)]	4 (3.36)	8 (7.92)	2.202	0.138
2 points [n (%)]	55 (46.22)	46 (45.54)	0.010	0.920
3 points [n (%)]	60 (50.42)	47 (46.53)	0.330	0.566
Post-Treatment				
0 points [n (%)]	0 (0.0)	6 (6.0)	5.201	0.023
1 point [n (%)]	62 (52.5)	70 (70.0)	6.739	0.009
2 points [n (%)]	45 (37.5)	25 (24.0)	4.297	0.038
3 points [n (%)]	12 (12.0)	0 (0.0)	10.772	0.001


Figure 2. Corneal FLS scores. A. Pre-treatment; B. Post-treatment. FLS: Fluorescein Staining. No statistically significant difference; *: $P < 0.05$.

points ($\chi^2 = 5.201$, $P = 0.023$), 1 point ($\chi^2 = 6.739$, $P = 0.009$), 2 points ($\chi^2 = 4.297$, $P = 0.038$), and 3 points ($\chi^2 = 10.772$, $P = 0.001$), indicating that acupuncture significantly reduced gland dropout compared with massage alone.

Corneal fluorescein staining (FLS) scores

Baseline FLS scores were comparable between groups ($P = 0.382$) (**Figure 2**). After treatment, both groups showed significant improvement, with the Acupuncture Group achieving a greater reduction ($t = 2.499$, $P = 0.013$).

Subjective symptom, MGYSS, and EMAS scores

Pre-treatment scores for subjective symptoms, MGYSS, and EMAS were not significantly different between groups (all $P > 0.05$) (**Figure 3**). Post-treatment, both groups improved significantly, with the Acupuncture Group showing greater reductions in subjective symptom scores ($t = 2.934$, $P = 0.004$), MGYSS ($t = 2.368$, $P = 0.019$), and EMAS ($t = 2.972$, $P = 0.003$).

Efficacy

The total clinical effectiveness rate was significantly higher in the Acupuncture Group than in the Massage Group ($\chi^2 = 16.805$, $P < 0.001$) (**Table 4**). Improvement was observed in 78 of 119 patients (65.55%) in the Massage Group and 90 of 101 patients (89.11%) in the Acupuncture Group, confirming the superior overall efficacy of combined therapy.

Meibomian gland massage and acupuncture

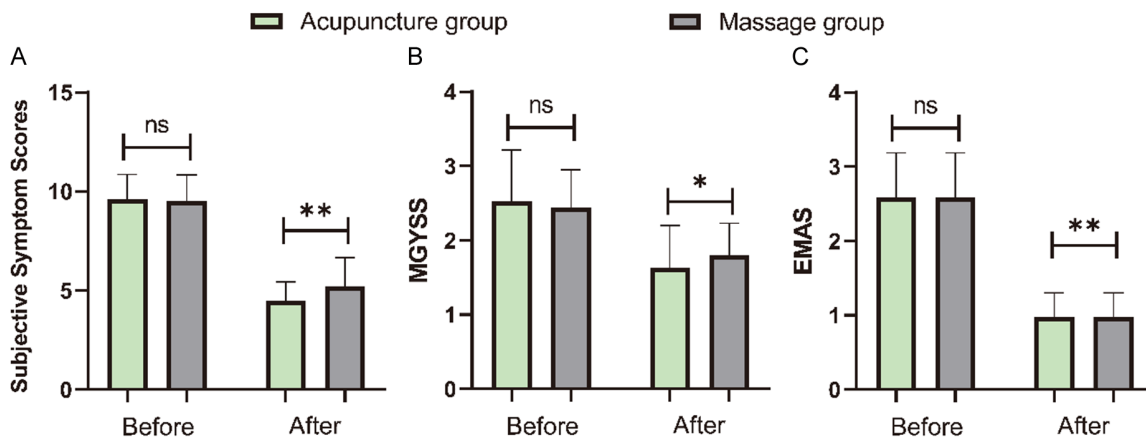


Figure 3. Subjective symptom scores, MGYSS and EMAS scores. A. Subjective Symptom Scores; B. MGYSS; C. EMAS. MGYSS: Meibomian gland yields and secretion score; EMAS: Eyelid margin abnormality score. No statistically significant difference; *: $P < 0.05$; **: $P < 0.01$.

Table 4. Efficacy comparison

	Massage group (n = 119)	Acupuncture group (n = 101)	χ^2	P
Marked Efficacy [n (%)]	7 (5.89)	20 (19.80)		
Effective [n (%)]	71 (59.66)	70 (69.31)		
Ineffective [n (%)]	41 (34.45)	11 (10.89)		
Total Clinical Effectiveness [n (%)]	78 (65.55)	90 (89.11)	16.805	< 0.001

Table 5. Incidence of adverse reactions during treatment

	Massage group (n = 119)	Acupuncture group (n = 101)	χ^2	P
IPE [n (%)]	7 (5.88)	5 (4.95)	0.092	0.762
OI [n (%)]	4 (3.36)	3 (2.97)	0	1
CC [n (%)]	7 (5.88)	6 (5.94)	0	0.985
DF [n (%)]	2 (1.68)	0 (0.00)	0.355	0.551
Total [n (%)]	20 (16.81)	14 (13.86)	0.363	0.547

IPE: Intraocular pressure elevation; OI: Ocular irritation; CC: Conjunctival congestion; DF: Dizziness and fatigue.

Adverse reactions

Adverse reactions did not differ significantly between groups, including intraocular pressure elevation ($P = 0.762$), ocular irritation ($P = 1$), and conjunctival congestion ($P = 0.985$) (Table 5). Dizziness and fatigue were reported only in the Massage Group but were not statistically significant ($P = 0.551$). Overall, both treatments were well tolerated, with comparable safety profiles ($P = 0.547$).

Discussion

The present study investigated the therapeutic effects of combining meibomian gland massage with pressing acupuncture in patients

with MGD, a prevalent ocular disorder that markedly impairs quality of life. MGD is the primary cause of evaporative DED, characterized by alterations in the quality and quantity of glandular secretions [20, 21]. Our findings reaffirm the value of mechanical interventions, such as gland massage, which restore gland function by expressing meibum, relieving ductal obstruction, and stabilizing the tear film lipid layer [22, 23]. When appropriately performed, manual expression alleviates obstruction and improves glandular secretion.

Acupuncture, a traditional medical technique increasingly recognized in modern ophthalmology [24], demonstrated additional therapeutic benefits in our study. The Acupuncture Group

achieved superior outcomes in TBUT, SIT, gland expressibility, and dropout scores compared with massage alone. Acupuncture may act through multiple mechanisms, including modulation of neural activity, enhancement of local blood flow, and release of neuropeptides [25-27]. Stimulation of ocular acupoints such as Jingming (BL-1) and Cuanzhu (BL-2) may augment parasympathetic activity, thereby promoting lacrimal and meibomian gland secretion [28-31]. This neurovascular modulation could explain the observed improvements in both aqueous and lipid tear components.

MGD often involves chronic inflammation. Acupuncture has been shown to reduce pro-inflammatory cytokines and modulate immune responses, potentially mitigating ocular surface inflammation and epithelial damage [32, 33]. The greater reduction in FLS scores observed in the Acupuncture Group supports this anti-inflammatory role. Moreover, improvements in expressibility and dropout scores suggest that acupuncture may contribute to glandular renewal and repair through signaling pathways related to tissue proliferation and homeostasis [34, 35]. The superior reductions in subjective symptom scores, MGYSS, and EMAS further highlight acupuncture's role in alleviating discomfort and improving eyelid margin health.

Both treatments were well tolerated, and adverse reactions were minimal and comparable across groups, supporting the safety of combined therapy. The combined approach provides multidimensional benefits by addressing mechanical obstruction, neurovascular regulation, and inflammatory processes simultaneously. This integrative strategy offers advantages beyond those achievable with massage alone and may represent a more comprehensive approach to MGD management.

Several limitations should be noted. First, the retrospective design and reliance on static indices limit insights into dynamic physiological processes. Prospective trials with real-time imaging and molecular analyses are warranted to elucidate underlying mechanisms. Second, individual variability in treatment response, influenced by genetic, lifestyle, or environmental factors, was not fully explored. Future studies should investigate personalized treatment protocols and incorporate advanced diagno-

stic modalities to clarify the biochemical pathways mediating acupuncture's effects.

In conclusion, combining meibomian gland massage with pressing acupuncture yields superior therapeutic benefits over massage alone, improving gland function, tear film stability, and ocular surface health while maintaining a favorable safety profile. This integrative approach offers a promising, patient-centered strategy for MGD management. Future research should validate these findings in larger, diverse populations and further clarify the mechanistic basis of the observed benefits.

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Disclosure of conflict of interest

None.

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