

IDENTIFYING AND TREATING MEIBOMIAN GLAND DYSFUNCTION



A deep dive into diagnostic and comprehensive management strategies.

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Meibomian gland dysfunction (MGD) is the most common cause of dry eye disease (DED). The Tear Film & Ocular Surface Society's Dry Eye Workshop II identified MGD as a prevalent and chronic disorder. It is often characterized by increased epithelial cell growth, blockages, meibum accumulation, gland dilation, and, ultimately, gland loss due to atrophy.¹ The theory of epithelial hyperkeratinization remains a subject of debate,^{2,3} but the essential role of functional meibomian glands in secreting the tear film's lipid layer—and thereby preventing rapid tear evaporation and preserving ocular surface health—is universally acknowledged.⁴⁻⁷

MGD reduces or alters oil production, resulting in tear film instability and a host of ocular symptoms that can severely affect ocular health. These range in severity from dryness, blurred vision, and irritation to gland atrophy, contact lens intolerance, and an increased risk of infection.

This article provides tips on accurately diagnosing and effectively managing MGD.

DIAGNOSIS

Meibography. As a pivotal technique in diagnosing MGD, meibography has revolutionized our ability to educate

patients, identify gland dropout, and assess atrophy. Historically, it stood as the sole method for analyzing meibomian gland morphology. Obtaining accurate images can be challenging, however, due to factors such as inadequate lid eversion and variability in image clarity. These issues complicate the interpretation of gland dropout, making it difficult at times to distinguish between actual tissue loss and proximal tarsal tissue appearances. Traditional meibography also falls short in detailing the anatomic structure of acini and ducts, limiting its comprehensive assessment of glandular architecture.

Despite these challenges, meibography's ability to reveal the extent of gland dropout or atrophy—a direct marker of MGD severity—remains indispensable. It facilitates the early detection and accurate assessment of the condition, where a higher degree of gland dropout indicates more advanced disease. Recognizing gland dilation and the consequent secretion accumulation helps in diagnosing obstruction early, crucial for managing end-stage MGD characterized by significant gland atrophy.

(Editors' note: To explore the latest advances in meibography devices that address these challenges, see the sidebar.)

OCT imaging. The high-resolution cross-sectional images of ocular structures provided by OCT address some of meibography's limitations. OCT enables clinicians to assess the thickness and structure of the tear film, evaluate meibomian gland morphology, and quantify changes in glandular volume. These insights are invaluable to elucidating the pathophysiology of MGD, including the alterations in glandular architecture that contribute to tear film instability. By providing a deeper understanding of these mechanisms, OCT imaging enhances the diagnostic process and permits a more targeted approach to treatment.

In vivo confocal microscopy. By enabling real-time imaging of tissue at a cellular level, in vivo confocal microscopy represents another leap forward in the diagnosis of MGD. This technology opens a window into the cellular world of the meibomian glands—specifically, the acini, epithelial cells, and inflammatory cells within the eyelids. The detailed imagery provided is critical for identifying cellular changes associated with MGD, such as inflammatory infiltrates, epithelial metaplasia, and glandular atrophy. Perhaps most importantly, in vivo confocal microscopy can help practitioners distinguish MGD from other conditions with similar clinical presentations.

MEIBOGRAPHY DEVICES

DSL200 with DEM100 module (Reichert/SBM Sistemi)

An anterior imaging camera system that, when equipped with the dry eye module (DEM100), provides a complete dry eye assessment platform directly from the slit lamp. Features include interferometry, tear meniscus measurement, eye blink assessment, and standard and 3D meibography.¹

HD Analyzer (Keeler)

This diagnostic tool has capabilities such as the objective scatter index for optical quality assessment, high-definition meibomian gland imaging for meibomian gland dysfunction and dry eye disease diagnosis, and vision breakup time measurement.²

Idra Ocular Surface Analyzer (SBM Sistemi)

This comprehensive diagnostic system provides high-quality tear film analysis and detailed examinations. It evaluates all three layers of the tear film as well as the meibomian glands.³

LacryDiag (Quantel Medical)

This unit offers a complete diagnosis of the three tear film layers, produces images of the meibomian glands, and measures the percentage of glandular loss. It performs four noncontact examinations in 4 minutes.⁴

Meibox (Box Medical Solutions)

This portable, slit lamp-mounted, cloud-based infrared noncontact camera captures images of the external eye, including meibomian gland structures, in black and white.⁵

MX2 (Shaffer Vision Solutions)

This high-definition, cloud-based external ocular camera and meibographer is portable and compatible with slit lamps.⁶

Oculus Keratograph 5M (Oculus)

This advanced corneal topographer includes a real keratometer and a color camera for external imaging.⁷

OS1000 (Reichert/SBM Sistemi)

This corneal topographer also performs various tests, including pupillometry, white-to-white measurements, noninvasive tear breakup time, meibography, and more to offer a comprehensive picture of the ocular surface.⁸

Systane iLux (Alcon)

This portable device visualizes treatment zones to target blocked meibomian glands.⁹

TearScience LipiScan Dynamic Meibomian Imager (Johnson & Johnson Vision)

This unit images an eyelid in roughly 10 seconds and features dynamic illumination for an enhanced view of meibomian gland structure.¹⁰

TearScience LipiView II Ocular Surface Interferometer (Johnson & Johnson Vision)

This device provides real-time visualization of the lipid layer to evaluate the dynamic response of lipids to blinking. It uses advanced illumination technology to provide high-definition images.¹¹

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COMPREHENSIVE TREATMENT STRATEGIES

The first step of MGD treatment is a thorough assessment of the patient, including their symptoms and contributing factors. The latter include environmental influences, such as

prolonged use of digital devices and contact lens wear, and dietary habits, including the balance between omega-6 and omega-3 fatty acid intake. Based on this comprehensive evaluation, a personalized treatment plan is devised to address the specific needs of the patient.

Traditional first-line treatments.

These include lid hygiene measures such as warm compresses, which help liquefy meibum, making it easier to express. Antiinflammatory agents and antibiotics—both topical and systemic—play critical roles in

controlling inflammation and microbial colonization of the lid margin. Topical azithromycin offers specific anti-inflammatory benefits beyond its antimicrobial properties and has been prescribed off-label for the treatment of lid margin disease owing to the drug's long duration of action and deep penetration into the ocular tissues.

Additional strategies include microblepharoexfoliation with BlephEx (BlephEx), debridement, and the use of tea tree oil or hypochlorous acid. These interventions are often most effective after the underlying gland obstruction has been addressed.^{8,9}

Adjunctive therapies. Preservative-free, lipid-containing artificial tears can supplement the tear film's lipid layer, addressing the evaporative component of MGD-induced DED. Cyclosporine (CsA) ophthalmic emulsion 0.05% (Restasis, Allergan), CsA ophthalmic solution 0.1% (Vevye, Harrow), CsA ophthalmic solution 0.09% (Cequa, Sun Ophthalmics), and lifitegrast (Xiidra, Novartis) have proven efficacy for improving lipid layer thickness and managing tear film instability.¹⁰⁻¹⁴

High-quality reesterified omega-3 supplements have been shown to reduce DED symptoms, decrease inflammation, and improve the quality of the tear film.¹⁵

In-office procedures. If traditional and adjunctive therapies are insufficient, in-office procedures may be considered. Thermal pulsation systems such as LipiFlow (Johnson & Johnson Vision), iLux (Alcon), and TearCare (Sight Sciences) facilitate the expression of meibum, improving gland function. Intense pulsed light therapy targets telangiectatic vessels on the lid margin, reducing inflammation and improving meibomian

gland function. OptiLight (Lumenis) is an intense pulsed light device that is FDA approved for treating the signs of DED associated with MGD.

ADDRESSING COEXISTING CONDITIONS

It is essential to treat coexisting eyelid conditions, such as blepharitis, to ensure comprehensive management of MGD. Lotilaner ophthalmic solution 0.25% (Xdemvy, Tarsus Pharmaceuticals) is FDA approved for the treatment of *Demodex* infestation. Systemic medications, such as oral tetracyclines or immunomodulators, may be prescribed to control inflammation and modulate the immune response, particularly in patients with rosacea or severe MGD.

EMERGING TREATMENTS

Innovative treatments are in development. Reproxalap (Aldeyra Therapeutics) is a reactive aldehyde species inhibitor that reduces ocular inflammation by binding free aldehydes. Other examples include keratolytic formulations, such as AZR-MD-001 (Azura Ophthalmics), aimed at reducing keratin production and stimulating meibum production; transient receptor potential melastatin 8 agonists, such as IVW-1001 (iView Therapeutics); and topical spironolactone for its antiandrogenic properties.

Recent research suggests it may be possible for atrophied meibomian glands to regenerate or become reactivated.¹⁶ This would open up new avenues for treating MGD and DED and could facilitate patients' recovery following refractive and cataract surgery.

PATIENT EDUCATION AND LONG-TERM MANAGEMENT

Educating patients about the chronic nature of MGD and the

importance of adherence to treatment plans is crucial to long-term management success. Regular follow-up visits are vital for monitoring treatment efficacy, making necessary adjustments, and addressing any new concerns that may arise. ■

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