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## **DEMODEX BLEPHARITIS**

### ***Demodex* Infestation of the Eyelashes**

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**How to diagnose and manage blepharitis caused by *Demodex* overpopulation.**

BY ALISON NG, PHD, BSC (HONS), MCOPTOM, FIACLE;  
ETTY BITTON, OD, MSC, FAAO, FBCLA; & LYNDON JONES,  
PHD, FCOPTOM, FAAO

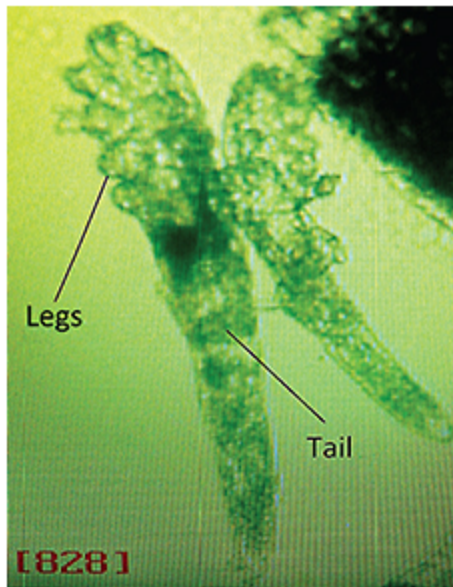
**T**he impact that *Demodex* mite infestation of the eyelashes has on ocular dryness symptoms has been a topic of much recent discussion. While little is known about the link of such infestation with contact lens discomfort (CLD), this will certainly play a role in some patients who report CLD given the high prevalence of *Demodex* in the population. This article will describe new information concerning the diagnosis and management of this condition.

#### **What Is *Demodex*?**

Human skin has a wealth of commensal (naturally occurring) microorganisms. Besides bacteria, human skin can be a host to commensal mites, of which *Demodex* are the most common ectoparasite (lives outside the body) of man. Of particular relevance for this article, *Demodex* have been found in the hair follicles of the eyelids, eyebrows, eyelashes, facial hair, and around the ears (Coston, 1967; Edmondson and Christenson, 1992).

*Demodex* can be found on humans of all ages, and their presence increases in frequency with increasing age. The prevalence of *Demodex* colonization reaches almost 100% in people aged 70 years and older (Hom et al, 2013). Besides age, compromised immunity (e.g., patients who have diabetes, patients on long-term corticosteroids or chemotherapy, or patients who have HIV/AIDS) also increases the prevalence and the risk of *Demodex* infestation (Edmondson and Christenson, 1992). It is thought that direct contact is required for transmission of mites from one person to another, and that the disease processes described begin when there is an overpopulation of *Demodex* (Lacey et al, 2009).

*Demodex* are pilosebaceous mites that feed on sebum and follicular epithelium in and around the hair follicle. The genus name, *Demodex*, arises from the Greek "demos" meaning "fat" and "dex" meaning "worm" (Coston, 1967). The upper third of a *Demodex* mite has four pairs of legs, allowing it to travel from one follicle to the next. The remaining body is comprised of the abdomen-tail, giving the mite its "worm-like" appearance (Edmondson and Christenson, 1992) (**Figure 1**).



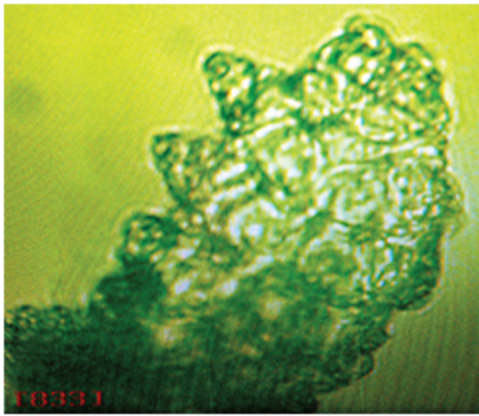
**Figure 1. Image of two *D. folliculorum* viewed laterally under light microscope. The legs and tail of one of the mites are labeled. To view a video of this courtesy of Scott Schachter, OD, Vision Source, Pismo Beach, CA, [click here](#).**

More than 100 species of *Demodex* mites have been identified (Lacey et al, 2009). Human skin hosts two particular species: *Demodex folliculorum* and *Demodex brevis*. **Table 1** summarizes some key characteristics of these two species. While there has been growing interest in recent times regarding *Demodex* mite infestations, the first documented discovery of the *Demodex* mite on humans was made in 1841 (Nutting, 1976).

**TABLE 1 Comparison of the characteristics of *D. folliculorum* and *D. brevis***

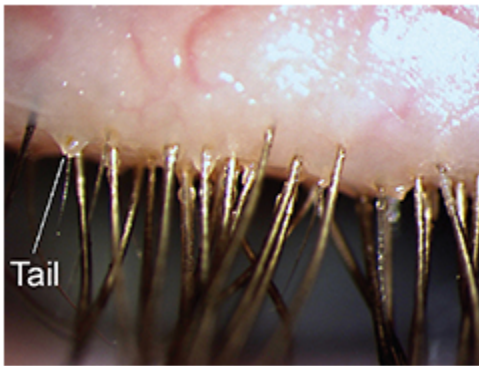
<b>DEMODEX FOLLICULORUM</b>	<b>DEMODEX BREVIS</b>
0.3mm to 0.4mm long	0.2mm to 0.3mm long
Longer legs	Shorter legs
Found clustered at hair follicle (up to six to eight mites per follicle)	Resides singularly within sebaceous glands (Zeis or meibomian glands)
Typical number of mites detectable on epilated lashes: one to four	Typical number of mites detectable on epilated lashes: zero to one
Deposits ova around the hair follicle	Deposits ova within the sebaceous gland

*D. folliculorum* is most commonly identified and typically buries itself head-first within a hair follicle, with its tail protruding from the follicle. During infestation, several mites will be found clustered around one follicle (Edmondson and Christenson, 1992). The sharp mouth of *D. folliculorum* pierces intact follicular epithelium to consume the cytoplasm; damaged cells are further destroyed by the sharp claws on the legs of the mite (**Figure 2**). The accumulation of degenerated, hyperkeratinized cellular debris with sebum and lipid creates the familiar sign of cuffs, cylindrical dandruff, or “sleeves” commonly seen at the base of the lashes in patients who have *D. folliculorum* infestation. During slit lamp examination, these appear as clear, waxy deposits that encircle the base of the eyelash, like a cuff or a sleeve (**Figure 3**).



**Figure 2. Image of the head of *D. folliculorum*. Note the claw-like pincers on the legs.**

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**Figure 3. Clinical signs of *Demodex* blepharitis. This image shows several clinical manifestations: cylindrical dandruff at the base of the lashes, lash loss, and greasy lids. The tail of a *Demodex* mite can also be seen (labeled).**

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*D. brevis*, the smaller of the two species, prefers to reside in areas of skin abundant in sebaceous glands. *D. brevis* has been implicated in several chronic facial dermatological conditions, such as acne rosacea, pityriasis folliculorum, and perioral dermatitis (Lacey et al, 2009). Around the eyes, *D. brevis* thrive in the Zeis and meibomian glands, as they favor sebum-rich environments. Due to their smaller size, this species lives deep within the glands themselves and is less commonly identified. Additionally, unlike *D. folliculorum*, *D. brevis* is found in isolation within each gland. *D. brevis* excavate and feed on intact glandular cells of sebaceous glands. Infestation of sebaceous glands results in gland obstruction and secondary complications, including chalazia, chronic conjunctival inflammation, and corneal lesions (Gao et al, 2007; Liu et al, 2010).

## **Pathogenesis of *Demodex* Blepharitis**

Three distinct pathological processes of *Demodex* blepharitis have been identified: mechanical, bacterial, and hypersensitivity (Liu et al, 2010).

**Mechanical** The way in which *Demodex* mites mechanically consume follicular or sebaceous epithelium causes localized mechanical tissue damage, in addition to the inadvertent damage caused by the sharp claws on their legs. *D. brevis* can physically block the sebaceous glands (including meibomian glands) in which they reside, which can result in tear lipid layer deficiency. Additionally, the accumulation of cylindrical dandruff from the base of the lashes can trap *D. brevis* within the sebaceous gland.

**Bacterial** As mites migrate across the surface of the skin, they can also act as a vector for the transfer of bacteria such as *Streptococci* and *Staphylococci*, which are well established in the pathogenesis of acne rosacea (Liu et al, 2010). Although *Demodex* do not excrete fecal matter, it is postulated that bacteria (*Bacillus oleronius*) found within the *Demodex* gut are released when the mites die, causing a localized inflammatory response (Lacey et al, 2009).

**Hypersensitivity** The cycle of mite death and release of waste products has been attributed to a delayed hypersensitivity response (Liu et al, 2010). This results in a conjunctival papillary response, which can be misdiagnosed as ocular allergy (Hom et al, 2013).

## Demodex Blepharitis Symptoms and Signs

Some patients who have *Demodex* infestation are asymptomatic, and therefore they may be overlooked in clinical practice (Liu et al, 2010). However, other patients may become symptomatic after prolonged infestation and the subsequent disruption that impacts their periocular wellness.

Symptoms of *Demodex* blepharitis can vary among patients and may include dryness, severe itching along the lid margin, allergic symptoms, burning, foreign body sensation, heavy lid, and blurry vision (Hom et al, 2013). A link between meibomian gland dysfunction, blepharitis, and *Demodex* infestation is emerging (Hom et al, 2013); thus, practitioners should bear *Demodex* infestation in mind when examining a patient who has signs and symptoms of the former conditions. Taking a full patient history, noting any signs or previous diagnosis of acne rosacea, is also important for the appropriate identification and management of *Demodex* blepharitis.

One of the earliest signs of mite infestation is cylindrical dandruff (CD). This accumulation of fine, waxy, dry debris that collects at the base of the lash and extends up to 2mm along the length of the lashes is most noticeable on the upper lashes. Using the highest magnification of the slit lamp, careful examination of the base of the eyelashes will reveal the CD. To observe the back row of the upper eyelashes, use your fingers to "roll" the upper eyelid to slightly evert the lashes and move the back row to the forefront. The presence of CD is highly specific for *Demodex* infestation, and 100% of patients who have CD have *Demodex* infestation (Hom et al, 2013).

Formal diagnostic methods for identifying *Demodex* have previously involved epilating eyelashes; mounting the lashes onto glass slides with a drop of oil, saline, alcohol, or fluorescein; and viewing them under magnification using light microscopy (Mastrota, 2013). With lash epilation, *D. folliculorum* is more often detected because these mites cluster around the follicle. However, some mites can remain in the lash follicle. Detection of *D. brevis* with lash epilation is much less successful (Hom et al, 2013).

Slit lamp identification is easily accessible to eyecare practitioners, but it may require some practice to identify the small, translucent mites. The tails of *Demodex* are narrower than the width of a human hair, and as they are also light-sensitive, they have a tendency to recess further into the hair follicles under bright slit lamp illumination (Edmondson and Christenson, 1992), making visual identification problematic. Mastrota (2013) has described a successful method of detecting *Demodex* by viewing the lashes under high slit lamp magnification without the need for epilation. By gently grasping, applying tension to, and rotating a single eyelash with forceps, mites are encouraged to emerge from the follicle and can subsequently be eliminated (Mastrota, 2013). A video showing this technique is available at [www.youtube.com/watch?v=16bSxfCS0wI](http://www.youtube.com/watch?v=16bSxfCS0wI).

In early stages of *Demodex* infestation, the lashes may appear distended, thinner, more brittle, and easier to remove (Edmondson and Christensen, 1992). In chronic cases, lash loss (madarosis) or misdirection (trichiasis) can occur (Liu et al, 2010). Careful examination of the lid margin is also necessary—the lids will appear more greasy and oily, in addition to

exhibiting increased hyperemia, telangiectasia, and lid thickening (tylosis). Some patients encounter a delayed hypersensitivity response to *Demodex* mites and show a conjunctival papillary response, which may be chronic in longstanding cases. **Figure 3** shows several clinical signs of *Demodex* blepharitis in one case presentation.

## Managing *Demodex* Blepharitis

If signs are observed, regardless of the presence of symptoms, initiate treatment before it becomes an infestation with symptoms. *Demodex* blepharitis requires an additional consideration within the management of ocular surface disease, in an effort to reduce mite numbers and keep them to a minimum. Eyelid and facial hygiene is essential but does not seem to be enough for patients who have *Demodex* infestation. Daily lid scrubs with baby shampoo for one year have been shown to be ineffective in 50% of patients who have *Demodex* infestations (Lacey et al, 2009). Part of managing *Demodex* is clear differentiation between various forms of anterior blepharitis (**Table 2**). While *Staphylococcal*-related blepharitis may readily respond to lid hygiene and antibiotic therapy, this has no real effect on mites.

**TABLE 2** Origins and clinical presentations of different types of anterior blepharitis

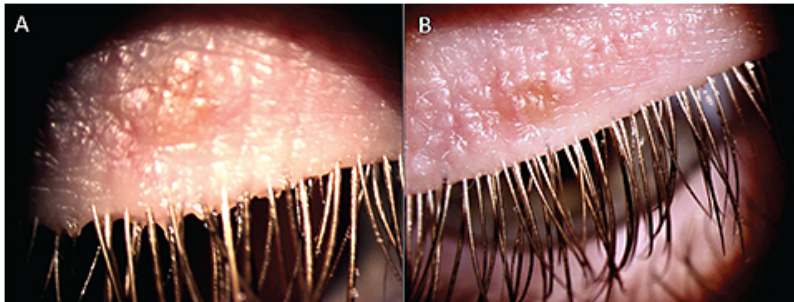
	<b><i>Staphylococcal</i> blepharitis</b>	<b>Seborrheic blepharitis</b>	<b><i>Demodex</i> blepharitis</b>
Causative pathogen	Bacteria	Yeast	Parasite
Type of debris	Dry scales / collarettes	Flaky, greasy scales	Cylindrical dandruff (clear sleeves), fine and waxy
Placement of debris	Starts at the base of lashes or all along the lash, but moves along the lash with lash growth	At the base	Cylindrical dandruff from base of the lash up to 2mm along the lash
Lid margin swelling or thickening (tylosis)	Yes	No	Yes
Lid margin redness	Yes	Yes	Yes
Trichiasis	Yes	No	Yes
Madarosis	Yes	No	Yes
Other dermatological associations	None	Seborrheic dermatitis	Acne rosacea

Previous pharmacological mite treatments have included yellow mercuric oxide ointment, pilocarpine gel, sulphur ointment, and camphorated oil to trap and suffocate mites (Liu et al, 2010). Mites have proven to be resistant to antiseptic treatments, including 75% alcohol and 10% povidone iodine, but can be successfully managed with tea tree oil (TTO) (Liu et al, 2010).

TTO is a natural, essential oil from steamed *Melaleuca alternifolia* leaves (from the narrow-leaved Paperbark or Tea tree, native to Australia) that exhibits antimicrobial, anti-inflammatory, antifungal, and antiviral properties (Carson et al, 2006). One study has shown that a weekly in-office treatment of 50% TTO in addition to daily at-home lid hygiene with TTO shampoo was effective in drawing *Demodex* mites out of hair follicles and eradicating infestation (Gao et al, 2005). A follow-up study showed that a lower TTO

concentration (5%) was also effective at reducing signs and symptoms associated with *Demodex* (Gao et al, 2012).

However, TTO can be toxic and causes ocular stinging and irritation if used in its pure form. There are pre-formulated wipes containing the active component of TTO (4-Terpineol) equivalent to 25% whole TTO, which reduces the risk of toxicity to the ocular surface. The wipes are suitable for cleaning the external lid (with closed eyes), lashes, brows, and face. However, patients should be warned of a sensation of heat, followed by a sensation of cooling upon first use of the product, almost like a "menthol" feeling. In mild cases of *Demodex* blepharitis, this regimen can be followed one to two times per day (b.i.d. dosing) for two to three weeks, continuing for once-a-day treatment for another two to three weeks. **Figure 4** shows the improvement in clinical signs following sustained lid hygiene treatment with these wipes in a young patient.



**Figure 4. Clinical presentation of a 20-year-old male who has *Demodex* blepharitis before (A) and after (B) treatment using wipes containing diluted tea tree oil twice daily for one month.**

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In more severe cases of *Demodex* blepharitis, in-office treatment should be combined with at-home treatment. Careful monitoring and follow up using photography to log improvement can be useful in maintaining patient compliance. You can accomplish this simply and effectively with most cell phone cameras by turning off the flash and holding the camera up at the slit lamp ocular.

For maximum efficacy of *Demodex* in-office treatment, removing the CD from the lashes prior to treatment allows TTO to reach the follicles and sebaceous glands. This can be done using lid wipes as a "pre-treatment." For more stubborn CD, BlephEx (Rysurg LLC) is a handheld "scrubbing" device, with a single-use, disposable micrograde sponge on the tip designed to mechanically remove CD, debris, and scurf from the base of the lashes. The BlephEx device looks similar to an Alger brush used for debridement of the superficial epithelium of the cornea, but instead of a rotating metallic tip, the device has a rotating sponge. It is advised to pre-treat the lid margins with warm compresses to help loosen and soften the CD prior to using the BlephEx device. A video of the BlephEx procedure can be viewed at <https://www.youtube.com/watch?v=rnVYXqk8D28>.

Following lid cleansing and CD removal, instill topical anesthetic and apply a 50% TTO solution directly to the lash margin, leaving it on for 10 minutes. For in-office treatments, dilute the TTO using nut oil such as macadamia oil, which further draws mites out because it is a food source for them. For patients who have nut allergies, mineral oil is preferred. Any application of the TTO treatment must be rinsed off thoroughly, and caution should be taken to avoid contact of the solution with the ocular surface.

The entire life cycle of a mite from ovum to adult lasts between 14 to 18 days, and mating becomes an important aspect of maintaining their infestation on the skin (Liu et al, 2010). Therefore, treatment must be sustained not only to eliminate adult mites, which may be seen protruding from the follicles, but also those that may subsequently hatch.

Patients need to continue with self-maintenance after in-office treatments. Symptoms of itchiness, foreign body sensation, and ocular redness have been shown to be significantly reduced after four weeks of treatment involving TTO (Gao et al, 2007; Gao et al, 2005; Gao et al, 2012). In addition to daily lid and face-hygiene cleansing, cleaning pillows and sheets using a high heat will destroy larvae. Spouses and other family members in the home should also be examined to check for transmission between them.

Furthermore, a holistic approach to ocular surface management needs to be considered. Lipid-based emulsion eye drops should be avoided, as the lipid components act as a food source for the mites. Also avoid topical steroid use for lid inflammation as topical steroids have been shown to increase mite numbers due to their immunosuppressive action (Dolenc-Voljc et al, 2005). Users of face and eye cosmetics should dispose of any products and their applicators, especially as *D. brevis* has an affinity for oil-based cosmetics (Edmondson and Christenson, 1992). Products such as mascara should be discarded and recommenced only after successful management of *Demodex* infestation because it is applied directly along the lashes.

## Conclusion

It is well recognized that optimal periocular hygiene is essential to maintaining a healthy ocular surface and tear film. Identifying and managing blepharitis and meibomian gland dysfunction have been discussed extensively in the literature and continue to form one key component in successful contact lens wear.

While eyecare practitioners are comfortable with prescribing conventional lid hygiene for patients who have the more common *Staphylococcal* blepharitis, blepharitis due to *Demodex* infestation requires alternative treatments involving TTO. Appropriate diagnosis and educating the patient on *Demodex* will go a long way in maintaining compliance and managing mite infestation to regain ocular comfort. **CLS**

To obtain references for this article, please visit <http://www.clspectrum.com/references> and click on document #229.



Dr. Ng is a post-doctoral fellow at the Centre for Contact Lens Research (CCLR) School of Optometry and Vision Science, University of Waterloo. She has received honoraria from The Vision Care Institute of Johnson & Johnson Medical Ltd., UK.



Dr. Bitton is an associate professor and director of the Dry Eye Clinic at the École d'optométrie, Université de Montréal. She is a consultant or advisor to Alcon Canada, Allergan Canada, and Labtician and has received research funding from Alcon.



Dr. Jones is a professor at the School of Optometry and Vision Science, University Research Chair, and director of the CCLR at the University of Waterloo. He is a consultant or advisor to J&J, Alcon, and CooperVision, and has received research funds from Advanced Vision Research, Alcon, AlgiPharma, Allergan, CooperVision, Essilor, J+J, Oculus, and TearScience.

