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Demodex Mites – Commensals, Parasites or Mutualistic Organisms?

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The German dermatologist Gustav Simon is credited with the first description of *Demodex* mites [1]. He was studying the microanatomical structure of acne vulgaris lesions by examining material expressed from sebaceous follicles under the microscope. He noted structures within this material and was able to identify a worm-like object with a head, legs, and anterior and posterior body parts that made him think this was 'an animal' of some sort. Suspicion became certainty when he pressed the object gently between two slides and observed that 'it moved'! The term *Demodex* was coined by Richard Owen in 1843 for this genus [2], borrowing from the Greek the words 'demo' (lard) and 'dex' (boring worm) to describe the form and location of preference of this organism. The anatomical details were subsequently described by Desch and Nutting [3, 4]. These included (for *Demodex folliculorum*) 4 pairs of articulated legs, complex mouth parts, genital organs (either penis or vagina), a rudimentary gastrointestinal tract but surprisingly no anus!

We now know that 2 mite species *(Demodex brevis* and *D. folliculorum)* inhabit normal adult human facial sebaceous follicles. Mites are not found in the skin of newborn infants. Sebaceous follicles are thought to become colonised during later childhood and early adult life by transfer from adult family members. The mites' life cycle was studied by Spickett [5] by histological and rudimentary in vitro experiments. From a synthesis of this data generated, he proposed that the life cycle of *D. folliculorum* mites was about 14.5 days. He also demonstrated that all life stages of these mites were negatively phototaxic, that is they were more mobile in a dark environment and relatively inert when bright light was shone on them. However, until optimal in vitro culture techniques and conditions allow *Demodex* proliferation in the laboratory, the true life cycle of *Demodex* remains uncertain. Mites are mobile and can travel at a speed of up to 16 mm/h [6]. Mites found from time to time on the skin surface suggest that they emerge from follicles (probably at night to avoid light exposure) and migrate across the surface of the facial skin.

Mites are known to contain lipase enzymes [7], to carry bacteria on the surface [6] and they may have endobacteria [8].

Any potential role of these complex organisms in the biobalance of the skin has been largely ignored. They are regarded by most investigators as simple commensals benefiting from the human sebum in its sheltered ecological follicular niche and without adversely affecting its host, but in animals the pathogenic potential of *Demodex* species is well documented. Demodectic mange in dogs is a potentially lethal condition, and goats can be similarly affected. Both disorders are caused by a massive proliferation of the normal mite population [9]. In humans there is mounting evidence that *Demodex* mites, like oth-

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er cutaneous microflora, may be opportunistic pathogens, that is they have the potential to change status from commensals to parasites (the mites benefit but cause harm to the host) if the host cutaneous environment facilitates their proliferation [10, 11].

Demodex mite numbers have been repeatedly shown to be increased in patients with rosacea, and a recent report using meta-analysis of previous studies has shown a statistically significant association between *Demodex* species infestation and the development of rosacea [12]. Rosaceiform dermatitis has been reported following repeated facial application of topical steroids and other immunomodulators with similarly increased numbers of mites recorded [13]. Several other studies have shown that *Demodex* mite numbers are increased in immunosuppressed patients, children with leukaemia receiving chemotherapy [14], patients with HIV infection and AIDS [15, 16], patients undergoing phototherapy [17] and patients on chronic dialysis [18].

In this issue, Gerber et al. [19] introduce a new clinical setting in which *Demodex* numbers were found to be increased. In their retrospective study these authors demonstrated increased numbers of *D. folliculorum* in the cheek region of patients presenting with papulopustular lesions induced by epidermal growth factor receptor inhibitor following therapy for cancer. The authors propose that their findings suggest that epidermal growth factor receptor inhibitor may reduce/impair cutaneous defence mechanisms resulting in increased *Demodex* proliferation.

Our present state of knowledge suggests that *Demodex* mites normally have a symbiotic relationship with humans. In usual circumstances they appear to live as commensals feeding on their host's sebum. It is possible in this role that they may even confer a mutualistic host benefit by ingesting bacteria or other organisms in the follicular canal. The host's innate immune system appears to tolerate the presence of these mites (possibly being downregulated by the mites themselves) but it may have a 'culling' or inhibitory effect on mite proliferation keeping numbers in the canal under control without inducing an inflammatory response. If mite numbers increase to a critical level (possibly causing physical distension of follicles with keratinocyte disruption), they possibly develop a pathogenic role causing host 'insult'. Thus, cytokine/chemokine release may be initiated, and a humoral immune inflammatory response ensues with clinically visible cutaneous changes. If the follicle is damaged to the point of rupture, a granulomatous 'foreign-body' type of reaction subsequently results.

Several factors could allow proliferation of mites to this critical level. For example the particular physical barrier characteristics of an individual's facial skin may facilitate their increased population. Our preliminary studies have shown that patients with papulopustular rosacea have increased facial pH and reduced skin surface hydration levels [20]. Papulopustular rosacea patients also have abnormal fatty acid composition of their skin surface lipid layer, with increased levels of linoleic acid and myristic acid, as well as reduced levels of specific saturated fatty acids [21]. This type of facial cutaneous microenvironment may prove conducive to mite proliferation. Alternatively, the aberrant innate immune response as previously reported in rosacea patients [22] may facilitate mite multiplication to the point where the humoral response is initiated and cutaneous inflammation results.

The role of suppression of the host immune response in the facilitation of mite proliferation is suggested by the studies cited above and the publication by Gerber et al. [19] in this issue.

Studies of *Demodex* mites and their role in healthy skin as well as their potential to cause host damage have the potential to give insight into this complex and important area of cutaneous medicine. It may well be that *Demodex* mites, like some cutaneous microbes, take on different roles depending on host status [23], changing from commensals (or even mutuals) to parasites as the host's defences are altered.

References

1 Crissey JT, Parish LC: The Dermatology and Syphilology of the Nineteenth Century. Westport, Praeger Publishers, 1981, p 124.

2 Owen R: Lectures on the Comparative Anatomy and Physiology of the Invertebrate Animals. London, Longman, 1843, pp 251–252.

3 Desch C, Nutting WB: *Demodex folliculorum* (Simon) and *D. brevis* Akbulatova of man: redescription and reevaluation. J Parasitol 1972;58:169–177.

4 Desch CE, Nutting WB: Morphology and functional anatomy of *Demodex folliculorum* (Simon) of man. Acarologia 1977;19:422–462.

5 Spickett SG: Studies on *Demodex folliculorum* Simon. Parasitology 1961;51:181–192.

6 Norn MS: The follicle mite *(Demodex folliculorum).* Eye Ear Nose Throat Mon 1972;51:187–191.

7 Acosta FJ, Planas L, Penneys N: *Demodex* mites contain immunoreactive lipase. Arch Dermatol 1989;125:1432–1433.

8 Lacey N, et al: Mite-related bacterial antigens stimulate inflammatory cells in rosacea. Br J Dermatol 2007;157:474–481.

9 Scott DW, Miller WH, Griffin CE: Muller and Kirk's Small Animal Dermatology, ed 6. Philadelphia, Saunders, 2001, pp 457–513.

10 Dahl MV, Ross AJ, Schlievert PM: Temperature regulates bacterial protein production: possible role in rosacea. J Am Acad Dermatol 2004;50:266–272.
11 Whitfeld M, et al: *Staphylococcus epidermidis:* a possible role in the pustules of rosacea. J Am Acad Dermatol, E-pub ahead of print.
12 Zhao YE, Wu LP, Peng Y, Cheng H: Retrospective Analysis of the association between *Demodex* infestation and rosacea. Arch Dermatol 2010;146:896–902.
13 Fujiwara S, Okubo Y, Irisawa R, Tsuboi R: Rosaceiform dermatitis associated with topical tacrolimus treatment. J Am Acad Dermatol 2010;62:1050–1052.
14 Ivy SP, Mackall CL, Gore L, et al: Demodicidosis in childhood acute lymphoblastic leukemia: an opportunistic infection occurring with immunosuppression. J Paediatr 1995; 127:751–754.
15 Aquilina C, Viraben R, Sire S: Ivermectin-responsive *Demodex* infestation during human immunodeficiency virus infection. Dermatology 2002;205:394–397.
16 Dominey A, Rosen T, Tschen J: Papulonodular demodicidosis associated with acquired immunodeficiency syndrome. J Am Acad Dermatol 1989;20:197–201.
17 Kulac M, Ciftci IH, Karaca S, Cetinkaya Z: Clinical importance of *Demodex folliculorum* in patients receiving phototherapy. Int J Dermatol 2008;47:72–77.
18 Karincaoglu Y, Seyhan ME, Bayran N, Aycan O, Taskapan H: Incidence of *Demodex folliculorum* in patients with end stage chronic renal failure. Renal Failure 2005;27:495–499.
19 Gerber PA, Kukova G, Buhren BA, Homey B: Density of *Demodex folliculorum* in patients receiving epidermal growth factor receptor inhibitors. Dermatology DOI: 10.1159/000323001.
20 Ní Raghallaigh S, Powell FC: The cutaneous microenvironment in papulopustular rosacea. Br J Dermatol 2009;161:25.
21 Ní Raghallaigh S, Bender K, Lacey N, Brennan L, Powell FC: The fatty acid profile of the skin surface lipid layer in patients with papulopustular rosacea. J Invest Dermatol 2010; 130:S65.
22 Yamasaki K, et al: Increased serine protease activity and cathelicidin promotes skin inflammation in rosacea. Nat Med 2007;13: 975–980.
23 Cogen AL, Nizet V, Gallo RL: Skin microbiota: a source of disease or defence? Br J Dermatol 2008;158:442–455.