Supplement to

Ophthalmology

Improving Awareness, Identification, and Management of Meibomian Gland Dysfunction

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Ocular surface disorders—and dry eye, in particular—are a leading reason for visits to eye care professionals. It has been generally accepted that meibomian gland dysfunction (MGD) is a leading cause of evaporative dry eye as well as being associated with aqueous-deficient dry eye. Yet researchers and clinicians have lacked a global consensus on the definition of MGD, its epidemiology, pathophysiology, and management. Various systemic diseases and medications have been associated with the progression of both dry eye and MGD, as have several ocular disorders beyond those directly affecting the surface. It is in the best interest of patients for clinicians to be able to better identify and diagnose MGD, differentiating it from other ocular surface disorders, and to recognize the effects of MGD on the ocular surface and thus initiate appropriate therapy. This CME activity provides expert insight into the Tear Film and Ocular Surface Society’s International Workshop on MGD consensus report, offering practical application of its findings to better manage MGD patient care, particularly for those patients facing or undergoing ocular surgery.

Target Audience

This educational activity is intended for ophthalmologists.
Learning Objectives
After successfully completing this activity, you will have improved your ability to:

- Describe new terminology and classifications of blepharitis and meibomian gland dysfunction
- Distinguish blepharitis/meibomian gland dysfunction from other ocular conditions
- Describe treatment implications for meibomian gland dysfunction with or without the presence of additional ocular surface disorders

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Improving Awareness, Identification, and Management of Meibomian Gland Dysfunction

Gary N. Foulks, MD, FACS, Kelly K. Nichols, OD, PhD, Anthony J. Bron, FRCPhth, FMedSci, Edward J. Holland, MD, Marguerite B. McDonald, MD, FACS, J. Daniel Nelson, MD

Ocular surface disorders—and dry eye, in particular—is a leading reason for visits to eye care professionals. It has been generally accepted that meibomian gland dysfunction (MGD) is a leading cause of evaporative dry eye, as well as being associated with aqueous-deficient dry eye. Yet, researchers and clinicians have lacked a global consensus on the definition of MGD, its epidemiology, pathophysiology, and management. Various systemic diseases and medications have been associated with the progression of both dry eye and MGD, as have several ocular disorders beyond those directly affecting the surface. It is in the best interest of patients for clinicians to be able to better identify and diagnose MGD, differentiating it from other ocular surface disorders, and to recognize the effects of MGD on the ocular surface, and thus initiate appropriate therapy. This CME activity provides expert insight into the Tear Film and Ocular Surface Society’s International Workshop on MGD consensus report, offering practical application of its findings to better manage MGD patient care, particularly for those patients facing or undergoing ocular surgery. Ophthalmology 2012;119:S1–S12 © 2012 by the American Academy of Ophthalmology.

Letter From Guest Editors Gary N. Foulks, MD, and Kelly K. Nichols, OD, PhD

Over the course of the past 2 decades or so, clinicians and researchers alike have become more aware of how intricately even the most subtle changes on the ocular surface affect vision, quality of life, and intraocular surgical outcomes. Since the early days of refractive surgery, we have known that patient discomfort during the extended postoperative period is likely the result of a dry ocular surface. Significant advances in dry eye research have led to a better understanding of the condition’s pathophysiologic characteristics, which in turn has led to a more comprehensive definition of, more efficient diagnostics for, and extended treatment platforms for dry eye. Clinicians have remained challenged in distinguishing the underlying causes of patient symptoms, however, because there is substantial overlap between dry eye, meibomian gland dysfunction (MGD), and blepharitis. Under the auspices of the Tear Film and Ocular Surface Society* (TFOS), the International Dry Eye Workshop Definition and Classification Subcommittee in 2007 published a consensus indicating that evaporative dry eye results from the excessive evaporation of water from the tear film. Such tear film alterations are influenced directly by MGD. Work from the International Dry Eye Workshop report led us to realize that a similar need existed for understanding MGD, and TFOS rose to the challenge.

The purpose of the TFOS International Workshop on Meibomian Gland Dysfunction in 2010 (MGD Workshop) was to emulate the method of the International Dry Eye Workshop and finally to bring together a consensus on the definition of MGD, its pathophysiology, and treatment and management options for the clinician. A secondary goal was to effect awareness of the issues researchers from around the world faced when undertaking a clinical study on MGD. The MGD Workshop results are the culmination of more than 2 years of work with more than 50 international expert participants. The report “is the most current, definitive summary of the meibomian gland in health and disease.”

It is one thing for us to read the report and understand its ramifications in research, and quite another to determine how the report will affect clinical practice in typical office settings around the world. It is, perhaps, even more difficult to ascertain how the findings from the MGD Workshop will affect surgical outcomes of patients, because many clinicians overlook the meibomian gland when evaluating patients for signs and symptoms of dry eye before or during the postoperative period. Yet MGD is associated with evaporative dry eye and may indeed be a contributing cause of aqueous-deficient dry eye.

Ophthalmology has lacked a precise definition of MGD until now. Our absence of understanding of the meibomian gland’s relationship to other ocular surface diseases (primarily dry eye and blepharitis) has been problematic in both diagnosis and treatment. It is hoped that by combining the consensus findings of the MGD Workshop with the clinical opinions of the experts here assembled—some of whom collaborated on the MGD

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Overview of the Disease State

It is well documented that ocular surface disorders are a leading cause—if not the primary cause—of visits to eye care providers.4-9 Patients often present with multiple symptoms, and clinical signs may not correlate well with patient-reported symptoms. Perhaps the most prevalent of the ocular surface diseases that fits this description of patient symptoms is dry eye. The 2 forms of dry eye, evaporative and aqueous deficient, are neither mutually inclusive nor mutually exclusive. Meibomian gland dysfunction is likely the primary cause of evaporative dry eye and may occur in conjunction with aqueous-deficient dry eye.3 To date, the scientific community has lacked agreement on how to quantify and characterize patient-reported symptoms or clinician-reported signs of MGD. In evaporative dry eye, the inflammatory process may be related to or caused by the meibomian glands, or both, which in turn may create tear film changes.11,12 This codependency between the tear film and the meibomian glands may explain why there has been such difficulty separating MGD from other ocular surface diseases in treatment and pathogenesis.9

Clinically, MGD may be implicated in less-than-desirable outcomes after cataract, refractive, and corneal surgeries.13-15 Classification of the dysfunction has been relegated to anatomic or pathophysiologic changes, or by severity on presentation. Clinicians and researchers alike acknowledge that healthy ocular surfaces can be adversely affected by unhealthy meibomian glands.9

Diseases involving the meibomian gland have been discussed since the early 1900s, but the term meibomian gland dysfunction as an entity separate from meibomian gland disease was first introduced to the literature in 1980.16 Description of the dysfunction condition has been less uniform, with numerous criteria applied in various studies.3 It is generally accepted, however, that MGD refers to functional abnormalities of the glands, whereas a broader definition that incorporates MGD, neoplasia, and congenital diseases is appropriate for the term meibomian gland disease.3 It also has been generally accepted that MGD is age related: various studies of Asian origin report that more than half of the population older than 60 years is affected.5

The terms MGD and posterior blepharitis have been used interchangeably,4,7,9,17,18 leading to some loss of descriptive clarity. Although posterior blepharitis always will involve the meibomian glands, MGD, in its earliest manifestations, is not necessarily associated with some of the biomicroscopic lid margin signs classic of blepharitis, including inflammation of the eyelid.3 Conversely, anterior blepharitis occurs in the region concentrated around the lashes, anterior to the gray line, and therefore does not commonly involve the meibomian glands. The posterior lid margin—where posterior blepharitis occurs—is anatomically inclusive of more than just the meibomian glands themselves. Vascularization of the posterior lid margin also has been noted as an important element in the clinical presentation of MGD.19 Hence, MGD is but 1 potential cause of posterior blepharitis and should be diagnosed and treated as a separate entity.

The true prevalence of MGD is not known for certain, because published figures are likely to be influenced by the varied diagnostic criteria used.10,20 However, population-based studies have found that the prevalence is lowest in whites, at approximately 20%.21,22 A much higher prevalence, of approximately 60%, has been reported in most studies evaluating MGD in those of Asian ethnicity.2,20,23-25 One outlier study found a 46.2% prevalence rate in Thailand,26 but inappropriate sampling has yielded questions about its findings.20

The MGD Workshop has recommended that MGD be classified into 2 additional states: low delivery and high delivery, depending on gland secretion.3 The group of experts advocates the low-delivery state to be quantified further into hyposecretory and obstructive categories. Hyposecretion is associated predominantly with gland atrophy, whereas obstruction is considered the most common form of MGD.3,11 Hypersecretory MGD, the high-delivery state, has been linked to several dermatologic disorders, including acne and seborrheic dermatitis.27,28

Meibomian gland dysfunction-created tear film lipid abnormalities adversely affect tear film composition and functioning. In the post-LASIK patient, this condition can manifest as evaporative dry eye. Systemic hormonal treatments also affect the ocular surface and may be implicated in the development or progression of MGD. In women, for instance, estrogen replacement therapy has been linked in numerous studies to increased dry eye symptoms.29 Anti-androgen therapy in men also has been linked to complex and significant changes in meibomian gland secretions, suggesting that androgen deficiency may lead to MGD and evaporative dry eye.29 Moving beyond any particular therapy, several etiologic factors are thought to correlate with MGD. These include aniridia, Demodex folliculorum, eyelid tattooing, floppy eyelid syndrome, giant papillary conjunctivitis, and trachoma, among others.20 Systemic risk factors are numerous—atopy, benign prostatic hyperplasia, cicatricial pemphigoid, discoid lupus erythematosus, Parkinson disease, psoriasis, rosacea, Stevens-Johnson syndrome, Turner syndrome, and more.30 Several medication classes have been evaluated for their implication in dry eye, but not for their role in MGD specifically.

In an ideal world, clinicians would be able to address the underlying cause of various ocular surface diseases individually and to have evidence-based treatment strategies for each particular disease. Until that time, however, uniformly quantifying and classifying a disease’s state will help to advance knowledge toward that goal.
The New Definition of Meibomian Gland Dysfunction

The MGD Workshop group has proposed the following new definition of MGD: “Meibomian gland dysfunction (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. This may result in alteration of the tear film, symptoms of eye irritation, clinically apparent inflammation, and ocular surface disease.”3 The proposed new definition of MGD provides clinicians with a definitive geographic location for the abnormality, separate from other diseases of the lid margins. This MGD Workshop definition has begun to be incorporated into many studies. Proceedings from the roundtable discussion on MGD follow.

**Dr. Nichols:** How has your perception of MGD changed in light of the new terminology? Is it changing how you think about managing patients?

**Dr. Bron:** The MGD Workshop’s definition has clarified the nature of the disease. Now that we have distinguished MGD from posterior blepharitis, I think it is easier for clinicians to explain the condition to their patients. Posterior blepharitis is a general term that simply means inflammation at the posterior lid margin. Meibomian gland dysfunction is 1 cause, but other conditions can give rise to posterior blepharitis—chronic conjunctivitis, for instance—and so it is better to use separate terms. Meibomian gland dysfunction specifically applies to a disorder affecting the terminal ducts of the meibomian gland. There is no reason to use the other term.

**Dr. Holland:** Over the past 20 years, several terms have been used interchangeably, each one coming in and out of vogue. The confusion in terminology made it difficult to really define the group of patients with MGD, never mind trying to adopt a consensus on treatment paradigms. The MGD Workshop report gave us the consensus definition we needed, and gives me something I can refer to when I am teaching comprehensive ophthalmologists, optometrists, or residents.

**Dr. Nelson:** Agreed. The report has given us a common language to use with each other; now when we say “MGD,” we are being very specific about the disorder.

**Dr. McDonald:** The MGD Workshop report will influence and change the way ophthalmic medicine is practiced. The release of this report is increasing awareness of the disorder and the need for clinicians to look for it specifically because of the disconnect between signs and symptoms.

**Dr. Foulks:** In the grand scheme of things, the new definition of MGD may provide regulatory authorities an opportunity to refine their terminology. We all know we have had difficulty with coding because there was not a consensus definition.

Right now, blepharitis is the only category that has a CPT (Current Procedural Terminology) code—ICD-9-CM (International Classification of Diseases, Ninth Edition, Clinical Modification) 373.00 for lid margin disease other than focal problems such as hordeola (ICD-9-CM 373.11 and 373.12) or chalazia (ICD-9-CM 373.2). It is our hope that the new definition and treatment algorithm can be adopted or refined into future ICD reports or guidelines. Once that has happened, we will be better able to categorize and quantitate exactly how frequently MGD is encountered in our patient population.

**Literature Review on Pathophysiology of Meibomian Gland Dysfunction**

Located in the tarsal plates of the eyelids, the meibomian glands are large sebaceous glands that act to synthesize and secrete lipids and proteins. Korb and Henriquez16 and Henriquez and Korb30 first described hyperkeratinization as a primary cause of obstructive MGD in patients with only transient or minimal symptoms. Contact lens (CL) intolerance transitioned the symptoms to clinical relevance. Contact lens intolerance dissipated after gland expression and plug removal. In those with symptomatic dry eye, excretory duct obstruction by increased keratinization signs were verified on histologic examination.

Although an overwhelming number of articles have been published on sebaceous glands (and the literature provides a fairly detailed discussion and understanding of how these glands develop, proliferate, and secrete), relatively little has been published on the meibomian glands themselves. In fact, there have been fewer than 50 papers published in the past century that address the topic of physiologic control of the meibomian glands.29 What is known is that these glands secrete both lipids and proteins.29 The lipids play a crucial role in promoting tear film stability and in preventing tear film evaporation; however, our full knowledge of the role of the protein secretions remains incomplete.

Mouse models have been used to help clarify the role of the meibomian glands; meibomian gland atrophy in certain knockout mice, or absence in others, results in corneal erosions and defects. Healthy meibomian gland secretions are clear; unhealthy glandular secretions may be cloudy, turbid, inspissated, or toothpaste-like in consistency.29 Meibomian gland dysfunction, at its simplest, occurs when there is an obstruction sufficient enough to prevent the meibum from performing its job. Indeed, obstructive MGD seems to be the most common form of the condition.29 Figure 1 illustrates the current classification of MGD. Among the associated functional complexes that interact with the pathogenesis of MGD are seborrhea (including seborrheic blepharitis), potential commensal bacterial growth, and subclinical inflammatory events. In addition, age-dependent changes may have a direct effect on the physiology of the glands, leading to a gradual decline in function.29

Finally, obstructive MGD has been described in terms of its association with CL intolerance, but there is still debate about the relationship. Recently, Arita et al31 found that CL wearers had a higher level of meibomian gland dropout than did non-CL wearers; shortly thereafter, Knop et al29 found that the incidence correlated with the amount of time the patient wore CLs, but not with the type of lens. In short, the pathophysiologic characteristics of MGD are not yet well understood.
understood; although the role of forces such as inflammation and infection are well known in diseases such as blepharitis and meibomitis, much still needs to be determined for MGD. A commentary from the roundtable participants on the pathophysiology of MGD follows.

Dr. Bron: The key event in MGD is hyperkeratinization of the terminal duct linings. This leads to obstruction of the glands and accounts for the cloudiness and increased viscosity of the expressed meibum because of the presence of keratinized debris. With time, chronic glandular obstruction leads to a secondary disuse atrophy of the glands and a loss of secretory acini. Glands frequently may be replaced by cystic changes. The cause of the hyperkeratinization is unknown, although a role for inflammatory mediators is suspected. Clinicians also should be aware that scarring diseases that affect the conjunctiva may cause MGD by dragging the terminal ducts of the gland back into the conjunctiva of the tarsal plate. Thus, MGD is encountered in erythema multiforme, ocular pemphigoid, and trachoma and follows chemical burns to the ocular surface.

Glandular loss can be demonstrated readily as gland dropout by using meibography. These days, meibography can be performed noninvasively, using an infrared technique. Gland dropout begins to appear in the general population near the age of approximately 40 or 50 years, and the prevalence of MGD increases thereafter. Although MGD is encountered as a primary event with no known cause, it also may occur secondary to systemic disease and possibly local ocular surface disease. Systemic causes include skin diseases such as rosacea and atopic and seborrheic dermatitis. Meibomian gland dysfunction also is caused by systemic retinoids, used in the treatment of acne vulgaris, and by antiandrogen drugs used in the therapy of benign prostatic hyperplasia. The detection of MGD in a young person, particularly, should alert the clinician to the possibility of systemic disease.

Dr. Foulks: When the MGD Workshop report discussed lipid alteration and the function of the meibomian glands, CL wear was a fairly prominent part of the discussion. When patients now seek treatment with CL issues, what concerns do you have that you may not have had before the report was published?

Dr. Nelson: When patients seek treatment because they are CL intolerant, clinicians need to differentiate among causes. Is the cause aqueous deficiency or, in the case of younger patients, oftentimes a result of rosacea blepharitis? Deposits develop on the lenses, and the issue is determining how to help the patient be successful with CL wear.

Dr. McDonald: We know CL intolerance increases with age because of overall increasing aqueous deficiency, especially in perimenopausal women. The MGD Workshop report highlights the fact that there are now some data sup-
porting the concept that CLs can cause MGD in some people. Researchers and clinicians are still trying to determine how the 2—MGD and CL wear—are interrelated, if it is mechanical trauma or some other function.

**Dr. Nichols:** Arita et al31–33 have looked at that issue and have published some results on the technique of infrared meibography and the association with lens wear. This research team is evaluating whether changes in meibomian gland structure occur in newly fitted CL wearers. Those who do not wear lenses are undergoing infrared meibography, as are their CL-wearing counterparts. Those results should yield quite a bit of useful information. Until then, the concept of CL wear potentially causing a change in gland structure is very intriguing. We hope to learn if the association is mechanical or is caused perhaps by an immune reaction to the lens or to the solutions. For now, it is a very intriguing concept to determine if there is a change in the gland structure and, if it can be seen, whether it is mechanical or an immune reaction to the lens or to the solutions people use. Right now, there is just not enough information to predict definitively the exact nature of the link.

**Dr. Foulks:** As mentioned previously, Korb and Henriquez16 were the first to call attention to the issue, and several others followed, all finding that treating MGD results in improved CL tolerance. The MGD Workshop report served as a valuable reminder for me about that connection. It will be interesting to follow Arita et al’s work to learn whether there is a causative relationship between CLs and MGD, or if one aggravates the other.

**Dr. Nichols:** From a surgical perspective, it also makes me wonder how many patients in the past who had some sort of CL intolerance and who underwent LASIK surgery also may have had MGD. We did not know then about the relationship of CL wear and MGD, so we were not looking for MGD, especially during the early phases of LASIK use.

### New Directions for Meibomian Gland Dysfunction Diagnosis

Diagnosis of MGD can be accomplished best through the use of 2 sets of tests, which, conducted within the bounds of diagnosing any ocular surface disorder, will aid in detection of potential causal relationships to both aqueous-deficient and evaporative dry eye. In the first set of tests, clinicians distinguish those with dry eye of any type from those without dry eye; the second set of tests differentiates between aqueous-deficient dry eye and MGD-related evaporative dry eye. Further, gland expression of the eyelids in asymptomatic adults is recommended as an addition to the cadre of testing as a means of detecting asymptomatic, nonobvious MGD.34

It is the recommendation of the International MGD Workshop report that a preferred sequence for evaluation and testing of patients with MGD begin with a questionnaire, followed by progressively more invasive physical testing of the ocular surface and eyelids. Positive or negative results from any 1 test dictate what the subsequent test should be. If tear flow and volume are normal after a generic dry eye disease diagnosis, then the diagnosis migrates to evaporative dry eye, necessitating the quantification of MGD.

Table 1 discusses the various stages of MGD, plus disease, and subsequent suggested treatments, as proposed for an evidence-based approach for the management of MGD. The absence of a response at each level drives the move to the subsequent level. The roundtable participants offered their thoughts, as follows.

**Dr. Foulks:** Bearing in mind the MGD Workshop report, what are its most important take-home points in how to diagnose patients with MGD?

**Dr. Bron:** Clinicians should always be aware of the possibility of MGD and should examine the meibomian orifices and posterior lid margin with care. Orifice plugging and lid margin telangiectasia should be noted, and diagnostic gland expression should be performed as a routine. The MGD Workshop provided schemes for quantifying each part of the assessment. Meibomian gland dysfunction is a common disorder that can cause ocular surface changes in its own right or can influence the outcome of other ocular surface diseases. Meibomian gland dysfunction should be suspected in any patient with ocular surface symptoms and signs, especially in people older than 40 years. As Blackie et al15 have noted, MGD may be the basis of ocular surface symptoms and signs in patients whose lid margins appear quite normal on simple inspection with the slit lamp. In this nonobvious MGD, the diagnosis comes to light only when gland expression demonstrates the presence of cloudy or thickened secretions, or even when there is an inability to express meibum from the glands.

**Dr. Holland:** The key is meibomian gland expression. That was a primary message in the study by Blackie et al; the only way to diagnose these patients for MGD is for clinicians to express the glands. In my practice, our overall approach in diagnosis has been similar to what the MGD Workshop report suggested—use a staged assessment and management of patients with MGD. The report has helped to stratify the grading and severity of MGD and its subsequent treatment. We have been paying more attention to identifying meibum quality and expressibility. We use a staged treatment regimen similar to that described in the report.

**Dr. McDonald:** Yes, for people with symptoms, a good history is paramount; you often know exactly what you are going to see at the slit lamp just by the personal history, but the MGD Workshop report certainly reminded us of the importance of examining the lid margins, the features, the expression. Because we are touching the patient’s eyes anyway during these examinations, I usually push gently in the middle third of the lower lid. Just because someone does...
Table 1. Treatment Algorithm for Meibomian Gland Dysfunction

<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical Description</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No symptoms of ocular discomfort, itching, or photophobia</td>
<td>Inform patient about MGD, the potential impact of diet, and the effect of work and home environments on tear evaporation, and the possible drying effect of certain systemic medications. Consider eyelid hygiene including warming/expression as described below (±)</td>
</tr>
<tr>
<td></td>
<td><strong>Clinical signs</strong> of MGD based on gland expression</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimally altered secretions: grade ≥2–4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expressibility: 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No ocular surface <strong>staining</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Minimal to mild symptoms of ocular discomfort, itching, or photophobia</td>
<td>Advise patient on improving ambient humidity; optimizing workstations and increasing dietary omega-3 fatty acid intake (±)</td>
</tr>
<tr>
<td></td>
<td><strong>Clinical signs</strong> of MGD based on gland expression</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scattered lid margin features</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mildly altered secretions: grade ≥4–&lt;8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expressibility: 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>None to limited ocular surface <strong>staining</strong>: DEWS grade 0–7; Oxford grade 0–3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Moderate symptoms of ocular discomfort, itching, or photophobia with limitations of activities</td>
<td>All the above, plus (±)</td>
</tr>
<tr>
<td></td>
<td><strong>Clinical signs</strong> of MGD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ lid margin features: plugging, vascularity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderately altered secretions: grade ≥8–&lt;13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expressibility: 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mild to moderate conjunctival and peripheral corneal <strong>staining</strong>, often inferior: DEWS grade 8–23; Oxford grade 4–10</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Marked symptoms of ocular discomfort, itching or photophobia with definite limitation of activities</td>
<td>All the above, plus</td>
</tr>
<tr>
<td></td>
<td><strong>Clinical signs</strong> of MGD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ lid margin features: dropout, displacement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severely altered secretions: grade ≥13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expressibility: 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased conjunctival and corneal <strong>staining</strong>, including central <strong>staining</strong>: DEWS grade 24–33; Oxford grade 11–15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ signs of inflammation: moderate conjunctival hyperemia, phlyctenules</td>
<td></td>
</tr>
<tr>
<td>&quot;Plus&quot; disease</td>
<td>Specific conditions occurring at any stage and requiring treatment. May be causal of, or secondary to, MGD or may occur incidentally</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Exacerbated inflammatory ocular surface disease</td>
<td>1. Pulsed soft steroid as indicated</td>
</tr>
<tr>
<td>2.</td>
<td>Mucosal keratinization</td>
<td>2. Bandage contact lens/scleral contact lens</td>
</tr>
<tr>
<td>3.</td>
<td>Phlyctenular keratitis</td>
<td>3. Steroid therapy</td>
</tr>
<tr>
<td>4.</td>
<td>Trichiasis (e.g., in cicatricial conjunctivitis, ocular cicatricial pemphigoid)</td>
<td>4. Epilation, cryotherapy</td>
</tr>
<tr>
<td>5.</td>
<td>Chalazion</td>
<td>5. Intrallesional steroid or excision</td>
</tr>
<tr>
<td>6.</td>
<td>Anterior blepharitis</td>
<td>6. Topical antibiotic or antibiotic/steroid</td>
</tr>
<tr>
<td>7.</td>
<td>Demodex-related anterior blepharitis, with cylindrical dandruff</td>
<td>7. Tea tree oil scrubs</td>
</tr>
</tbody>
</table>

DEWS = International Dry Eye Workshop; MGD = meibomian gland dysfunction.

At each treatment level, lack of response to therapy moves treatment to the next level. A ± sign means that the evidence to support the use of the treatment at that level is limited or emerging; thus, its use should be based on clinical judgment. A + sign indicates that the treatment is supported by the evidence at that stage of disease.

Meibum quality is assessed in each of 8 glands of the central third of the lower lid on a scale of 0 to 3 for each gland: 0, clear; 1, cloudy; 2, cloudy with debris (granular); and 3, thick, like toothpaste (total score range, 0–24). Expressibility is assessed on a scale of 0 to 3 in 5 glands in the lower or upper lid, according to the number of glands expressible: 0, all glands; 1, 3 to 4 glands; 2, 1 to 2 glands; and 3, no glands. Staining scores are obtained by summing the scores of the exposed cornea and conjunctiva. Oxford staining score range, 1–15; DEWS staining score range, 0–33.

not seek treatment with symptoms does not mean you should not evaluate their glands.

**Dr. Holland:** It has been my experience that even corneal specialists do not express the glands as often as they should—maybe 10% of the time or so. Comprehensive ophthalmologists and optometrists likely express much less often than that. The MGD Workshop report convinced us that meibomian gland expression should be part of the routine examination, and then, by default, an examination of the eyelids.

**Modifications for the Treatment and Management of Meibomian Gland Dysfunction**

Acknowledgment that MGD has been both underdiagnosed and underreported supports the contention that there has existed an inability to assess practice patterns accurately, considering the varied treatment practices and therapies used across continents. Simply stated, treatment of MGD previously has lacked a consensus. Also lacking has been an inability to assess practice patterns accurately, and underreported supports the contention that there has existed an inability to assess practice patterns accurately, considering the varied treatment practices and therapies used across continents. Simply stated, treatment of MGD previously has lacked a consensus. Also lacking has been a consensus of severity levels for MGD; that situation, in turn, creates problems when attempting to develop treatment plans for the disorder. To those ends, the MGD Workshop incorporated a treatment algorithm in its findings (see Table 1) to help address the problem.

**Dr. Foulks:** How is the management of MGD as described in this algorithm changing your clinical practice of patients with MGD, particularly regarding referral patients with more severe forms of MGD?

**Dr. Bron:** For me, the big change was the accumulating evidence intimating that the use of topical agents for MGD may be beneficial. Topical azithromycin, specifically with its characteristics, is a valuable antibiotic as well as an anti-inflammatory agent. I think of patients in 3-month blocks to recognize whether there was a clinical benefit during that time. The big difficulty with any topical or systemic antibiotic is our wariness of prescribing over the long term for a chronic disease like MGD. I suspect that from time to time I am going to have to introduce a block of therapy—a burst of therapy—because I suspect that the disease is perpetuated by inflammatory events of the ocular surface that act on the terminal ducts of the meibomian gland. That is just an intuition-derived hypothesis, rather than something derived from the literature.

**Dr. McDonald:** Previously, it was more difficult to treat someone without symptoms. Now I have something I can refer to that can begin the discussion with patients. I can explain the condition and explain the minimal therapy I want to use to prevent the disease from progressing. The algorithm reconfirms the advantage of evaluating the eyelid margins in the absence of symptoms.

**Dr. Foulks:** Preventive diagnosis—finding patients who are at risk and treating them to prevent them from progressing to the symptomatic phases of the disease—is crucial.

**Dr. Holland:** Expression must be a mandatory step in an examination of a patient with ocular surface symptoms, both for diagnosis and ongoing management. It is the same concept as a workup for a glaucoma patient—you would never dream of not taking pressure readings. We should be vigilant about expressing the glands.

**Dr. McDonald:** There is concern by comprehensive ophthalmologists and optometrists that all this takes so much time. It does not. Expression literally takes an extra second or two.

**Dr. Holland:** I completely agree with the staging and the treatment outline at each stage. For the comprehensive ophthalmologist or optometrist, I think the algorithm is something simple to keep handy for reference.

**Dr. Nichols:** One management area that may need additional explanation is the recommendation of omega-3 fatty acid supplementation. As with many treatments, the literature is relatively sparse in terms of defining the appropriate patients, yet most reports, as well as clinician impressions, indicate that supplementation is safe and could be effective at the earlier stages of MGD. What are your thoughts on this topic, as well as recommended dosing?

**Dr. Foulks:** My recommendation is to not exceed the American Heart Association guidelines, especially if patients are being prescribed anticoagulants. That subgroup of patients often is overlooked.

**Dr. Nelson:** The algorithm makes it easier to have a common language among clinicians. Being asked to consult on a patient and knowing beforehand that he or she has gone through treatment stages 1 through 3—and knowing what therapies have been tried in accordance with this algorithm—will help immensely in being able to proceed quickly with the next treatment phases and to prescribe a systemic regimen. The comprehensive ophthalmologist should be comfortable in using and prescribing the treatments for stages 1 through 3. In stage 4, topical steroids are added. The same clinician may be uncomfortable with this treatment recommendation because of the possible complications of topical steroids and so may want to obtain a second opinion from a cornea or external disease specialist before starting a patient on topical steroids.

**Dr. McDonald:** The one thing that was new or different to me is that the liposomal spray, which I had been reserving for stage 3, is now recommended for stage 2. Patients at stage 3 and 4 usually are quite willing to do whatever it takes to obtain relief. I estimate approximately one third of my patients at stage 2 use this spray 4 times daily, as directed. The spray is very effective, and even 2 doses daily—morning and evening—are helpful in relieving symptoms.

**Dr. Nichols:** That is a great approach for preventive management. What about the patient you are preparing for ocular surgery?

**Dr. McDonald:** If I am trying to prevent progression, I follow the treatment protocols exactly the way they are. If someone is preparing for surgery, I kick it up a notch and tell the patient that we have to really clean up the lids. There is research showing that the few people who experience a postoperative infection are those with out-of-control lid disease. I tell my patients we are going to intensify the treatments to get their lids into tip-top shape, and then after the surgery we can draw back again to the maintenance levels they were using previously.
Dr. Nelson: Exactly. You have to kick it up a notch and make sure the lids are as good as they can be before any ocular surgery. The addition of topical azithromycin or erythromycin ointment and oral tetracycline-like agents, along with the religious use of eyelid hygiene and warm compresses, may be necessary to optimize the eyelids before surgery.

Overall Closing Thoughts

The MGD Workshop report reveals that MGD is more common than aqueous-deficient dry eye. An emphasis on lid expression and early use of artificial lubricants, topical azithromycin, liposomal spray, topical emollient lubricants, and oral tetracycline derivatives will help to achieve successful diagnosis and treatment of MGD.

Case Reports

Panelists were asked to evaluate 3 different patients and to describe their treatment plans based on the information now available from the MGD Workshop report.

Case 1

A 60-year-old white woman was referred for intractable eye irritation unresponsive to lubricants and topical cyclosporine emulsion therapy. The patient reported having used multiple over-the-counter artificial lubricants and occasional decongestant or vasoconstrictor drops in the past. She is now using a topical lubricant eye drop 4 times daily beginning 1 year ago and topical cyclosporine, 0.05% twice daily for the past 3 months with slight improvement in symptoms. She still reports a foreign body sensation and trouble with reading vision. Her visual acuity was 20/20 in both eyes and J2 print at near with her reading glasses. Intraocular pressure was 16 mmHg in the right eye and 18 mmHg in the left, with full motility and pupillary function. Slit-lamp examination revealed a tear meniscus of 0.6 mm with scant mucus debris and a small amount of frothy deposit at the lateral canthus. Tear film break-up time measured 2 seconds on the right and 3 seconds on the left. There was fluorescein staining of the inferior cornea with approximately 10 dots of punctate staining bilaterally. Lissamine green staining of the interpalpebral conjunctiva was present in both eyes, with nasal areas staining more than temporal areas. Schirmer testing without anesthesia measured 7 mm on the right and 8 mm on the left. There was meibomian gland plugging and inspissation with formation of domes over 2 or 3 meibomian gland orifices in both the right and left eyelids. One area of lid notching was apparent on the left lower lid margin. Gentle pressure on the lid expressed a turbid liquid (Fig 2).

Dr. Bron: This patient has ocular surface symptoms, a very short tear film break-up time, and ocular surface staining, nasal more than temporal. Based on her Schirmer test results, this patient’s aqueous tear production is normal according to the most strict criteria (≤5.0 mm cutoff), but some clinicians use a broader cutoff (<10 mm). The tear meniscus height is within normal limits. However, she has clear evidence of MGD, based on both the clinical description of her lids and the illustration included with the case report. So my diagnosis is evaporative dry eye resulting from MGD. The MGD is most likely primary rather than secondary, but a systemic cause such as rosacea should be excluded by history and clinical examination if necessary.

This patient has not yet received any treatment for her MGD and so there is some expectation that her clinical condition can be improved and that she can achieve symptomatic relief. She should be made aware that MGD is a chronic condition that will need long-term therapy. She will need instruction on how to initiate treatment of the glands with the application of heat to the lids, followed by lid massage, initially on a twice-daily basis and later on a daily basis. Because lid massage must be performed in a specific way to ensure the unblocking of the glands, it is important for the clinician to demonstrate how this should be carried out.

One way is to massage the lids firmly with a smooth hard object such as a plastic rod, running from the fixed to the free margin of the lid. I would wait 1 to 2 months before re-evaluating. General advice can be given about factors in the environment that could exacerbate drying of the ocular surface, and the patient could be advised how to minimize the effects of air conditioning and computer use.

The use of topical or systemic antibiotic therapies should be kept in reserve until the response to heat and massage can be appraised at follow-up. If there is limited improvement, I would consider topical azithromycin in the first instance, although there is not yet a randomized clinical trial on its efficacy in MGD.

The patient has been using an artificial tear preparation, which will be of help to manage symptoms after therapy directed toward her MGD has been established. But in view of the long-standing nature of her disease, it would be sensible to switch to a nonpreserved formulation.

Cyclosporine is of value in the treatment of aqueous-deficient dry eye, and there are some reports of benefit in MGD. For the time being, while waiting to see her response to therapy targeting MGD directly, I would stop this patient’s cyclosporine. It can be reintroduced later if needed.

Dr. Holland: I think this patient has a combination of aqueous tear deficiency and MGD stage 3. Her symptoms improved with topical cyclosporine, which suggests an element of aqueous deficiency. I would diagnose MGD as stage 3 based on the moderate symptoms, mild peripheral corneal staining, moderately altered expressibility, secretion quality (frothy deposit, plugging and inspissation of meibum, and expression of turbid liquid), and lid notching.
Dr. Foulks: Would anyone consider treating with steroids?

Dr. Holland: I would consider topical steroids for patients with corneal involvement from MGD. Neovascularization and marginal infiltrates should be treated with a course of steroids until the corneal findings resolve. In addition, patients with moderate to severe conjunctival inflammation with pain often need topical steroids to treat the discomfort effectively.

Dr. Nelson: This patient has blepharitis with MGD and possible borderline tear dysfunction, based on corneal staining and conjunctival lissamine green staining. A presentation with punctate staining of the cornea and lissamine green staining—although it is not mentioned here—suggests low-grade ocular surface inflammation. Likely we would see mild-to-moderate papillary conjunctivitis. My diagnosis is a chronic obstructive MGD with ocular surface inflammation and perhaps a borderline tear dysfunction that could be attributed to the blepharitis.

I would put this patient on a regimen of warm compresses for 5 minutes at bedtime and in the morning. I may add gentle lid scrubs with preparations that contain tea tree oil or commercially available eyelid cleansing pads. I no longer recommend baby shampoo or cotton swab scrubs because I have found that patients inadvertently traumatize their conjunctiva and their lids, leading to more inflammation.

The MGD Workshop report emphasized the obstructive nature of the disease and that patients do not blink enough. I now put my patients on a regimen of 20 blinks 4 times daily.

Dr. McDonald: Workplace environment is important, and 2 simple adjustments can make a big difference. Because there is often an element of aqueous-deficient dry eye along with the MGD, I advise my patients to position their computer screens as low as humanly possible. The interpalpebral fissure is at approximately only 3 mm when the screen is located in a low position; one can easily see the full screen while the evaporative loss of tears is cut by reducing the area of ocular surface exposure.

Also, if they are not near an oxygen tank, I suggest they strike a match, and if they see the flame flicker, then they know that maybe they should change the orientation of their desk or get housekeeping to close the overhead vents right over their desk, or even to move their workspace to a different room.

Dr. Foulks: What are the outlook and prospects for this patient?

Dr. McDonald: Meibomian gland dysfunction and the associated dry eye can be controlled, but not cured. It is amazing to me how many people think that for some reason these conditions go away, like a cold.

I think liposome spray would be helpful in this patient. I would absolutely consider an azithromycin solution. At least in the United States, the commercially available prescription-only preparation is somewhat expensive, so I instruct people on how to make the medicine last longer. They can do this by storing the bottle in an upside-down position, because the solution is thick; they then put a single drop on 1 index finger and rub this single drop between both index fingers. Next, they rub this solution into the 4 lid margins. Using 1 drop in the morning and 1 in the evening, as opposed to 2 drops each time, makes the medicine last twice as long. In addition, there is very little stinging, because the drop is placed directly onto the target tissues, the lids, without much getting into the eye.

Dr. Nelson: This is a somewhat subtle observation to keep in mind, but I have found a significant number of patients who, because they are not fully corrected at near vision, tend to stare and not to blink as much when they read or do close work, such as at the computer. This leads to problems with plugging and stagnation of the meibomian glands. I always make sure a patient’s near vision is fully corrected and that reading glasses are used consistently when reading for prolonged periods.

Dr. McDonald: Because the tear meniscus is high, but with a rapid tear film break-up time, evaporative tear loss is indicated. The meibomian gland is either producing abnormal meibum or not enough meibum.

Dr. Bron: Because this patient is going for surgery, we need to be concerned about the presence of MGD and its effect on the surgical outcome. The MGD needs vigorous treatment. We also need to think about the patient’s systemic status. For instance, if atopic dermatitis was the basis of his MGD, then intensive treatment with antimicrobials would be needed in addition to general treatment for the atopy. Atopic dermatitis is associated with a high frequency of positive lid cultures for *Staphylococcus aureus*. In any case, blepharitis, in general, is associated with an increased bacterial load at the lid margin, and although there are not any studies that have looked at the lid margin flora in patients with MGD on its own, it would be important to ensure that the lid margins were free of pathogens.

Dr. Foulks: Would you consider delaying the surgery?

Dr. McDonald: Absolutely. As I mentioned earlier, there is not a lot in the literature, but the 1991 study by Speaker et al examined vitreous cultures from acute endophthalmitis cases; in 82% of the cases, the genetic identity of the intraocular isolate was indistinguishable from the patients’ own external cultures, ocular and nasal, obtained at the time of admission for treatment. The investigators concluded that attention should be focused on the external tissues, specifically reduction in the colonization of the microbial flora in the prophylaxis and prevention of postoperative bacterial endophthalmitis. In another paper, a 4-year, multicenter, prospective study of endophthalmitis vitrectomy patients, Bannerman et al found that 67.7% of the eyelid isolates were absolutely indistinguishable from intraocular isolates. They stressed cleaning up the ocular surface before initiating any surgical procedure.
Dr. Foulks: How would you treat this patient?

Dr. McDonald: I would immediately initiate soaks and scrubs twice daily, that is, hot compresses for 2 to 5 minutes followed by lid cleansing with over-the-counter eyelid cleansing pads. I also would prescribe unpreserved tears that contain both lipids and emollients every 2 hours while awake, rubbing azithromycin solution into the lid margins twice daily immediately after the lid soaks and scrubs. I would start this patient on omega-3 supplements and low-dose oral doxycycline. I then would bring the patient back for re-evaluation after a minimum of 4 to 6 weeks.

Dr. Nelson: Because he likely will be taking topical steroids after surgery, I might start this patient on topical steroids at some point before surgery, too, to reduce the inflammation, as the lid looks quite inflamed.

Dr. Bron: For how long a period of time before surgery? I would do the heat and massage, and then bring in the azithromycin and doxycycline nearer the time of surgery; so for me it would be 1 to 2 months of topical steroids before surgery.

Dr. McDonald: I like to have 1 month of azithromycin solution, oral doxycycline, and omega-3 supplementation before the surgery, and I would see the patient 1 last time. If I did not like the way he looked, I would put the surgery off again and add a month of topical steroid therapy with loteprednol etabonate, 0.5% solution, 4 times daily for 2 weeks followed by twice daily for 2 weeks.

Dr. Foulks: In the studies that we did with azithromycin and doxycycline, it took a month to get the lipids back to close to functional normal with azithromycin, and 2 months with doxycycline (Foulks GN, Borchman D, Yappert MC. Comparative effectiveness of azithromycin and doxycycline in therapy of meibomian gland dysfunction. Poster presented at: ARVO Annual Meeting, May 1–5, 2011; Fort Lauderdale, FL).

Dr. Bron: Would anyone culture this patient? I was concerned about evidence of bacterial growth.

Dr. Foulks: With that eyelid, I would be really nervous about doing any surgery. I think setting the patient’s expectations ahead of time and being very strict with proposed therapies before any surgery are crucial to a successful outcome.

Dr. McDonald: Agreed. I tell the patient, “I am going to address the surface issues for a few months before surgery to move you from high risk to low risk, but right now you are a high-risk candidate for laser vision correction. And even after we move you down to low risk, you will still have a somewhat higher chance of needing an enhancement.”

Dr. Foulks: Or consider the patient who is very happy in CLs for a long time and then becomes CL intolerant, which pushes her toward wanting refractive surgery. After treating the lids and improving MGD and tear film, the patient can return to CL wear, happy and comfortable, possibly electing not to have the refractive surgery. So treating the existing MGD can make a difference, both in tolerance of the lens and in comfort.

Dr. Holland: I agree with Dr. Foulks. Treating this patient’s significant MGD will improve her ocular surface and may allow her once again to be a successful CL wearer. If she prefers laser vision correction, I would consider that as well, but only after I treated her MGD.

Dr. Nichols: What triggers you to look more carefully at the lipid secretions in your presurgical cases?

Dr. McDonald: I actually express everybody, because reaching up to touch the lids is part of a routine examination anyway. Putting your thumb in the middle third of the lower lid and pressing takes a fraction of a second. If I find an obstruction or turbid fluid coming out, then I press in the middle third of the upper lid to confirm.

Dr. Bron: I agree, and gland expression should be standard practice. Our expectation of abnormality is quite low until patients reach their 40s or 50s. Lid expression is so straightforward, though, that you may get some surprises, like a dermatologic disorder that had not been disclosed.

Dr. Holland: The clinical finding most concerning when evaluating a patient for refractive surgery is punctate staining of the
corneal. Such a finding indicates significant dry eye from MDG or aqueous tear deficiency, or both. If punctuate staining is present, I would definitely postpone the surgery and treat the ocular surface disease first. You will have a disappointed patient before surgery, but are less likely to have a disappointed and unhappy patient after surgery.

**Dr. Foulks:** Any tips or hints about how to assess or evaluate what is secondary versus what may be an expression of an underlying primary ocular surface problem after surgery?

**Dr. McDonald:** Dry eye after photorefractive keratectomy disappears in a few weeks; long-standing dry eye is something more common with post-LASIK patients because of the interruption of the neurogenic feedback loop from the cornea, which can take up to 2 years to re-establish. After looking at the tear meniscus and break-up time, observing the lids and lid expression, it becomes obvious very quickly if the patient has aqueous-deficient dry eye or evaporative dry eye with or without significant MGD. **Dr. Foulks:** Does that push you to an earlier use of systemic doxycycline therapy or modify your approach at all?

**Dr. McDonald:** I think sometimes clinicians are a bit timid about using doxycycline, even at low doses. I often add it to the regimen for my moderate-to-severe cases; it makes a significant difference.

**Dr. Foulks:** What about postoperative care for this patient?

**Dr. Nelson:** The difficulty occurs when everything looks fairly normal to the examining physician and the patient still has significant pain. Then I believe I am dealing with a neurogenic type of pain, with more symptoms than findings. Postoperative patients, if they have been taking topical steroids and antibiotics, may become more symptomatic after the course of topical steroids and antibiotics is completed, requiring the continuation of more aggressive therapy with oral tetracyclines, topical anti-inflammatory agents, or both.

**Dr. McDonald:** Postcataract patients and post-LASIK surgery patients can have an undiagnosed external disease issue—exposure keratitis as a result of lagophthalmos. In both groups of patients, especially older LASIK patients, cranking the speculum really wide can cause edema in those flaccid older lids. Recovery can take months. Exposure keratitis, especially nocturnal exposure keratitis, is very underappreciated. If I suspect this because of inferior corneal staining, positive flashlight test results, or both, I prescribe a bland ointment at night for patients, which greatly helps.

### References

Footnotes and Financial Disclosures

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Improving Awareness, Identification, and Management of Meibomian Gland Dysfunction

1. Which of the following statements is most accurate?
   a. Clinical signs of dry eye correlate well with patient-reported symptoms
   b. Evaporative dry eye and aqueous-deficient dry eye are mutually exclusive conditions
   c. Meibomian gland dysfunction is a primary cause of aqueous-deficient dry eye
   d. Meibomian gland dysfunction is a primary cause of evaporative dry eye

2. According to the International Workshop on Meibomian Gland Dysfunction’s proposed new definition, which best describes the location or extent of meibomian glands affected by meibomian gland dysfunction?
   a. Chronic diffuse
   b. Limited diffuse
   c. Upper eyelids
   d. Lower eyelids

3. Meibomian gland dysfunction is:
   a. Synonymous with meibomian gland disease
   b. A cause of ocular neoplasia
   c. Synonymous with anterior blepharitis
   d. A cause of posterior blepharitis

4. Which is the most common form of meibomian gland dysfunction?
   a. Obstructive meibomian gland dysfunction
   b. Meibomian sicca
   c. Hypersecretory meibomian gland dysfunction
   d. Meibomian seborrhea

5. Which systemic disease would most likely contribute to the pathogenesis of meibomian gland dysfunction?
   a. Osteoporosis
   b. Depression
   c. Asthma
   d. Rosacea

6. Which is a function of the lipids synthesized by and secreted from the meibomian glands?
   a. Promotion of tear film turnover
   b. Prevention of tear film evaporation
   c. Production of anti-inflammatory proteins
   d. The function of these lipids remains incompletely understood

7. Which is a function of the proteins synthesized by and secreted from the meibomian glands?
   a. Promotion of tear film turnover
   b. Prevention of tear film evaporation
   c. Production of anti-inflammatory lipids
   d. The function of these proteins remains incompletely understood

8. As recently evidenced, which factor causes meibomian gland dropout?
   a. Hot, humid weather
   b. Eyeglass wear
   c. Cold, dry weather
   d. Contact lens wear

9. A 42-year-old man presents with ocular discomfort, itching, and photophobia. Based on the International Workshop on Meibomian Gland Dysfunction’s guidance, which of the following is most likely the best first approach to the diagnosis?
   a. Differentiate between aqueous-deficient dry eye and evaporative dry eye
   b. Differentiate between meibomian gland disease and meibomian gland dysfunction
   c. Determine if the patient has anterior blepharitis
   d. Determine if the patient has dry eye

10. A 55-year-old woman presents to the ophthalmology clinic complaining of contact lens intolerance. She is taking estrogen replacement therapy. Based on the International Workshop on Meibomian Gland Dysfunction’s guidance, which of the following is likely the most appropriate first assessment that should be performed?
    a. Measurement of the tear film break-up time (TBUT)
    b. Meibography
    c. Administration of a symptom questionnaire
    d. Meibomian gland expression

11. A 41-year-old woman is referred to your ophthalmology clinic by her general practitioner with complaints of ocular discomfort. Measurement of lower tear meniscus height shows reduced tear volume and a Schirmer test shows reduced tear production. Meibomian gland expression releases clear meibum and all glands are expressible (expressibility score 0). What is the most likely diagnosis?
    a. Meibomian gland disease-related evaporative dry eye
    b. Aqueous-deficient dry eye
    c. Meibomitis
    d. Anterior blepharitis

12. Which diagnostic assessment did the International Workshop on Meibomian Gland Dysfunction group emphasize the most as a means of determining meibomian gland dysfunction staging?
    a. Measurement of the blink rate and calculation of the blink interval
    b. Routine meibomian gland expression
    c. Measurement of the TBUT
    d. Schirmer test
13. A 45-year-old woman presents with contact lens intolerance. The patient does not complain of any other ocular symptoms. Medical history is positive for moderate plaque psoriasis. Meibomian gland expression releases minimally altered secretions (grade 3), with an expressibility score of 1. No ocular surface staining is found. What is the most likely diagnosis?
   a. Meibomian gland dysfunction
   b. Posterior blepharitis
   c. Anterior blepharitis
   d. Aqueous-deficient dry eye

14. A 68-year-old woman presents with complaints of ocular discomfort and photophobia that limits her ability to play competitive tennis. Slit-lamp examination finds meibomian gland plugging and vascularization of the posterior lid margin. Meibomian gland expression releases moderately altered secretion quality (grade 11), with an expressibility score of 2. She has moderate conjunctival and peripheral corneal staining. Which stage of meibomian gland dysfunction is most likely included in the diagnosis?
   a. 1
   b. 2
   c. 3
   d. 4

15. Which clinical assessment is recommended as a means to detect asymptomatic, nonobvious meibomian gland dysfunction?
   a. Fluorescein staining
   b. Schirmer test
   c. Meibomian gland expression
   d. Osmolarity testing

16. A 76-year-old man is diagnosed with stage 2 meibomian gland dysfunction. The patient takes warfarin 7.5 mg daily for atrial fibrillation. Of the therapeutic options listed below, which is LEAST appropriate for this patient?
   a. Topical azithromycin
   b. Omega-3 fatty acid supplements
   c. Topical liposomal spray
   d. Lipid-based tear supplement

17. Which statement represents important clinical guidance relevant to the management of meibomian gland dysfunction, as developed by the International Workshop on Meibomian Gland Dysfunction?
   a. Avoid unnecessary treatment in the absence of symptoms
   b. Treat asymptomatic patients with signs of meibomian gland dysfunction to prevent disease progression
   c. Proactively treat with topical anti-inflammatory therapy at the first sign of altered meibomian gland secretion
   d. Withhold oral tetracycline therapy until stage 4 meibomian gland dysfunction to minimize antibiotic resistance

18. Which of the following can contribute to the pathogenesis of meibomian gland dysfunction?
   a. Antioxidants
   b. Bacterial growth
   c. Artificial sunlight exposure
   d. Cyclosporine ophthalmic emulsion

19. Which of the following would likely be part of appropriate treatment for a patient with stage 2 meibomian gland dysfunction and Demodex-related anterior blepharitis, with cylindrical dandruff?
   a. Eyelid hygiene
   b. Liposomal spray
   c. Tea tree oil scrubs
   d. All the above are likely appropriate treatments

20. A 70-year-old man is seen 1 week prior to a scheduled small incision phacoemulsification. He complains of ocular itching and photophobia. There is marked redness of the eyelids, a tear meniscus of 0.8 mm, and rapid TBUT is present. Meibomian gland expression releases moderately altered secretion quality (grade 10). Which of the following is likely the most appropriate treatment plan?
   a. Prescribe eyelid hygiene, emollient lubricants, and topical azithromycin; proceed with surgery
   b. Prescribe eyelid hygiene, emollient lubricants, and topical oral doxycycline; proceed with surgery
   c. Prescribe eyelid hygiene, emollient lubricants, and oral steroid therapy; delay surgery, and reexamine the patient in 1 month
   d. Prescribe eyelid hygiene, emollient lubricants, and topical azithromycin; delay surgery, and reexamine the patient in 1 month
ACTIVITY EVALUATION/CREDIT REQUEST

Improving Awareness, Identification, and Management of Meibomian Gland Dysfunction


To receive AMA PRA Category 1 Credits™, you must complete this Evaluation form and the Post Test. Record your answers to the Post Test in the Answer Box located below. Mail or Fax this completed page to The New York Eye and Ear Infirmary–ICME, 310 East 14th Street, New York, NY 10003 (Fax: 212-353-5703). Your comments help us to determine the extent to which this educational activity has met its stated objectives, assess future educational needs, and create timely and pertinent future activities. Please provide all the requested information below. This ensures that your certificate is filled out correctly and is mailed to the proper address. It also enables us to contact you about future CME activities. Please print clearly or type. Illegible submissions cannot be processed.

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☐ Yes  ☐ No  I and/or my family member have a financial relationship with The New York Eye and Ear Infirmary and/or refer Medicare/Medicaid patients to it.

☐ Yes  ☐ No  I have participated in the entire activity and claim 3.0 AMA PRA Category 1 Credits™.

Signature Required __________________________ Date Completed __________________________

OUTCOMES MEASUREMENT

☐ Yes  ☐ No  Did you perceive any commercial bias in any part of this activity? IMPORTANT! If you answered “Yes,” we urge you to be specific about where the bias occurred so we can address the perceived bias with the contributor and/or in the subject matter in future activities.

Circle the number that best reflects your opinion on the degree to which the following learning objectives were met:

5 = Strongly Agree  4 = Agree  3 = Neutral  2 = Disagree  1 = Strongly Disagree

After successfully completing this activity, I have improved my ability to:

• Describe new terminology and classifications of blepharitis and meibomian gland dysfunction 5 4 3 2 1
• Distinguish blepharitis/meibomian gland dysfunction from other ocular conditions 5 4 3 2 1
• Describe treatment implications for meibomian gland dysfunction with or without the presence of additional ocular surface disorders 5 4 3 2 1

1. Please list one or more things, if any, you learned from participating in this educational activity that you did not already know.

2. As a result of the knowledge gained in this educational activity, how likely are you to implement changes in your practice?

4 = definitely will implement changes  3 = likely will implement changes  2 = likely will not implement any changes  1 = definitely will not make any changes

Please describe the change(s) you plan to make:

3. Related to what you learned in this activity, what barriers to implementing these changes or achieving better patient outcomes do you face?

4. Please check the Core Competencies (as defined by the Accreditation Council for Graduate Medical Education) that were enhanced for you through participation in this activity.  ☑ Patient Care  ☑ Practice-Based Learning and Improvement  ☑ Professionalism  ☑ Interpersonal and Communication Skills  ☑ Systems-Based Practice

5. What other topics would you like to see covered in future CME programs?

ADDITIONAL COMMENTS

POST TEST ANSWER BOX

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