Meibomian Gland Dysfunction or MGD is often seen as a nuisance or an 'excuse diagnosis’ for a troublesome patient. In truth, MGD is incredibly common and the more you look for it, the more often you find it. MGD is the common underlying feature of several irritating eye conditions. Dry Eye sensations are reported by a quarter of patients attending ophthalmic clinics making it one of the most prevalent complaints seen by eye health professionals (REF 1). Blepharitis is probably the single most common disease entity seen in general ophthalmology or optometry clinics and it often a consequence of MGD (REF 2) Contact lens intolerance is common and in one study of 38 consecutive patients, all had MGD (REF 3). Chalazion and stye are also manifestations of MGD. Various authors have drawn up classifications of tarsal gland dysfunction but these systems are not widely used. (REFS 4 and 5) There is considerable clinical and symptomatic overlap between Evaporative Dry Eye, Blepharitis, Triple S syndrome (Sicca syndrome, Seborrhoea and Staphylococcal colonisation of the lids) and Contact Lens Intolerance. These conditions have common features and Meibomian Gland Dysfunction is the common denominator.

Heinrich Meibom, after whom the tarsal glands are named, described the glands in detail in 1666(REF 6). But it is only recently that the chemistry of the normal meibomian secretions, often referred to as meibum, has been elucidated. Meibomian oil contains mainly sterol esters and waxes with lesser amounts of organic fatty acids, di-esters, tri-esters, triglycerides, sterols and oleamide (REF 7). Normal meibum is an oil at body temperature. There is a fluid-to-solid phase change in MGD as the meibum alters from an oil to become a more solid greasy substance. It is this phase change, which is responsible for the clinical features of MGD.
History and symptoms.
Although patients often volunteer their ocular symptoms, direct questioning can usually elicit some or all of the following:

- Soreness
- Scratchiness
- Grittiness
- Burning
- Stinging
- Momentary blurriness clearing with repeated blinking
- Stickiness
- Tiredness
- Transient foreign body sensation
- Paradoxical watering / epiphora
- Short reading duration because of discomfort
- Constant awareness of the eyes.
- Dry feeling eyes
- Distress from being unable to achieve any ocular comfort or relief

Signs of Meibomian Gland Dysfunction.
Careful examination of the lids, lid margins and pre-corneal tear film is necessary to appreciate all the signs of MGD but more florid disease can be seen easily without slit lamp biomicroscopy. Signs you may see are:

- Champagne / lemonade bubbles as lid margin froth
- Abnormally thick viscous Meibomian secretions
- Turbid white or yellow cloudy material can be expressed from orifices
- Inspissated secretions with ‘pointy’ solidified proud ends
- Glandular obstruction with masking or loss of orifices
- Capping of orifices with ‘pseudo-blisters’
- Vascularised lid margins
- Macerated soggy lid edges
- Collarettes of debris around lashes
- Crusty debris at lid margin
- Conjunctivalisation of the posterior margin of lid
- Keratinisation of the lid margin with obfuscated MG orifices
- Scarring and irregularity of lid margin
- Increased blinking, both frequency and forceful orbicularis closure
- Eye rubbing.

To understand how these clinical symptoms and signs occur as clinical features of MGD we have to consider the normal functions of Meibomian oil. In their 1996 review article on Meibomian Gland Dysfunction, Driver and Lemp cite Fuchs 1917 paper. Fuchs attributed three functions to the meibomian secretions; prevention of tear overflow, creation of a watertight seal with lid closure and prevention of maceration of the lid margins by the tears (Ref 8).

Meibum appears to perform several other functions in the normal healthy eye. The force of each blink causes release of a small quantity of meibomian oil onto the lid margins. As the lids open and close with normal and reflex blinking, both the lid/lid and the lid/globe interactions are lubricated. The optical surface is refreshed with each blink as meibum also has a physiological 'screen wash' function. This removes dust, and debris maintaining a clear optical surface. Apart from lubricating the blink, meibum also has a surface spreading function, which facilitates and maintains the aqueous phase of the pre-corneal tear film.

Many symptoms of MGD are caused by meibum phase change from liquid oil to semi-solid yellow grease or firmer white waxy material. This inspissated material (inspissated means thickened or congealed and refers to the secretions themselves, not the gland nor the orifices) is often seen pointing from the gland orifices. Chemical changes in the constituents of the meibomian secretions alter the physical properties of the meibum. MGD meibum has an increased proportion of branched-chain fatty acids and lower levels of saturated fatty acids, especially lower levels of palmitic and stearic acids compared to normal meibum. (REF 9)

These changes in the lipid chemistry elevate the melting point of the meibum causing the dysfunctional secretions to remain solid at ambient eyelid temperature, which is about 33.5°C. This situation is analogous to olive oil versus butter, lard or candle wax at room temperature. Differences in the saturation and composition of the fatty acids and their length have a major impact on the melting point of the inspissated meibum.

Soreness, scratchiness, stickiness, tiredness and dry-feeling eyes can be attributed to impaired lid/globe lubrication, whilst burning and stinging may be attributable to altered lid margin water-wettability. Grains of particulate matter from the lashes or lid margins may cause grittiness, transient foreign body sensation and paradoxical watering. The reason these autologous foreign bodies are not seen on eye examination is that they have either melted, or dissolved, or both. The history fits this premise well; the foreign body sensations come on with an immediacy that fits with a genuine bit of particulate matter, the sensation is typically variable in location, as if the particle moves around easily within the conjunctival sac and the sensation passes off after several minutes. MGD related lid margin debris is often crusty and
granular. The fragments of debris that accumulate around the eyelash roots are known colloquially as ‘poppadoms’ or ‘skips’ (the prawn cocktail flavour ones!) by some ophthalmologists. It’s a very short journey from the lashes and lid margin to the pre-corneal tear film. Once wetted and warmed the particles hydrate, soften and disperse, loosing their sharp irritant qualities. Transient blurring occurs. If the particle is mainly lipid or fat from a Meibomian gland, it creates a local smear as it melts and incorporates into the lipid layer of the pre-corneal tear film. During this melting and assimilation, the turbid greasy material often drifts into the visual axis. Because it melts rapidly and clarifies (just like melting butter or ghee) the visual blurring is quite short lived and improves rapidly after a few moments blinking. Paradoxical watering arises when ocular irritation provokes lachrymation in an otherwise ‘dry’ eye. This is strongly suggestive of “evaporative dry eye” secondary to MGD and the epiphora confirms lachrymal gland function, albeit reflex.

Short reading duration and loss of enjoyment when reading probably relates to the corneal position relative to the lower lid and decreased blink frequency associated with attentive concentration. More of the cornea will be adjacent to more of the lower lid margin while reading for prolonged periods; this could increase corneal irritation and abbreviate pleasurable reading. If there are moderate evaporative dry eye problems, a short increase in the time between blinks will have a disproportionately large effect on the symptoms.

When you start looking assiduously for signs of MGD, you find them everywhere. The gross signs with thick white viscous Meibomian seborrhoea are not easily overlooked, but the sparse row of champagne bubbles along the postero-lateral aspect of the lower lid margins can be missed or dismissed easily. Patients don’t develop full-blown established MGD overnight; bubbles represent one stage in the natural history of the condition. Plain water doesn’t bubble, nor do oils or fats. Protein in solution promotes bubble formation and so do molecules with detergent properties such as soaps. At some stage in the MGD progression, the lid margin chemistry and physical properties of the molecules there, create an environment which is just right for bubble formation. These circumstances don’t usually persist for long, which explains why the bubbles aren’t always seen.

Evaporative Dry Eye.

Dry eye syndromes occur because of a poor lipid layer or a poor aqueous layer in the pre-corneal tear film. (REF 1 and 10) The term ‘Evaporative Dry Eye’ or lipid tear deficiency (LTD) describes the situation when the poor quantity and quality meibomian secretions of MGD result in a feeble pre-corneal lipid layer and rapid evaporation of the aqueous tear layer. Aqueous Tear deficiency or ATD occurs as a result of lachrymal gland dysfunction and the patients are
sicca! Tear evaporation rates are significantly higher than normal in patients with meibomian gland dysfunction because of the unstable tear film. (REF 11 and 12) Ocular lubricants have been the mainstay of Dry Eye treatments for many years. General practitioners and rheumatology clinics still use hypromellose drops as first line therapy for these patients despite the advances in therapeutic options over the last 20 years. New ‘Dry Eye’ products are being marketed monthly. Historically, most drops were aqueous tear replacements. With increased understanding of the pre-corneal tear film (PCTF) dynamics over the last few years, treatments are becoming available which act on the lipid component of the PCTF. Because MGD is the major contributory factor in Evaporative Dry Eye, regular use of an effective warm compress 2 to 4 times daily can have a major impact on these patients’ symptoms and signs. The expense of the new generation ‘artificial tears’ together with the inconvenience of frequent drop administration means that sufferers are increasingly using warm compresses in conjunction with these other treatments. Dry eye is particularly prevalent in arthritis sufferers, who may have major problems with frequent drop administration, especially if their bilateral manual dexterity is compromised as a result of the arthritis. Regular application of a simple warm compress can diminish dependence on drops and improve symptoms dramatically. Although primary and secondary Sjögren's syndrome is commoner in patients with arthritis, pure lachrymal gland failure is fortunately quite rare.

Post Laser Dry Eye

Perimenopausal women are at high risk of developing dry eye problems immediately following corneal laser treatment. This can be a major problem for the patients and the clinicians involved. One study concluded "Patients undergoing laser in situ keratomileusis develop dry eye with compromised tear function for at least 1 month after surgery. It is worthwhile knowing this is likely to occur and anticipating the problem. Warm compresses together with ocular lubricants are usually adequate to control symptoms for the three-month post op period, by which time symptoms have usually improved.” Ref 12a

Blepharitis and Blepharoconjunctivitis

Blepharitis is probably the single most common disease seen by optometrists and ophthalmologists, but poorly recognised by many GPs. In many cases the blepharitis is secondary to MGD. Extensive discussion of blepharitis per se is beyond the scope of this article. Managing the MGD and lid hygiene are the main treatments. (REFs 2 and 13) McCulley

MGD in Contact Lens Intolerance.
Contact lens intolerance is a big problem for patients and their contact lens practitioners. Some calculate up to 20% of lens users will stop CL wear at some time because their eyes feel dry. In one study of 38 consecutive patients with contact lens intolerance, all 38 had MGD Refs Henriquez and Korb. Treatment of MGD in this patient group will enable CL users to continue wearing their lenses comfortably. Kelly Nichols, associate professor at Ohio State University College of Optometry writes about managing MGD in lens wearers, saying “Almost any published information regarding the management of lid disease mentions the use of a warm compress for five to 10 minutes, two to three times each day... Interestingly, many reports that recommend warm compresses neglect to describe how to prepare or use one”. (Ref 14) Regular use of warm compresses together with lid hygiene and occasional lubricant drops can diminish the dry eye feeling and improve tolerance, helping to keep patients in their lenses. This leads to happier patients and happier contact lens practitioners.

Chalazion.
Many chalazia resolve on their own within one year if left alone, but treatment options do exist and the first serious Randomised Controlled Trial of chalazion management was published in 2007. Carried out by ophthalmologists Aynah Goawalla and Vickie Lee at the Central Middlesex Hospital in London, this study compared hot compress treatment with steroid injection or surgery. 46% (16/35 patients) of patients using hot compresses for 5 to 10 minutes three times a day for 5 days had complete resolution of the chalazion avoiding the need for any further treatment. (Ref 15)

The Management of Meibomian Gland Dysfunction.
There are stages in disease progression in MGD and up to a point they show reversibility. As with most inflammatory diseases, the features can be due to disease activity or to established damage as a result of prior inflammation. The objective is to treat the active disease, so minimising the risk of disease progression and associated damage to lid margins, tarsal plates or cornea. The lynchpin of the management strategy is to transform the meibum from a dysfunctional solid or semi-solid inspissated secretion to a more functional less viscous oil. This will diminish the signs and allow symptom control.

Warm compresses.
There is no doubt about the impact of eyelid warming on meibomian secretions.(REFs 16 17 and 18) Using quantitative meibometry, John Tiffany’s group at the Nuffield Laboratory of Ophthalmology at Oxford, studied the impact of temperature on the delivery of meibomian oil. They found normal lid temperature to be 33.4°C. When they increased lid temperature by nearly 5°C to about 38°C there was a significant increase in meibomian oil production. Cooling
the eyelids by 7.6˚C to about 26˚C using a crushed ice compress resulted in a concomitant decrease in meibomian oil secretion. They concluded that ‘our results... agree with the reported benefit of warm compresses to improve delivery from dysfunctional glands. The most likely explanation is a change in the viscosity of the meibomian oil’. (REF19). Most hospital eye departments and many eye-care professionals have patient information leaflets and handouts for ‘blepharitis/MGD sufferers’, frequently recommending hot wet flannel techniques. Because this is an inconvenient palaver patient compliance is poor – most patients just don’t do it well enough or often enough to gain demonstrable benefit. This usually means return visits and grumbling patient dissatisfaction. On direct questioning, patients are unusually frank about their failure to comply with the ad hoc warming treatment and complain about the inconvenience. Different warming devices have been described (REF 20 21 22 23) and are commercially available. (asterisk to disclosure of financial interest at end of article).

Doxycycline.
Antibiotics are often used to treat severe MGD. The tetracycline drug, doxycycline, is the first choice treatment, being prescribed at a dose of 100mgs once a day for 3 months. Doxycycline should be avoided in pregnancy and in children, and patients should be warned of side effects – the skin photosensitivity can be particularly nasty. (Ref 23) It is normal to prescribe a fortnight’s supply of the capsules to check that the patient will tolerate the medicine before dispensing the full 3 months supply. The dose of doxycycline appears fairly arbitrary with little objective difference when doses varied from 40mg to 400mgs daily (Ref 24). As the best treatment is the one the patient actually takes! for reasons of compliance, in Britain it is usual to give one 100mg capsule once a day. Where tetracyclines are contra-indicated, the macrolide antibiotic, erythromycin is a good second line treatment, usually being administered as 250mgs twice daily for a three-month period. There is evidence that oral treatment with the omega-6 essential fatty acids linoleic and gamma–linoleic acid, improves MGD symptoms and signs, especially when used in conjunction with lid hygiene measures. (REF 25). Lid wipes, weak solutions of baby shampoo, bicarbonate of soda and physically scrubbing the lid margins with cotton buds have all been recommended at various times. These different lid hygiene methods do benefit some people, but again, compliance is often poor because the processes are fiddly and time consuming. Cyclosporin eye drops have recently been assessed in the treatment of MGD but results were equivocal (REF 26).

To summarise, Meibomian Gland Dysfunction is very prevalent. MGD is often the underlying problem in several eye conditions; blepharitis, evaporative dry eye, contact lens intolerance, chalazion and stye. Inspissation of the meibum occurs because of changes in the lipids and chemical composition of the secretions but the cause of these changes remains elusive. The
melting point of the meibum is elevated in MGD. Warm compresses deliver a sustained
elevation in eyelid temperature, which drops the viscosity of the secretions resulting in better
function of the pre-corneal tear film. Antibiotics are helpful in more severe MGD. Oral
treatment with omega-6 essential fatty acids may be of benefit in MGD in conjunction with lid
hygiene.

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Ref 26

BOX 1 – Symptoms

Unable to achieve ocular comfort or relief
Aware of each blink
Soreness, Scratchiness, Grittiness
Burning, Stinging, Tiredness
Stickiness with dry feeling eyes
Constant awareness of the eyes
Transient foreign body sensation
Paradoxical watering / epiphora
Short reading duration because of discomfort
Momentary blurriness clearing with repeated blinking

History and symptoms. Although patients often volunteer their ocular symptoms, direct questioning can usually elicit some or all of the above

Box 2 – Signs of Meibomian Gland Dysfunction

Champagne / lemonade bubbles as a lid margin froth scanty or profuse
Increased frequency and force of eye rubbing.
Crusty debris at lid margins
Macerated soggy lid edges
Vascularised lid margins
Macerated 'soggy' lid margins
Conjunctivalisation of the posterior margin of lid
Collarettes of debris around lashes
Capping of orifices with ‘pseudoblisters’
Abnormally thick viscous Meibomian secretions
Inspissated secretions with ‘pointy’ solidified proud ends
Turbid white or yellow cloudy material can be expressed from orifices
Glandular obstruction with masking or loss / 'drop out' of orifices
Scarring and irregularity of lid margins
Increased blinking, both frequent and forced orbicularis closure

Careful examination of the lids, lid margins and pre-corneal tear film is necessary to appreciate all the signs of MGD but more florid disease can be seen easily without slit lamp biomicroscopy. Signs you may see are listed above.

**Box 3 – Management of MGD**

<table>
<thead>
<tr>
<th>Mild MGD</th>
<th>Moderate MGD</th>
<th>Severe MGD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm compress 5 minutes once or twice daily + lid massage</td>
<td>Warm compress 10 minutes 2 or 3 times a day + lid massage. + Lid hygiene daily. ± Chloramphenicol or fucithalmic ointment to lid margins three times a day.</td>
<td>Warm compress 10 to 15 minutes 4 times daily until symptoms controlled. + vigorous lid massage straight after warming. Lid hygiene at least twice daily Chloramphenicol or fucithalmic ointment to lid margins three times a day. Doxycycline 100mgs once a day for 3 months if tolerated or erythromycin 250mgs twice a day for 3 months. Maybe steroid drops in extreme cases</td>
</tr>
<tr>
<td>± Lid hygiene / wipes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Most or all of these patients could benefit from additional ocular lubricants. You can choose from the plethora of available treatments. Punctum plugs may be helpful in dry eye patients but caution is needed as pro-inflammatory molecules may remain in the pre-corneal tear film and conjunctival sac, causing exacerbation of symptoms. The role of topical cyclosporin
(restasis) and oral linseed / flax supplements is unclear but both may be worth trying in chronic or difficult to treat disease.