# High Prevalence of *Demodex brevis* Infestation in Chalazia

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• PURPOSE: To investigate the correlation between demodicosis and chalazia in patients with the latter.
• DESIGN: Prospective, observational, comparative study.
• METHODS: Forty-four adult and 47 pediatric patients with chalazia and 34 adult and 30 pediatric age- and sex-matched patients without chalazia treated at an institutional referral eye center were included. All 155 patients underwent lash sampling followed by microscopic identification and counting of *Demodex* mites. All 91 patients with chalazia underwent surgical removal, and among them, 74 were followed up for 18 ± 4.3 months after surgery. Statistical correlation between ocular demodicosis and chalazia and its postoperative recurrence was performed.
• RESULTS: Demodicosis was significantly more prevalent in chalazia patients than in control patients as a group (69.2% vs 20.3%) and when separated into pediatric (70.2% vs 13.3%) and adult (68.2% vs 26.5%) subgroups (all $P < .001$). Demodicosis was associated strongly with chalazia (odds ratio, 4.39; 95% confidence interval, 2.17 to 8.87; $P < .001$). *D. brevis* was significantly more prevalent (odds ratio, 18.21; 95% confidence interval, 2.22 to 149.74; $P = .01$) than *D. folliculorum* (odds ratio, 2.82; 95% confidence interval, 1.16 to 6.84, $P = .02$) in patients with chalazia. Patients with demodicosis tended to demonstrate recurrence (33.3% vs 10.3%; $P = .02$), especially in those with *D. brevis* (35.1% vs 13.5%; $P = .03$).
• CONCLUSIONS: There is a high prevalence of demodicosis, especially cases of caused by *D. brevis*, in adult and pediatric patients with chalazia, suggesting that ocular demodicosis is a risk factor for chalazia. (Am J Ophthalmol 2013;■:■–■. © 2013 by Elsevier Inc. All rights reserved.)

AMONG DIFFERENT SPECIES OF MITES, *DEMODEX folliculorum* and *Demodex brevis* are the only 2 affecting the human skin. The larger *D. folliculorum*, approximately 0.3 to 0.4 mm long, congregates as a group in the hair follicle, whereas the smaller *D. brevis*, approximately 0.2 to 0.3 mm long, solitarily resides in the sebaceous gland.[1–3] The eye also can be infested by *Demodex* mites. In the eye, *D. folliculorum* resides in the lash follicle, whereas *D. brevis* burrows deep into the lash's sebaceous gland and the meibomian gland.[3] Because the eye is surrounded by protruding body parts such as the nose, the brow, and the cheek, it is not as accessible as the rest of the body by daily hygiene. Therefore, after *Demodex* infestation (demodicosis) occurs in the face, it is likely to spread and flourish in the eye.[3] It is no wonder that the first documented disorder associated with demodicosis was blepharitis, dated as early as 1899 (reviewed in ref. 2). Although *D. folliculorum* is detected more frequently from lash sampling (detailed in the Discussion), *D. brevis* also was found in 3 of 6 patients exhibiting corneal diseases associated with demodicosis.[4] It remains unclear whether these 2 *Demodex* species may have a different pathogenic role in the hair follicle of the skin and lashes and the sebaceous gland and meibomian gland of the skin and the eye, respectively.

Besides blepharitis, ocular demodicosis has been implicated with eyelash loss or abnormal alignment, as well as chronic inflammation in the meibomian gland leading to lipid tear deficiency, in the conjunctiva leading to conjunctivitis and in the cornea leading to sight-threatening keratitis.[3–7] Although demodicosis generally is regarded as rare in children younger than 10 years,[8,9] we recently detected *Demodex* mites in all 12 pediatric patients in whom blepharoconjunctivitis was refractory to topical antimicrobial and anti-inflammatory therapies, and intriguingly, 4 of them had recurrent chalazia at presentation.[10] We thus wondered whether ocular demodicosis could play a pathogenic role in chalazia.

Chalazia is one of the most common eye diseases affecting all ages, including children, and it consequently gains significant attention from ophthalmologists. The key pathologic finding of chalazia is chronic inflammatory granuloma in the meibomian gland, which is a specialized sebaceous gland in the eyelid.[11] Because of the presence of giant cell infiltration in this chronic inflammatory granuloma, many suspect that chalazia is caused by a host response to a foreign body derived from several pathogens, including mites.[11] Taking mites as an example, only 2 past reports described the presence of mites in tissue sections of a surgical specimen[12] and in lashes of an adult patient with chalazia.[13] Recently, Yam and associates reported a high incidence of 72.9% of *Demodex* infestation in 30 adult

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patients with recurrent chalazia.[14] However, their retrospective study lacked a control group, given that demodicosis is rather common in the general population. Neither does this study tell us the total *Demodex* count, nor whether a specific *Demodex* species was involved. Although ocular demodicosis has been implicated in blepharitis[3–7] and chalazia is associated with blepharitis,[15,16] it remains unclear whether ocular demodicosis can act as an independent risk factor in chalazia. To address these questions, we conducted a prospective, comparative study to correlate ocular demodicosis with chalazia in adult and pediatric patients as a first step to delineate the pathogenic role of *Demodex* mites in chalazia.

## METHODS

• **PATIENTS:** This study followed the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Zhongshan Ophthalmic Center (Guangzhou, China) to investigate prospectively the correlation between ocular demodicosis and chalazia. Informed consent was obtained from all patients for sampling of lashes in the clinic for adult patients, but in the operating room for pediatric patients because of poor cooperation. The diagnosis of chalazia was made based on the patient's history of showing gradual enlargement of eyelid nodules that exhibited pain, inflammation, and tenderness in the acute phase and a persistent nontender mass in the chronic phase.[11] We studied patients at the chronic, but not acute, stage to avoid potential microbial infection in the latter. Severity of chalazia was subdivided further into those with a single nodule and those with multiple nodules in the present illness. The study group consisted of 91 consecutive patients who underwent surgical removal of chalazia at the Zhongshan Ophthalmic Center (Guangzhou, China) between May 2010 and October 2011. Because demodicosis is common in the adult population,[8] we further divided the study group into a subgroup of 47 pediatric patients younger than 14 years and a subgroup of 44 adult patients older than 15 years to minimize the bias. We enrolled an age- and gender-matched control group consisting of 30 pediatric patients and 43 adult patients from the Zhongshan Ophthalmic Center during the same period without a past history or present illness of chalazia. The adult control patients sought refractive correction of refractive error, and the pediatric control patients underwent surgery for strabismus, congenital ptosis, congenital cataract, or ocular trauma. Surgical pediatric patients were chosen for the ease of sampling lashes. Patients with acute ocular surface infection, such as conjunctivitis, keratitis, and dacryocystitis, and those taking topical or systemic immunosuppressants were excluded. Because of known high association between demodicosis and rosacea,[6,17–20] we also excluded patients with a past history and present illness of rosacea in both the study and control groups. A history was obtained from all patients, and all patients underwent complete external and slit-lamp examinations. Blepharitis was defined as lid margin inflammation that carried one of the following signs: telangiectasia or collarettes, for which the grading was reported.[21] All the patients in the study group received routine antibiotics combined with topical steroid eye drops 4 times daily and ointment every night for 1 to 2 weeks after surgery. Recurrence was defined as reappearance of chalazia in a different location after surgical removal noted at least 4 weeks after surgery, to differentiate from failed surgeries that might have resulted in early reappearance in the same location.

• **LASH SAMPLING AND MICROSCOPIC MITE COUNTING:** Lash sampling and microscopic mite counting were performed, as previously established.[10,22,23] In brief, 2 lashes were removed from each eyelid by fine forceps under a slit-lamp microscope for adult patients. Because demodicosis is not as common in the pediatric population,[8] 4 lashes were removed from each eyelid under a surgical microscope during general anesthesia and before surgery in pediatric patients to increase the chance of detection, as previously reported.[10] Removed lashes from each eyelid were placed separately on a glass slide. *Demodex* detection and counting were performed by an independent masked technician who had no knowledge about each patient's clinical information. Under a light microscope, 1 drop of saline or fluorescein-containing solution was applied by a pipette to the edge of the coverslip before counting and identifying *D. brevis* and *D. folliculorum* mites as reported previously.[22,23]

• **STATISTICAL ANALYSIS:** Descriptive statistics are reported as mean ± standard deviation for normally distributed continuous variables. Nonnumerical data were recorded as presence (yes) or absence (no). The independent samples *t* test was used to determine age matching between the 2 groups. The Pearson chi-square test and Fisher exact test were used for the rest of comparative and correlative analyses between the 2 groups. For those data with high standard deviations, we used the Wilcoxon sign-rank test to analyze the data expressed as medians with tenth to ninetieth percentiles. A binary logistic regression analysis was performed to evaluate the risk factors of chalazia. All statistical analyses were performed using SPSS software version 17.0 (SPSS, Inc, Chicago, Illinois, USA) and were reported as 2-tailed probabilities, with $P < .05$ being considered significant.

## RESULTS

THE STUDY AND THE CONTROL GROUPS WERE COMPARABLE in pediatric patients regarding age (4 ± 3.2 years [range, 1 to 14 years] vs 5.5 ± 4 years [range, 1 to 14 years]; $P = .08$)

and gender (28 males and 19 females vs 18 males and 12 females; $P = .42$). The 2 groups in adult patients also were comparable regarding age (33.4 ± 12.7 years [range, 20 to 60 years vs 37.4 ± 13.3 years [range, 18 to 62 years]; $P = .12$) and gender (12 males and 32 females vs 14 males and 20 females; $P = .20$).

• **DEMODICOSIS, ESPECIALLY *DEMODEX BREVIS*, IS SIGNIFICANTLY MORE PREVALENT IN PATIENTS WITH CHALAZIA:** As shown in Table 1, demodicosis, judged by the presence of mites, was detected in 69.2% of 91 patients in the study group, a significant prevalence compared with that of the control group, 20.3% of 64 patients ($P < .001$). When we subdivided the patients into pediatric and adult subgroups, demodicosis in patients with chalazia (70.2% of 47 patients and 68.2% of 44 patients, respectively) was still significantly more prevalent than in patients without chalazia (13.3% of 30 patients and 26.5% of 34 patients, respectively; both $P < .001$). The mean mite count was significantly higher in the study group than that in the control group (2.8 ± 3.2 [n = 91] vs 0.5 ± 1.4 [n = 64]; $P < .001$), no matter whether we looked into the pediatric subgroup (2.6 ± 3.2 [n = 47] vs 0.1 ± 0.4 [n = 30]; $P < .001$) or the adult subgroup (3 ± 3.2 [n = 44] vs 0.9 ± 1.8 [n = 34]; $P < .001$).

Blepharitis was detected in 18 (19.78%) of 91 patients with chalazia, which is a greater prevalence than that in the control group (2/64 [3.13%]; $P = .003$). Because blepharitis is known to be associated frequently with chalazia,[15,16] binary logistic regression was performed to adjust the coexistence effect, which disclosed that both demodicosis (odds ratio [OR], 4.39; 95% confidence interval [CI], 2.17 to 8.87; $P < .001$) and blepharitis (OR, 8.9; 95% CI, 1.9 to 41.64; $P = .006$) were associated independently and strongly with chalazia.

We then examined the relative importance of *D. folliculorum* and *D. brevis* in the above correlation. Our results showed that *D. folliculorum* was detected more frequently than *D. brevis* in the control groups without chalazia, that is, 18.8% versus 3.1% in the entire group, 10% versus 3.3% in the pediatric subgroup, and 26.5% versus 2.9% in the adult subgroup (all $P < .01$; Table 1). In contrast, *D. brevis* and *D. folliculorum* were detected similarly in the study groups with chalazia, that is, 50.5% versus 58.2% in the entire group, 53.2% versus 55.3% in the pediatric subgroup, and 47.7% versus 61.4% in the adult subgroup (all $P > .05$; Table 1). Collectively, these results indicated that *D. brevis* was detected in 50.5% of 91 study patients, which was significantly more frequently than that detected in control patients, 3.1% of 64 patients ($P < .001$). Using a multivariate binary logistic regression analysis, we noted that *D. brevis* (OR, 18.21; 95% CI, 2.22 to 149.74; $P = .01$) was significantly more prevalent than *D. folliculorum* (OR, 2.82; 95% CI, 1.16 to 6.84; $P = .02$) in patients with chalazia. The same finding was noted if we broke the entire group into pediatric ($P < .001$ for both *D. brevis* and *D. folliculorum*) and adult ($P < .001$ for *D. brevis* and $P = .002$ for *D. folliculorum*; Table 1) subgroups. The total count of *D. brevis* in study patients was significantly higher than that in control patients in either the entire group or when the group was divided into pediatric and adult subgroups (all $P < .001$). The total count of *D. folliculorum* in study patients also was significantly higher than that in control patients for the entire group and for the pediatric subgroup (both $P < .05$). Because prevalence of *D. folliculorum* is age dependent in the skin[24,25] and epilated lashes,[26] it was expected to be found more frequently in adult patients. Under this scenario, we still observed a significantly high prevalence of *D. folliculorum* in the adult subgroup with chalazia ($P = .002$). Taken together, the above data indicated that ocular demodicosis, especially that caused by *D. brevis*, was significantly more prevalent in patients with chalazia.

• **DEMODICOSIS IS MORE PREVALENT IN PATIENTS WITH MULTIPLE CHALAZIA:** We then subdivided all 91 study patients into those with a single chalazion (39.6%) and those with multiple chalazia (60.4%; Table 2). For adult study patients, demodicosis was detected more frequently in those with multiple chalazia than those with a single chalazion ($P = .03$), but was detected similarly in the entire group ($P = .07$) and the pediatric subgroup ($P = .51$). The median *Demodex* count in patients with multiple chalazia reached a marginally significantly higher count than that in patients with a single chalazion when analyzed in the entire group ($P = .05$), but not separately in the pediatric or adult subgroup (both $P > .05$). Compared with patients with a single chalazion, patients with multiple chalazia tended to show more infestation of *D. folliculorum* in adults ($P = .02$; Table 2). These results suggested that demodicosis was more prevalent in patients with multiple chalazia.

• **PATIENTS WITH DEMODICOSIS, ESPECIALLY BY *DEMODEX BREVIS*, TEND TO EXPERIENCE RECURRENCE AFTER SURGERY:** Because demodicosis was more prevalent in patients with chalazia (Table 1) and tended to be correlated with the severity of chalazion (Table 2), we wondered if it also correlated with recurrence after surgical removal. Excluding 17 patients (12 children and 5 adults) who were lost to follow-up, the remaining 74 patients were followed up for 18 ± 4.3 months (range, 12 to 28 months). Recurrences were noted in 33.3% of 45 patients with demodicosis, which was significantly higher than the 10.3% of 29 patients without demodicosis ($P = .02$; Table 3). Although the same trend also was noted in both pediatric and adult study patients, such a difference was not statistically significant ($P = .10$ and $P = .12$, respectively; Table 3). All recurrences developed in a different location after surgical removal of granuloma at least 4 weeks after surgery. Furthermore, patients with *D. brevis* infestation tended to have more recurrences (13/37 [35.1%]) than those without

**TABLE 1.** *Demodex* Infestation in Study Group with Chalazia and in Control Group without Chalazia

| | Total | | | Pediatric | | | Adult | | |
|---|---|---|---|---|---|---|---|---|---|
| | Study (n = 91) | Control (n = 64) | *P* Value | Study (n = 47) | Control (n = 30) | *P* Value | Study (n = 44) | Control (n = 34) | *P* Value |
| *Demodex* infestation cases (%) | 63 (69.2) | 13 (20.3) | <.001 | 33 (70.2) | 4 (13.3) | <.001 | 30 (68.2) | 9 (26.5) | <.001 |
| Median *Demodex* counts (10th to 90th percentile) | 2 (0 to 6) | 0 (0 to 3) | <.001 | 2 (0 to 6) | 0 (0 to 0.9) | <.001 | 3 (0 to 5.5) | 0 (0 to 4) | <.001 |
| *Demodex brevis* cases (%) | 46 (50.5) | 2 (3.1) | <.001 | 25 (53.2) | 1 (3.3) | <.001 | 21 (47.7) | 1 (2.9) | <.001 |
| Median *D. brevis* counts (10th to 90th percentile) | 1 (0 to 3) | 0 (0 to 2.5) | <.001 | 1 (0 to 3) | 0 (0 to 0) | <.001 | 0 (0 to 3.5) | 0 (0 to 0) | <.001 |
| *Demodex folliculorum* cases (%) | 53 (58.2) | 12 (18.8) | <.001 | 26 (55.3) | 3 (10) | <.001 | 27 (61.4) | 9 (26.5) | .002 |
| Median *D. folliculorum* counts (10th to 90th percentile) | 1 (0 to 4) | 0 (0 to 2.5) | <.001 | 1 (0 to 4.2) | 0 (0-0.9) | <.001 | 1 (0 to 4) | 0 (0 to 4) | .012 |

**TABLE 2.** *Demodex* Infestation in Patients with Single or Multiple Chalazia

| | Total (n = 91) | | | Pediatric (n = 47) | | | Adult (n = 44) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Single (n = 36) | Multiple (n = 55) | *P* Value | Single (n = 12) | Multiple (n = 35) | *P* Value | Single (n = 24) | Multiple (n = 20) | *P* Value |
| *Demodex* infestation cases (%) | 21 (58.3) | 42 (76.4) | .07 | 8 (66.7) | 25 (71.4) | .51 | 13 (54.2) | 17 (85) | .03 |
| Median *Demodex* counts (10th to 90th percentile) | 2 (0 to 4.3) | 3 (0 to 6) | .05 | 2 (0 to 4) | 2 (0 to 6) | .21 | 2 (0 to 6.5) | 3 (0 to 5.9) | .09 |
| *Demodex brevis* cases (%) | 15 (41.7) | 31 (56.4) | .17 | 5 (42) | 20 (57) | .35 | 10 (41.7) | 11 (55) | .38 |
| Median *D. brevis* counts (10th to 90th percentile) | 0 (0 to 3) | 1 (0 to 3.4) | .2 | 0 (0 to 2.7) | 1 (0 to 3.4) | .29 | 0 (0 to 4) | 1.5 (0 to 3.9) | .33 |
| *Demodex folliculorum* cases (%) | 17 (47.2) | 36 (65.5) | .09 | 6 (50) | 25 (71.4) | .18 | 11 (45.8) | 16 (80) | .02 |
| Median *D. folliculorum* counts (10th to 90th percentile) | 0 (0 to 3.6) | 1 (0 to 4) | .13 | 0.5 (0 to 4.8) | 1 (0 to 4.4) | .49 | 0 (0 to 4) | 1.5 (0 to 4) | .11 |

(5/37 [13.5%]; $P = .03$; Table 3). These results suggested that patients with ocular demodicosis, especially when caused by *D. brevis*, tended to experience recurrence after surgical treatment.

## DISCUSSION

ALTHOUGH *DEMODEX* MITES HAVE BEEN IMPLICATED AS A cause of many human skin disorders, their pathogenic role has long been debated.[27–29] This is partly because demodicosis has a high age-dependent prevalence and frequently is found in the skin of asymptomatic individuals.[24,25] In the eye, a similar debate also has been raised for blepharitis.[9,26,30,31] One way of resolving this issue is to conduct a correlative comparative study by including patients with a younger age because demodicosis is age dependent and rather rare in children.[8,32,33] We chose to study chalazia because the causative role, documented only by 2 case reports mentioned in the Introduction, is controversial and because our earlier study detected recurrent chalazia in 4 of 12 pediatric patients, all of whom had demodicosis and refractory blepharoconjunctivitis.[10]

Herein, our prospective and comparative study disclosed for the first time that ocular demodicosis was significantly more prevalent in patients with chalazia than those without, regardless of whether these patients were considered as an entire group or whether they were subdivided into pediatric and adult subgroups (Table 1). Although our results showed that blepharitis was more prevalent in patients with chalazia than the control group (19.78% vs 3.13%), similar to what was noted by Nemet and associates,[15,16] the prevalence of blepharitis was far less than that of demodicosis in patients with chalazia (19.78% vs 69.2%). More importantly, further binary logistic regression analysis showed that demodicosis is an independent risk factor of chalazia after adjusting the simultaneous effect of blepharitis. Furthermore, such

**TABLE 3.** Chalazia Recurrence in Patients with and without *Demodex* Infestation

| | *Demodex* Infestation | | | | | | *Demodex brevis* | | | | | | *Demodex folliculorum* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total (n = 74) | | Pediatric (n = 35) | | Adult (n = 39) | | Total (n = 74) | | Pediatric (n = 35) | | Adult (n = 39) | | Total (n = 74) | | Pediatric (n = 35) | | Adult (n = 39) | |
| | Yes (n = 45) | No (n = 29) | Yes (n = 22) | No (n = 13) | Yes (n = 23) | No (n = 16) | Yes (n = 37) | No (n = 37) | Yes (n = 20) | No (n = 15) | Yes (n = 17) | No (n = 22) | Yes (n = 41) | No (n = 33) | Yes (n = 18) | No (n = 17) | Yes (n = 23) | No (n = 16) |
| Recurrence cases (%) | 15 (33.3) | 3 (10.3) | 7 (31.8) | 1 (7.7) | 8 (34.8) | 2 (15.4) | 13 (35.1) | 5 (13.5) | 7 (35) | 1 (6.7) | 6 (35.3) | 4 (18.2) | 13 (31.7) | 5 (15.2) | 5 (27.8) | 3 (17.6) | 8 (34.8) | 2 (15.4) |
| *P* value | .02 | | .10 | | .12 | | .03 | | .06 | | .23 | | .08 | | .38 | | .12 | |

significant correlations between demodicosis and chalazia remained no matter whether demodicosis was judged by the presence or absence of mites, by the total mite count, or by separating mites into *D. folliculorum* and *D. brevis* (Table 1). It should be noted that in our pediatric patients, we did not detected such immune compromised conditions as, for example, after administration of immunosuppressive agents, leukemia, or human immunodeficiency virus, which have been recognized as risk factors resulting in pediatric dermatologic mite-related disease.[34–42] Although diabetes has been reported as a risk factor for demodicosis,[43] we noted a comparable incidence of diabetes in the adult control group and study group (9.1% vs. 5.9%; $P = .69$), whereas no diabetes was found in pediatric patients. This finding concurred with the notion that diabetes is not a risk factor for chalazia.[15] These findings strongly suggest that demodicosis is prevalent in pediatric patients with chalazia who are not immune compromised, underscoring the likely pathogenic role of *Demodex* mites in different ocular and cutaneous diseases.

The present clinical experiences subscribe the notion that the chance of detecting *D. brevis*, which normally resides singly in the sebaceous and meibomian glands, in epilated lashes is quite low, approximately 9.1% in the general patient population.[12,26] Indeed, this notion also is supported by this study, showing that *D. brevis* was detected at a rate of 3.1%, 3.3%, and 2.9% in the entire group, the pediatric subgroup, and the adult subgroup, respectively, in the control group without chalazia. In nonchalazia patients, the rate of detecting *D. brevis* was significantly less frequent than that of *D. folliculorum*: 18.8%, 10%, and 26.5%, respectively (Table 1; all $P < .01$). In contrast, surprisingly, *D. brevis* was detected more frequently in study patients with chalazia, that is, 50.5%, 53.2%, and 47.7%, respectively (Table 1; all $P < .001$). That was why *D. brevis* and *D. folliculorum* were detected similarly in patients with chalazia (all $P > .05$). Furthermore, recurrence was significantly more common in those with *D. brevis* infestation ($P = .03$) than those with *D. folliculorum* infestation ($P = .08$) than those without (Table 3). Collectively, these results suggest *D. brevis* may play a more important role than *D. folliculorum* in the pathogenesis of chalazia.

Unlike the skin, where sebaceous glands are adjacent to the hair follicle, the meibomian gland is separated from the lash follicle in the eye. The high prevalence of *D. brevis* bodes well with the propensity of inciting granuloma formation leading to chalazia in the meibomian gland. Future studies are needed to determine where there is a similar pathogenic role of *D. brevis* in diseases not only in the meibomian gland of the eye, but also in the sebaceous gland of the skin. Previously, several plausible pathogenic mechanisms have been suspected, including mechanical blockage of the meibomian gland duct and granulomatous or giant cell reaction to the chitinous exoskeleton of the mites as a

foreign body.[3] Because the mite count was not correlated consistently with the severity of chalazia (single vs multiple), we could not ignore the likelihood that mites also may serve as a vector to bring in microbes including symbiotic *Bacillus oleronius* to incite host innate immune responses, as suggested in rosacea.[6,44] In the present study, we demonstrated a significant association between ocular demodicosis, especially when caused by *D. brevis* infestation, and chalazia. We believe that continuous investigation is warranted so that it may shed new light on the pathogenic role of *Demodex* mites not only in the eye, but also in the skin.

ALL AUTHORS HAVE COMPLETED AND SUBMITTED THE ICMJE FORM FOR DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST and the following was reported. Dr Tseng has filed patents for the uses of tea tree oil and its ingredients for treating demodicosis. The other authors have no financial interest to disclose. Supported in part by Grant 10ykpy25 from Sun Yat-sen University, Guangzhou, China; Grant 20110171120104 from the Ministry of Education of China; Grant 2011B031800274 from the Technological Project Foundation of Guangdong Province, China; Grant 81300739 from the National Natural Science Foundation of China; and in part by an unrestricted grant from the Ocular Surface Research & Education Foundation, Miami, Florida, USA. The sponsor or funding organizations had no role in the design or conduct of this research. Involved in Design of study (S.C.G.T., L.L.); Conduct of study (S.C.G.T., L.L., X.D.); Data collection and management (L.L., S.C.G.T., X.D.); Analysis and interpretation of data (S.C.G.T., L.L., X.D.); Preparation and writing of manuscript (L.L., S.C.G.T.); and Review and approval of manuscript (S.C.G.T., L.L., X.D.).

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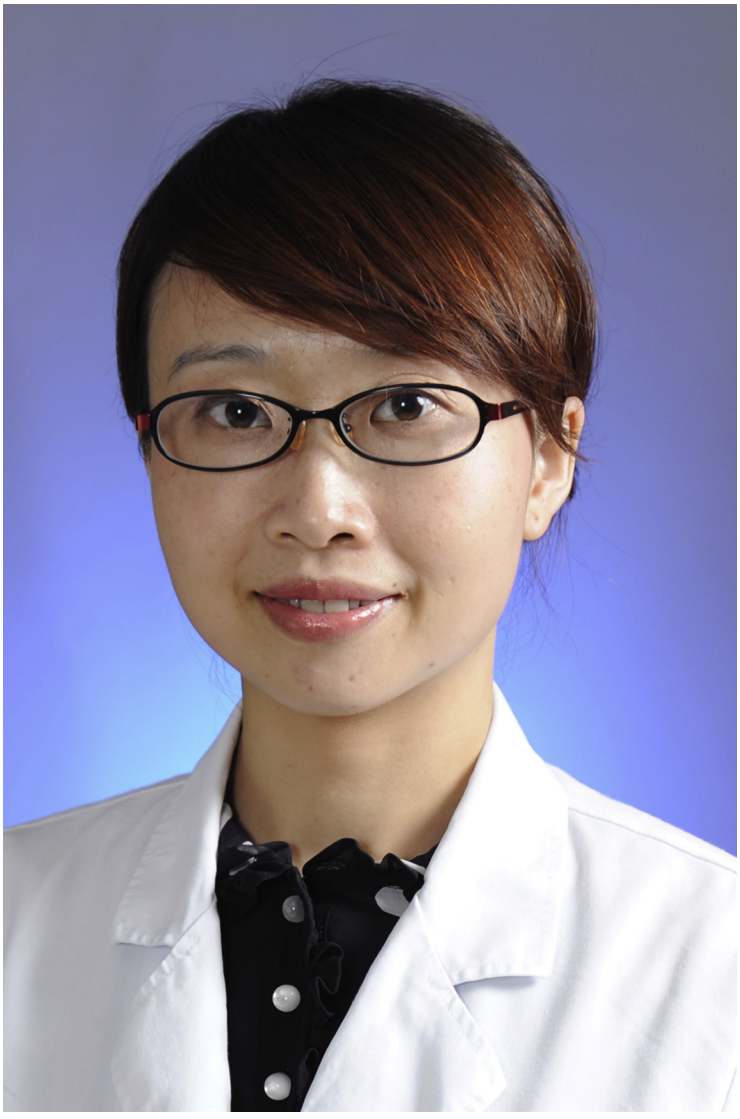

## Biosketch

Lingyi Liang, MD, PhD, is an associate professor of ophthalmology in Zhongshan Ophthalmic Center, State Key Laboratory of Ophthalmology, Sun Yat-sen University, Guangzhou, China. Dr Liang received her PhD from Zhongshan Ophthalmic Center, Sun Yat-sen University in 2009. Dr Liang completed a fellowship in corneal and ocular surface disease at the Ocular Surface Center, Miami, Florida in 2008. Her practice interests include cornea and ocular surface infection, dry eye, pterygium, and ocular surface reconstruction.