Research Article

The Prevalence of *Demodex folliculorum* and *Demodex brevis* in Cylindrical Dandruff Patients

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Purpose. To compare the prevalence of and factors associated with *Demodex brevis* and *Demodex folliculorum* in patients with cylindrical dandruff (CD group) and healthy controls. Methods. Eyelashes were taken from 1680 patients with CD and 1700 healthy controls in China from March 2015 to May 2017. All patients underwent a complete eye examination, and *Demodex* spp. were counted. The prevalence was analyzed according to age, gender, and clinical features. Results. Mean patient age was 42.93 ± 16.52 (3–88) and 39.4 ± 13.6 (7–81) years old in the CD and healthy control groups, respectively. In the CD and healthy groups, the positive rate for *Demodex folliculorum* was 27.92% and 8.47%, respectively, while that for *Demodex brevis* was 31.67% and 6.65%, respectively. In the CD group, the prevalence of *Demodex brevis* was higher than that of *Demodex folliculorum*, no matter in the females (33.65% versus 29.01%) or the males (28.54% versus 23.88%) in the CD group. Moreover, the numbers of *Demodex folliculorum* and *Demodex brevis* were significantly and positively correlated with age, in both children and old patients (both *P* < 0.001), as well as with the severity of eyelid congestion (all *P* < 0.05). Conclusions. In a large sample population, the prevalence of *Demodex brevis* and *Demodex folliculorum* was higher in the CD group than in healthy volunteers. In addition, the severity of eyelid congestion might be exacerbated by the number of *Demodex* spp., which may therefore provide a good clinical reference and objective guide.

1. Introduction

*Demodex*, one of the most common parasites in humans, resides in sites with numerous hair follicles and pilosebaceous glands, such as the eyelids [1], face [2], scalp [3], and upper chest [4]. Among more than 140 species of mites, only *Demodex folliculorum* and *Demodex brevis* are found on the human body. *Demodex folliculorum* is approximately 0.3–0.4 mm long, while *Demodex brevis* is approximately 0.2–0.3 mm long [5]. Their life cycle is approximately 14–16 days long, they move mostly at night, and they live in regions such as the sebaceous glands in facial skin, including the nose, nasolabial folds, eyelids, cheek, forehead, chin, and neck [6].

In ophthalmology, ocular demodicosis is typically accompanied by eyelash loss or abnormal alignment and chronic inflammation of the meibomian gland [7], leading to lipid tear deficiency in the conjunctiva [8]; in turn, this deficiency leads to conjunctivitis and sight-threatening keratitis in the cornea [9]. Several studies have also linked the presence of *Demodex* with chronic blepharitis because the mite can perpetuate the follicular inflammatory process [1, 10, 11]. Some researchers consider the mites to be merely passengers on skin because they are found on almost all normal adult skin and thus are coincidentally found on diseased skin [12, 13]. However, clinical observations have revealed that after ineffective conventional therapy, acaricidal therapy can eliminate the clinical symptoms of blepharitis [14]. Nevertheless, direct, absolute proof of a causal relationship has not yet been established because *Demodex* is a host-specific obligate parasite that currently cannot be cultured *in vitro* to parasitize and infect other animal hosts [15]. Therefore, clinical observations based on large samples are important for exploring the relationship between *Demodex* and clinical signs.

Cylindrical dandruff (CD) in the eyelashes, also known as cylindrical casts, are scales that form clear cuffs that collar the lash root and may be composed of keratins and lipids [16, 17]. CD is one of the clinical manifestations of ocular...
demodicosis, and Tseng’s study showed that eyelashes with CD did indeed have a significantly higher rate of Demodex infestation than was found in eyelashes without CD [6]. CD in the eyelashes is a common finding in some patients with ocular demodicosis, but whether it is pathognomonic of Demodex infestation remains controversial. This debate is partially attributed to the accuracy of methods used to sample and count Demodex [18]. Therefore, a modified sampling and counting method was established to enhance the accuracy of Demodex diagnosis [6].

However, the exact prevalence of Demodex and the pathogenic potential of these mites in eyes with CD remain uncertain. Thus, we performed a study of 1680 patients with CD and 1700 healthy volunteers in China that was designed to determine the prevalence of Demodex and the effect of the hosts’ factors such as gender, age, and eyelid inflammation score, on the presence or absence of Demodex.

2. Materials and Methods

2.1. Patient Data. A total of 1680 patients with eyelashes showing CD (representative pictures are shown in Figure 1(a)) and who complained of ocular surface irritation and 1700 healthy volunteers who visited our hospital between March 2015 and June 2017 were included in our study. In the healthy group, there were 1166 (68.6%) females and 534 (31.4%) males with an average age of 39.4 ± 16.5 (3–88) years; in the CD group, there were 1165 (69.4%) females and 515 (30.6%) males with an average age of 42.9 ± 16.5 (3–88) years. The collected data included basic information such as gender and age, the status of eyelid inflammation, and the results of Demodex counting. This study followed the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Zhongshan Ophthalmic Center (Guangzhou, China). A total of 3380 individuals in both groups all signed a consent document to participate in the study.

2.2. Demodex Sampling and Counting. The methods used here were previously described by Kheirkhah et al. [19]. Briefly, two lashes with CD were removed from each lid of each subject by fine forceps and were placed separately on each end of a glass slide for examination under a slit-lamp microscope (SL220; Carl Zeiss, Oberkochen, Germany) at a magnification of ×25. Thus, for each subject, a total of 8 lashes were prepared on 4 slides. A coverslip was mounted at the edge of the coverslip until it surrounded the lash. Then, 20 μL of 100% alcohol (Sigma-Aldrich, St. Louis, MO) was pipetted at the edge of the coverslip; this prolonged the counting time for up to 20 minutes and allowed the embedded Demodex to migrate from the CD. Under the microscope, the number of Demodex was counted three times, and all samples were photographed in a conventional manner by the same specialist (Doc Tan). The presence of Demodex in at least one of the 8 eyelashes was defined as Demodex-positive.

2.3. Eyelid Inflammation Evaluation. The status of eyelid inflammation was based on the presence of vascular congestion in the eyelid margin, as observed by external photography. These findings were subjectively rated on a four-point scale, as follows: 0, no vascular congestion; 1, mild vascular congestion; 2, moderate vascular congestion; and 3, severe vascular congestion [20].

2.4. Statistical Analysis. Data were evaluated using SPSS for Windows 11.5. An unpaired, two-tailed Student’s t-test was used to compare the numbers of Demodex brevis and Demodex folliculorum and the numbers of Demodex among the different grades of eyelid congestion. The chi-square test and Fisher’s exact test were used to evaluate differences in Demodex prevalence among different ages and genders. Correlation analysis was used to evaluate the relationship between Demodex numbers and age and between Demodex rates and eyelid congestion severity. The data were considered significant at P < 0.05.

3. Results

3.1. The Prevalence of Demodex Brevis and Demodex Folliculorum Was Higher in the CD Group than in the Healthy Group. Figures 1(b) and 1(c) show representative microscopic images of Demodex folliculorum and Demodex brevis. The positive rate of Demodex folliculorum was 27.92% and 8.47%, respectively, in the CD group and healthy group, and Demodex brevis’s prevalence was 31.67% and 6.65%, respectively, in these two groups (Figure 1(d)). Furthermore, the average number of Demodex folliculorum and Demodex brevis was 0.52 (0–18) and 0.86 (0–18) in the CD group, which was 0.06 (0–2) and 0.14 (0–2) in the healthy group; the average Demodex spp. number of all the positive subjects was more in the CD group than in the healthy group, no matter in Demodex folliculorum (2.23 ± 0.07 versus 1.37 ± 0.08, P < 0.01) or in Demodex brevis (2.72 ± 0.07 versus 1.29 ± 0.13, P < 0.05). Moreover, the average number of Demodex brevis was obviously greater than Demodex folliculorum in the CD group (P < 0.001) while not in the healthy group (Figure 1(e)). Thus, the prevalence of Demodex folliculorum and Demodex brevis was higher in CD group compared with that in the healthy group, and the positive rate of Demodex brevis was greater than that of Demodex folliculorum in the CD group.

3.2. The Number of Demodex Brevis Was Higher in Females than in Males. In the CD group, the positive rate of Demodex folliculorum was 23.88% and 29.10%, respectively, in males and females, while in the healthy group, it was 7.49% and 8.83%, respectively, in males and females. The prevalence of Demodex brevis showed a trend similar to that of Demodex folliculorum, with the positive rate of 28.54% and 33.65% in males and females in the CD group and 5.05% and 7.55% in males and females in the healthy group. The prevalence of Demodex folliculorum and Demodex brevis were higher in the CD group than in the healthy group in both males and females and higher in females than in males in both groups (Figure 2).

3.3. The Number of Demodex Increased with Age in Eyelashes with CD. In the CD and healthy groups, the prevalence of
Demodex folliculorum was 13.33% and 0% in children (<6 years old), 22.22% and 1.78% in juveniles (7–17 years old), 21.74% and 8.71% in youth (18–40 years old), 24.31% and 9.18% in middle-aged patients (41–65 years old), and 30.97% and 12.87% in old patients (66–88 years old) (Table 1). In the CD and healthy groups, the prevalence of Demodex brevis were 26.67% and 2.63% in children, 30.00% and 3.55% in juveniles, 29.55% and 6.46% in youth, 32.67% and 7.75% in middle-aged patients, and 37.42% and 8.77% in old patients. The prevalence of Demodex brevis and Demodex folliculorum appeared lower in younger age groups than in older age groups, respectively (Table 1). The prevalence differed among different groups, and old patients had the higher prevalence in Demodex folliculorum and Demodex brevis. Furthermore, in the CD group, the number of Demodex folliculorum and Demodex brevis per patient was positively correlated with age across all age groups (both $P < 0.001$). The following equations were used: number of Demodex folliculorum = 1.180 + 0.035 (age) ($r = 0.237$, $P < 0.01$) (Figure 3(a)) and number of Demodex brevis = 0.650 + 0.037 (age) ($r = 0.286$, $P < 0.001$) (Figure 3(b)).
### Table 1: Distribution of *Demodex folliculorum* and *Demodex brevis* by age in the CD and healthy groups.

| Age (years) | *Demodex folliculorum*, positive/n (%) | *Demodex brevis*, positive/n (%) |
|-------------|----------------------------------------|----------------------------------|
|             | CD group                               | Healthy group                    | CD group                           | Healthy group |
| 0–6         | 2/15 (13.33%)                          | 0/38 (0%)                        | 4/15 (26.67%)                      | 1/38 (2.63%)  |
| 7–17        | 20/90 (22.22%)                         | 3/169 (1.78%)                    | 27/90 (30.00%)                     | 6/169 (3.55%) |
| 18–40       | 142/653 (21.74%)                       | 62/712 (8.71%)                   | 193/653 (29.55%)                   | 46/712 (6.46%) |
| 41–65       | 186/765 (24.31%)                       | 56/610 (9.18%)                   | 250/765 (32.67%)                   | 46/610 (7.75%) |
| 66–88       | 48/155 (30.97%)                        | 22/171 (12.87%)                  | 58/155 (37.42%)                    | 15/171 (8.77%) |

**Figure 3:** The average number of *Demodex folliculorum* (a) and *Demodex brevis* (b) are significantly correlated with increasing age, from children to older patients. *P < 0.05; **P < 0.01; ***P < 0.001.

#### 3.4. The Prevalence and Number of Demodex Brevis Were Positively Correlated with the Severity of Eyelid Congestion.

In the CD group, we concluded that the severity of eyelid congestion was positively correlated with the prevalence of both *Demodex folliculorum* and *Demodex brevis* (both *P < 0.05*) (Figure 4(a)) according to the following equations: prevalence of *Demodex folliculorum* (%) = 18.25 + 10.19 (grade) (*r* = 0.999, *P* = 0.029) and prevalence of *Demodex brevis* (%) = 13.40 + 8.75 (grade) (*r* = 1.000, *P* = 0.015). The prevalence of *Demodex folliculorum* increased from 22.26% in Grade I to 30.66% in Grade II to 39.75% in Grade III, while the prevalence of *Demodex brevis* increased from 28.70% to 38.09% and 49.01% in Grade I, II, to Grade III, respectively. Furthermore, the highest numbers of *Demodex folliculorum* and *Demodex brevis* individuals were observed in Grade III cases, whereas the fewest were observed in the Grade I cases (all *P < 0.05*) (Figure 4(b)). Specifically, the prevalence and number of *Demodex folliculorum* and *Demodex brevis* increased with the severity of eyelid congestion.

#### 4. Discussion

*Demodex* is a parasite commonly observed on human skin [21], and some investigators have suggested that there is a symbiotic relationship between mites and humans that may even beneficial for the hosts because these mites ingest bacteria that can grow in the follicular canal [22, 23]. However, a growing body of evidence indicates that these mites may also act as pathogens in a number of skin diseases, such as rosacea [24], alopecia [25], and chronic blepharitis [11].

The prevalence of *Demodex folliculorum* and *Demodex brevis* was clearly higher in the CD group than in healthy volunteers in our study; although the positive rate of 27.92% and 31.67% was lower than the prevalence of 100% in Tseng’s study [6], it also provided strong evidence to support the high prevalence in CD lashes. The eye is surrounded by protruding body parts such as the nose, brow, and cheek; the eyelid is not as accessible as the face is to daily cleansing hygiene. Therefore, once a *Demodex* infestation is established in the face, it is likely to spread and flourish in the eyelids. Microabrasions caused by the mite’s claws can induce epithelial hyperplasia and reactive hyperkeratinization around the base of the lashes, forming CD [26], which is closely associated with *Demodex* infestation. In addition, differences in sample size and regions among studies have led to a lack of consistent results until now. For example, Wesolowska et al. [27] reported that the overall prevalence of *Demodex* spp. is 41% in Poland, a rate of positivity of 37.3% was reported for *Demodex* spp. in Turkish volunteers [28], and a prevalence rate of 21.2% was found in Shangqiu City of Henan Province [29], 36.3% in Tangshan [30], and 51.5% in Inner Mongolia [31]. Thus, the difference in prevalence between our and Tseng’s results might be normal.

Moreover, we found that the prevalence of *Demodex folliculorum* and *Demodex brevis* was higher in females than in males. The prevalence of *Demodex brevis* was 33.65%, which is similar to the rate of 39.3% found in women in the Malatya province in Turkey [32] but lower than the prevalence of 100% reported in Tseng’s study [6]. However, the gender distribution of *Demodex* spp. in the present study was not in agreement with the results of Elston’s study [33],...
Demodex folliculorum was more commonly seen in lash follicle-related diseases, such as posterior blepharitis, or keratoconjunctivitis [38].

In addition to CD, eyelid margin inflammation is one of the main clinical manifestations of ocular demodicosis; thus, the severity of eyelid inflammation may indicate the prognosis [40]. The increased number and extrafollicular localization of mites enhance the probability of a hypersensitivity reaction, inflammation, and the secretion of inflammatory cytokines. Regardless of the prevalence or number of Demodex folliculorum and Demodex brevis, both were positively correlated with eyelid congestion severity; these results demonstrate that the Demodex spp. infestation may act as a pathogen in ocular pathologic features. This result is in agreement with Tseng’s results [41].

In conclusion, we explored a large sample population and found that the prevalence of Demodex brevis and Demodex folliculorum were higher in the CD group than in healthy volunteers. Our results demonstrate that in eyelashes with CD, the prevalence of Demodex brevis is higher than that of Demodex folliculorum. We also found that the number of Demodex spp. increases with age and that females are attacked more easily than males by Demodex spp. In patients with CD eyelashes, the severity of eyelid congestion was exacerbated by the prevalence and number of Demodex spp. Further studies should focus on the specific mechanism of Demodex spp. infection, build diagnostic criteria for eyelid demodicosis, and explore the relationship between Demodex spp. and ocular immunology to develop therapies against Demodex.

**Data Availability**

The datasets will be provided via a link if required after publication.

**Conflicts of Interest**

None of the authors has any proprietary interests or conflicts of interest related to this submission. None of the authors has any conflicts of interest to disclose.
Authors’ Contributions
Jing Zhong and Yiwei Tan contributed equally to this work.

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References
[1] M. Galea, R. Sharma, S. Srinivasan, and F. Roberts, “Demodex blepharitis mimicking eyelid sebaceous gland carcinoma,” *Clinical & Experimental Ophthalmology*, vol. 42, no. 2, pp. 208–210, 2014.

[2] M. M. Hom, K. M. Mastrotta, and S. E. Schachter, “Demodex,” *Optometry and Vision Science*, vol. 90, no. 7, pp. e198–e205, 2013.

[3] W. Helou, E. Avitan-Hersh, and R. Bergman, “Demodex folliculitis of the scalp,” *American Journal of Dermatopathology*, vol. 38, no. 9, pp. 658–663, 2016.

[4] Y. E. Zhao, L. P. Wu, Y. Peng, and H. Cheng, “Retrospective analysis of the association between Demodex infestation and rosacea,” *Archives of Dermatology*, vol. 146, pp. 896–902, 2010.

[5] A. Horváth, D. Neubrandt, A. Ghidán, and K. Nagy, “Risk factors and prevalence of Demodex mites in young adults,” *Acta Microbiologica et Immunologica Hungarica*, vol. 58, no. 2, pp. 145–155, 2011.

[6] Y.-Y. Gao, M. A. DiPascuale, W. Li et al., “High prevalence of Demodex in eyelashes with cylindrical dandruff,” *Investigative Ophthalmology & Visual Science*, vol. 46, no. 9, pp. 3089–3094, 2005.

[7] K. G. Patel and V. K. Raju, “Ocular demodicosis,” *West Virginia Medical Journal*, vol. 109, pp. 16–18, 2013.

[8] W. Chen and G. Plevig, “Human demodicosis: revisit and a proposed classification,” *British Journal of Dermatology*, vol. 170, no. 6, pp. 1219–1225, 2014.

[9] S. H. Lee, Y. S. Chun, J. H. Kim, E. S. Kim, and J. C. Kim, “The relationship between Demodex and ocular discomfort,” *Investigative Ophthalmology & Visual Science*, vol. 51, no. 6, pp. 2906–2911, 2010.

[10] V. Bhandari and J. Reddy, “Blepharitis: always remember Demodex,” *Middle East African journal of ophthalmology*, vol. 21, no. 4, pp. 317–320, 2014.

[11] F. Laspina, M. Samudio, M. Arrúa et al., “Demodex spp. en pacientes con blefaritis crónica,” *Revista Chilena de Infectología*, vol. 32, no. 1, pp. 37–42, 2015.

[12] M. Kemal, Z. Sümer, M. I. Toker, H. Erdoğan, A. Topalkara, and M. Akbulut, “The prevalence of Demodex folliculorum blepharitis patients and the normal population,” *Ophthalmic Epidemiology*, vol. 12, no. 4, pp. 287–290, 2005.

[13] S. Talghini, D. F. Foulandi, S. Babaeinejad, R. Shenasi, and S. M. Samani, “Demodex mite, rosacea and skin melanoma; coincidence or association?”, *Turkish Journal of Parasitology*, vol. 39, no. 1, pp. 41–46, 2015.

[14] M. Türk, İ. Oztürk, A. G. Sener, S. Küçükabay, I. Afsar, and A. Maden, “Comparison of incidence of Demodex folliculorum on the eyelash follicle in normal people and blepharitis patients,” *Turkiye Parazitol Dergisi*, vol. 31, pp. 296-297, 2007.

[15] F. Forton, M.-A. Germaux, T. Brasseur et al., “Demodicosis and rosacea: epidemiology and significance in daily dermatologic practice,” *Journal of the American Academy of Dermatology*, vol. 52, no. 1, pp. 74–87, 2005.

[16] F. P. English, “Demodex folliculorum and oedema of the eyelash,” *British Journal of Ophthalmology*, vol. 55, no. 11, pp. 742–746, 1971.

[17] D. I. Kosik-Bogacka, N. Lanocha, A. Lanocha et al., “Demodex folliculorum and Demodex brevisin healthy and immuno-compromised patients,” *Ophthalmic Epidemiology*, vol. 20, no. 3, pp. 159–163, 2013.

[18] A. M. S. Cheng, H. Sheha, and S. C. G. Tseng, “Recent advances on ocular Demodex infestation,” *Current Opinion in Ophthalmology*, vol. 26, no. 4, pp. 295–300, 2015.

[19] A. Kheirkhah, G. Blanco, V. Casas, and S. C. G. Tseng, “Fluorescein dye improves microscopic evaluation and counting of Demodex in blepharitis with cylindrical dandruff,” *Cornea*, vol. 26, no. 6, pp. 697–700, 2007.

[20] N. K. Kuscu, A. B. Toprak, S. Vatansever, F. M. Koyuncu, and C. Guler, “Tear function changes of postmenopausal women in response to hormone replacement therapy,” *Maturitas*, vol. 44, no. 1, pp. 63–68, 2003.

[21] A. Ozer, U. Karaman, S. Degerli, C. Colak, M. Karadan, and E. Karci, “Investigation of Demodex spp. prevalence among managers and workers of health hazard bearing and sanitary establishment,” *Journal of the Formosan Medical Association*, vol. 111, no. 1, pp. 30–33, 2012.

[22] N. Lacey, S. Ní Raghallaigh, and F. C. Powell, “Demodex mites—commensals, parasites or mutualistic organisms?,” *Dermatology*, vol. 222, no. 2, pp. 128–130, 2011.

[23] K. Fischer and S. Walton, “Parasitic mites of medical and veterinary importance—is there a common research agenda?,” *International Journal for Parasitology*, vol. 44, no. 12, pp. 955–967, 2014.

[24] W. Chen and G. Plevig, “Are Demodex mites principal, conspirator, accomplice, witness or bystander in the cause of rosacea?,” *American Journal of Clinical Dermatology*, vol. 16, no. 16, pp. 67–72, 2015.

[25] S. F. Li, X. T. Zhang, S. L Qi et al., “Allergy to dust mites may contribute to early onset and severity of alopecia areata,” *Clinical and Experimental Dermatology*, vol. 40, no. 2, pp. 171–176, 2015.

[26] C. L. Bevins and F. T. Liu, “Rosacea: skin innate immunity gone awry?,” *Nature Medicine*, vol. 13, no. 8, pp. 904–906, 2007.

[27] M. Wesołowska, B. Knysz, A Reich et al., “Prevalence of Demodex spp. in eyelash follicles in different populations,” *Archives of Medical Science*, vol. 2, pp. 319–324, 2014.

[28] U. Karaman, Z. Koloren, O. Enginyurt, and A. Ozer, “The epidemiology of Demodex mites at the college students living in dormitories in the city of Ordu,” *Turkish Journal of Parasitology*, vol. 38, no. 3, pp. 166–171, 2014.

[29] J. H. Cui and C. Wang, “Facial Demodex infestation among urban and rural residents in Shangqiu city of Henan province,” *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi*, vol. 30, no. 4, pp. 283–285, 2012.

[30] Y. S. Cao, Q. X. You, I. Wang et al., “Facial Demodex infection among college students in Tangshan,” *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi*, vol. 27, no. 3, pp. 271–273, 2009.

[31] Q. Hu and Y. Wang, “Investigation on the prevalence of human Demodex among 2,248 medical students in inner Mongolia,” *Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi*, vol. 19, no. 4, pp. 239–240, 2001.

[32] O. Enginyurt, U. Karaman, F. Cetin, and A. Ozer, “The prevalence of Demodex species and its relationship with the metabolic syndrome in women of Malatya province, Turkey,” *Jundishapur Journal of Microbiology*, vol. 8, no. 10, article e24322, 2015.
[33] C. A. Elston and D. M. Elston, “Demodex mites,” Clinics in Dermatology, vol. 32, no. 6, pp. 739–743, 2014.
[34] D. A. Sullivan, B. D. Sullivan, J. E Evans et al., “Androgen deficiency, meibomian gland dysfunction, and evaporative dry eye,” Annals of the New York Academy of Sciences, vol. 966, no. 1, pp. 211–222, 2002.
[35] C. Gokce, O. Aycan-Kaya, E Yula et al., “The effect of blood glucose regulation on the presence of opportunistic Demodex folliculorum mites in patients with type 2 diabetes mellitus,” Journal of International Medical Research, vol. 41, no. 5, pp. 1752–1758, 2013.
[36] T. Yoshikawa and H. Kanazawa, “Association of plasma adiponectin levels with cellular hydration state measured using bioelectrical impedance analysis in patients with COPD,” International Journal of Chronic Obstructive Pulmonary Disease, vol. 7, pp. 515–521, 2012.
[37] S. Ni Raghallaigh, K. Bender, N. Lacey, L. Brennan, and F. C. Powell, “The fatty acid profile of the skin surface lipid layer in papulopustular rosacea,” British Journal of Dermatology, vol. 166, no. 2, pp. 279–287, 2012.
[38] J. Liu, H. Sheha, and S. C. Tseng, “Pathogenic role of Demodex mites in blepharitis,” Current Opinion in Allergy and Clinical Immunology, vol. 10, no. 5, pp. 505–510, 2010.
[39] E. Zeytun and Y. Karakurt, “Prevalence and load of Demodex folliculorum and Demodex brevis (Acari: Demodicidae) in patients with chronic blepharitis in the province of Erzincan, Turkey,” Journal of Medical Entomology, vol. 56, no. 1, pp. 2–9, 2019.
[40] S. L. Maskin, “Intraductal meibomian gland probing relieves symptoms of obstructive meibomian gland dysfunction,” Cornea, vol. 29, no. 10, pp. 1145–1152, 2010.
[41] A. Kheirkhah, V. Casas, W. Li, V. K. Raju, and S. C. Tseng, “Corneal manifestations of ocular Demodex infestation,” American Journal of Ophthalmology, vol. 143, no. 5, pp. 743–749, 2007.