

CLINICAL GRADING AND TREATMENT OUTCOMES OF MEIBOMIAN GLAND DYSFUNCTION IN AN EASTERN INDIAN HOSPITAL

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ABSTRACT

Background: Meibomian gland dysfunction (MGD) is an important component of ocular-surface disease and is frequently encountered in patients with dry-eye symptoms. The objective is to describe the clinical severity of MGD and evaluate short-term changes after severity-based treatment in adults presenting with dry-eye symptoms and signs at a tertiary-care hospital in Eastern India. **Materials and Methods:** This prospective, single-centre, interventional before-and-after study included 168 adults (336 eyes) evaluated between June 2022 and May 2024. Assessment included symptoms, Ocular Surface Disease Index (OSDI), tear break-up time (TBUT), Schirmer I test, Oxford ocular-surface staining and meibography. MGD was graded clinically and management was tailored to severity. Outcomes were reassessed after 1 month. **Results:** Mean age was 52.0±12.89 years; 113 (67.3%) participants were male. Itching was the most frequent symptom at baseline (250/336 eyes, 74.40%). After treatment, foreign-body sensation fell from 58.93% to 0.89%, sandy-gritty sensation from 56.85% to 0.60%, and itching from 74.40% to 8.33% (all $P < 0.001$). Mean TBUT increased from 9.02±3.85 to 15.15±4.44 seconds ($P < 0.001$), Schirmer I from 11.08±3.48 to 14.61±4.17 mm ($P = 0.012$), and OSDI decreased from 25.36±9.68 to 17.52±3.78 ($P = 0.019$). Grade III–IV Oxford staining decreased from 49.40% to 0%, while meiboscore II–III decreased from 59.52% to 1.19% and moderate/severe MGD from 53.57% to 1.19% (all $P < 0.001$). **Conclusion:** In this hospital-based Eastern Indian cohort, structured clinical assessment and severity-based management of MGD were associated with significant improvement in symptoms, tear-film measures, ocular-surface staining, OSDI, meibography grade and overall MGD severity after 1 month.

INTRODUCTION

Meibomian glands supply the lipid component of the tear film and contribute to limiting evaporation from the ocular surface. MGD encompasses chronic abnormalities of the glands, including ductal obstruction and altered meibum production, and is closely linked with evaporative dry-eye disease. Because symptoms may be nonspecific, assessment limited to aqueous tear production can miss clinically important meibomian gland disease. Contemporary dry-eye frameworks therefore emphasize examination of the lid margin, meibum

and gland morphology alongside conventional tear-film testing.^[1–7]

Indian hospital-based studies have demonstrated a substantial burden of dry-eye disease and MGD, but regional data remain limited.^[11–13,18,19]

This study was undertaken in a tertiary-care railway hospital in Eastern India to characterize the clinical severity of MGD among adults presenting with dry-eye symptoms and signs and to assess changes after treatment selected according to disease severity.

MATERIALS AND METHODS

Study design and participants: This was a prospective, single-centre, interventional before-and-after study conducted in the Department of Ophthalmology, Central Hospital South Eastern Railway, Garden Reach, Kolkata, from June 2022 to May 2024. Adults aged 18 years or older presenting with dry-eye symptoms and/or signs were evaluated. The study included 168 participants and 336 eyes. The planned sample size was 336 eyes, calculated using an assumed dry-eye prevalence of 32%, 5% precision and $\alpha=0.05$. Written informed consent was obtained.

Eligibility criteria

Patients with burning, sandy/gritty sensation, foreign-body sensation, photophobia, ocular irritation, ocular dryness, itching or redness, and/or recurrent internal hordeolum or chalazion were eligible. Patients younger than 18 years and those with contact-lens use, previous ocular surgery, infectious conjunctivitis, Stevens–Johnson syndrome, chemical, thermal or radiation injury, lid structural abnormalities, altered lacrimal drainage, acne rosacea, Sjögren syndrome or connective-tissue disorders were excluded.

Clinical assessment and grading: All participants underwent history and comprehensive ocular examination, including best-corrected visual acuity, slit-lamp examination of the lid margin and anterior segment, Oxford ocular-surface staining, TBUT, Schirmer I testing, tear-meniscus assessment, assessment of meibum quality and expressibility, non-contact meibography and the OSDI questionnaire. MGD severity was categorized as normal, subclinical, mild, moderate or severe using the study's clinical grading framework, which incorporated symptoms, OSDI, meibum characteristics, meibography/meiboscore, TBUT, conjunctival findings and gland expression.

Treatment and follow-up: Treatment was individualized according to the recorded MGD severity. Subclinical disease was managed with artificial tears, eyelid hygiene and warm compresses. Mild disease additionally received topical azithromycin 1% once daily for 4 weeks; moderate disease additionally received oral doxycycline 100 mg twice daily for 3 weeks and omega-3 fatty acids 300 mg daily for 3 months; severe disease additionally received topical cyclosporine 0.05% for 3 months. Patients were reassessed after 1 month. These treatment categories are reported exactly as documented in the study protocol.

Statistical analysis

Categorical variables were summarized as counts and percentages. Continuous variables were summarized using means and standard deviations. Pre- and post-treatment categorical outcomes were compared using Pearson's chi-square test or Fisher's exact test as appropriate, and paired continuous

outcomes were assessed using the Wilcoxon signed-rank test. Analyses were performed using SPSS version 25. A two-sided $P<0.05$ was considered statistically significant.

RESULTS

The study comprised 168 participants (336 eyes). Mean age was 52.0 ± 12.89 years. The largest age group was 51–60 years (52/168, 31.0%), followed by those aged >60 years (46/168, 27.4%). There were 113 male (67.3%) and 55 female (32.7%) participants. Right and left eyes contributed equally (168 eyes each).

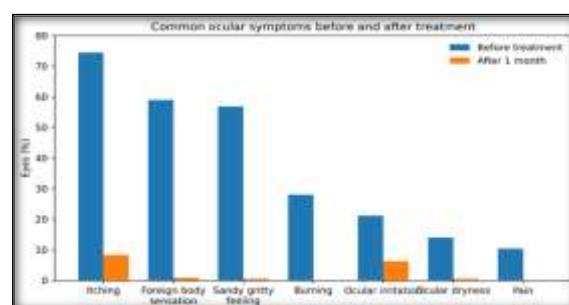


Figure 1: Reported symptom frequencies before treatment and at 1-month follow-up. Percentages are based on 336 eyes

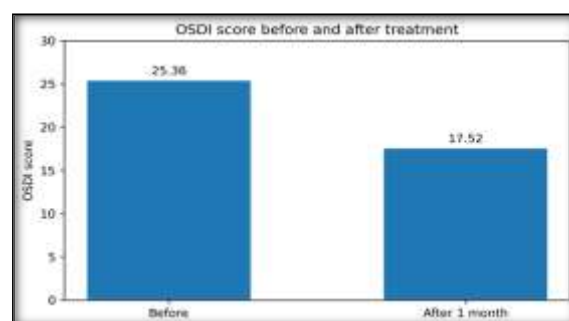


Figure 2: Mean OSDI score before treatment and after 1 month

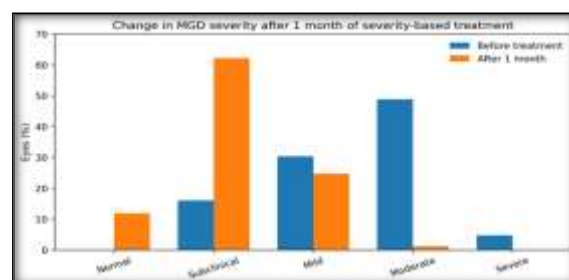


Figure 3: Distribution of reported MGD severity before treatment and after 1-month follow-up

Representative clinical images



Figure 4: Representative anterior-segment/lid-margin photographs from the study. Images are reproduced from the study material; participant consent for research use was documented



Figure 5: Representative meibography images from the study. Images are reproduced from the study material; participant consent for research use was documented

Table 1: Participant age distribution

Age group (years)	Participants, n (%)
21–30	14 (8.3%)
31–40	18 (10.7%)
41–50	38 (22.6%)
51–60	52 (31.0%)
>60	46 (27.4%)
Total	168 (100%)

Symptoms and symptom response

All recorded symptoms improved significantly after treatment (all $P < 0.001$). Itching was the most frequent baseline symptom (74.40%), followed by foreign-body sensation (58.93%) and sandy-gritty

sensation (56.85%). At 1 month, these had decreased to 8.33%, 0.89% and 0.60%, respectively. Burning, photophobia, watering and ocular pain were absent at follow-up in the reported dataset

Table 2: Symptom frequency before and after treatment

Symptom	Before, n (%)	After, n (%)	P value
Foreign-body sensation	198 (58.93)	3 (0.89)	<0.001
Sandy-gritty feeling	191 (56.85)	2 (0.60)	<0.001
Burning sensation	94 (27.98)	0 (0.00)	<0.001
Photophobia	14 (4.17)	0 (0.00)	<0.001
Itching	250 (74.40)	28 (8.33)	<0.001
Ocular irritation	71 (21.13)	21 (6.25)	<0.001
Ocular dryness	47 (13.99)	2 (0.60)	<0.001
Watering	13 (3.87)	0 (0.00)	<0.001
Redness	23 (6.85)	1 (0.30)	<0.001
Ocular pain	35 (10.42)	0 (0.00)	<0.001

Objective and patient-reported outcomes

Conjunctival hyperemia decreased from 17 eyes (5.06%) to none, and Oxford grade III–IV staining decreased from 166 eyes (49.40%) to none (both $P < 0.001$). Mean TBUT increased from 9.02 ± 3.85 to

15.15 ± 4.44 seconds ($P < 0.001$), while mean Schirmer I increased from 11.08 ± 3.48 to 14.61 ± 4.17 mm ($P = 0.012$). Mean OSDI decreased from 25.36 ± 9.68 to 17.52 ± 3.78 ($P = 0.019$).

Table 3: Objective and patient-reported outcomes before and after treatment

Outcome	Before	After 1 month	P value
Conjunctival hyperemia	17 (5.06%)	0 (0%)	<0.001
Oxford grade III–IV	166 (49.40%)	0 (0%)	<0.001
TBUT, mean $\pm$ SD (s)	9.02 ± 3.85	15.15 ± 4.44	<0.001
Schirmer I, mean $\pm$ SD (mm)	11.08 ± 3.48	14.61 ± 4.17	0.012
OSDI, mean $\pm$ SD	25.36 ± 9.68	17.52 ± 3.78	0.019
Meiboscore II–III	200 (59.52%)	4 (1.19%)	<0.001
Moderate/severe MGD	180 (53.57%)	4 (1.19%)	<0.001

MGD severity and meibography

Eyes with meiboscore II–III decreased from 200 (59.52%) at baseline to 4 (1.19%) after treatment ($P < 0.001$). Moderate/severe MGD decreased from 180 eyes (53.57%) to 4 eyes (1.19%) ($P < 0.001$). These results represent the grading outcomes recorded in the study and should not be interpreted as evidence of rapid anatomical gland regeneration over one month.

DISCUSSION

This study describes MGD in a symptomatic hospital population from Eastern India and demonstrates marked improvement across patient-reported symptoms and several ocular-surface measures after severity-based management. The mean age of 52 years and the greater representation

of older adults are consistent with the established relationship between increasing age and ocular-surface/meibomian gland disease.^[8,9,12,13]

Itching was the most frequent symptom, while foreign-body and gritty sensations were also common. The broad improvement across symptoms is consistent with reports that MGD contributes substantially to dry-eye symptom burden and that targeted treatment can improve both symptoms and clinical findings.^[9–11,20] Objective tear-film measures also improved: TBUT increased by more than six seconds on average, and Schirmer I showed a smaller but statistically significant increase. The TBUT finding is biologically compatible with improvement in the tear-film lipid component following measures directed at the meibomian glands.^[16,17]

The reduction in OSDI and Oxford staining indicates improvement in both perceived ocular-surface burden and epithelial staining. Similar treatment-related improvements have been described in Indian clinical cohorts.^[11] The reported reduction in meiboscore II–III and moderate/severe MGD over one month is striking. Because meibography is intended to characterize gland morphology, these short-interval changes should be interpreted within the grading system used in the present study rather than assumed to represent rapid structural restoration of glands. The study nevertheless supports the practical value of combining lid-margin examination, meibum assessment, tear-film testing and meibography when evaluating patients with dry-eye symptoms.

The findings are clinically relevant for ophthalmic services in which dry eye is common but the specific contribution of MGD may be overlooked. A structured MGD assessment allows severity to be documented and management to be directed toward the predominant ocular-surface mechanism. However, the absence of a parallel untreated control group means that the observed improvements cannot be attributed exclusively to the intervention; natural fluctuation, regression to the mean, adherence and concurrent components of dry-eye care may also have contributed.

Limitations

The study was conducted at a single tertiary-care hospital and therefore may not represent the wider community. The cohort consisted of symptomatic patients attending ophthalmic care, and several ocular and systemic conditions associated with dry eye were excluded, creating potential selection bias. The study did not quantify the volume or lipid composition of meibomian secretion. Finally, the before-and-after design lacked a parallel control group and follow-up was short; longer controlled studies are required to establish durability and the independent effect of individual treatment components.

CONCLUSION

MGD should be actively considered in adults presenting with dry-eye symptoms and signs. In this Eastern Indian hospital cohort, systematic clinical grading followed by severity-based treatment was associated with significant improvement in symptoms, TBUT, Schirmer I, OSDI, ocular-surface staining, meibography grade and overall MGD severity after 1 month. These findings support incorporating focused lid-margin, meibum and meibography assessment into routine evaluation of symptomatic dry-eye patients.

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