

## Tatami Mats: A Source of Pitted Keratolysis in a Martial Arts Athlete?

Dear Editor,

Pitted keratolysis (PK), also known as *keratosis plantaris sulcatum*, is a non-inflammatory, bacterial, superficial cutaneous infection, characterized by many discrete superficial crateriform "pits" and erosions in the thickly keratinized skin of the weight-bearing regions of the soles of the feet (1). The disease often goes unnoticed by the patient, but when it is noticed it is because of the unbearable malodor and hyperhidrosis of the feet, which are socially unacceptable and cause great anxiety to many of the patients. PK occurs worldwide, with the incidence rates varying based on the environment and occupation. The prevalence of this condition does not differ significantly based on age, sex, or race. People who sweat profusely or wash excessively, who wear occlusive footwear, or are barefoot especially in hot and humid weather are extremely prone to this condition (2). Physicians commonly misdiagnose it as tinea pedis or plantar warts. Treatment is quite simple and straightforward, with an excellent expected outcome if treated properly.



**Figure 1.** Punched-out pits and erosions along with the hyperkeratotic skin on the heel and metatarsal region of the plantar aspect of both feet.

We report a case of a 32-year-old male patient with skin changes of approximately one-year duration diagnosed as plantar verrucae, who was referred to our Department for cryotherapy. The patient presented with asymptomatic, malodorous punched-out pits and erosions along with hyperkeratotic skin on the heel and metatarsal region of the plantar aspect of both feet. The arches, toes, and sides of the feet were spared (Figure 1). Except for these skin changes, the patient was healthy and denied any other medical issues. He was an athlete active in martial arts and had a history of sweating of feet and training barefoot on the tatami mat for extended periods of time. The diagnosis of PK was established based on the clinical findings (crateriform pitting and malodor), negative KOH test for hyphae, and a history of prolonged sweating in addition to contact of the skin with tatami mats, which are often a source of infection if hygiene measures are not adequately implemented. Swabs could have been helpful to identify causative organisms, but they were not crucial for the diagnosis and treatment. The patient was prescribed with



**Figure 2.** Complete clinical regression after four-week treatment with clindamycin 1%-benzoyl peroxide 5% gel.

general measures to prevent excessive sweating (cotton socks, open footwear, and proper hygiene), antiseptic potassium permanganate foot soaks followed by clindamycin 1% and benzoyl peroxide 5% in a gel vehicle twice daily. At the one-month follow-up visit, the skin changes, hyperhidrosis, and malodor were entirely resolved (Figure 2).

Pitted keratolysis is common among athletes (3,4). The manifestations of PK are due to a superficial cutaneous infection caused by several bacterial Gram-positive species including *Corynebacterium species*, *Kytococcus sedentarius*, *Dermatophilus congolensis*, *Actinomices keratolytica*, and *Streptomyces* that proliferate and produce proteinase and sulfur-compound by-products under appropriate moist conditions (5-7). Proteinases digest the keratin and destroy the stratum corneum, producing the characteristic skin findings, while sulfur compounds (sulfides, thiols, and thioesters) are responsible for the malodor. Athletes and soldiers who wear occlusive footwear for prolonged periods of time or even barefooted people that sweat extensively and spend time on wet surfaces such as laborers, farmers, and marine workers are more prone to this problem (3,4,8-11). Martial arts athletes are at greater risk of skin infections due to the constant physical contact that can lead to transmission of viral, bacterial, and fungal pathogens directly but also indirectly through contact with the mat and the skin flora of another infected individual. A national survey of the epidemiology of skin infections among US high school athletes conducted by Ashack *et al.* supported the prevalent theory that contact sports are associated with an increased risk of skin infections. In this study, wrestling had the highest skin infection rate of predominantly bacterial origin (53.8%), followed by tinea (35.7%) and herpetic lesions (6.7%), which is consistent with other literature reporting (12). Being barefoot on the tatami mat in combination with excessive sweating and non-compliance with hygiene measures makes martial arts athletes more susceptible to skin infections, including PK. The diagnosis is clinical, by means of visual examination and recognition of the characteristic odor. Dermoscopy can be useful, revealing abundant pits with well-marked walls that sometimes show the bacterial colonies (13). Cultures, if taken, show Gram-positive bacilli or coccobacilli. Because of the ease of diagnosis on clinical findings, biopsy of pitted keratolysis is rarely performed. Skin scraping is often performed to exclude tinea pedis, which is one of the main differential diagnosis, the others including verrucae, punctate palmoplantar keratoderma, keratolysis exfoliativa, circumscribed palmoplantar hypokeratosis, and basal cell nevus syndrome. If unrecognized and left

untreated, skin findings and smelly feet can last for many years. Sometimes, if unrecognized, PK can be mistreated with antifungals, or even with aggressive treatment modalities such as cryotherapy. Appropriate treatment includes keeping feet dry with adequate treatment of hyperhidrosis, preventive measures, and topical antibiotic therapy. Topical forms of salicylic acid, sulfur, antibacterial soaps, neomycin, erythromycin, mupirocin, clindamycin and benzoyl peroxide, clotrimazole, imidazoles, and injectable botulinum toxin are all successful in treatment and prevention of PK (14,15). Topical antibiotics are the first line of medical treatment, among which fusidic acid, erythromycin 1% (solution or gel), mupirocin 2%, or clindamycin are the most recommended (14). As in our case, a fixed combination of two approved topical drugs – clindamycin 1%-benzoyl peroxide 5% gel, had been already demonstrated by Vlahovich *et al.* as an excellent treatment option with high adherence and no side-effect (16). The combined effect of this combination showed significantly greater effect due to the bactericidal and keratolytic properties of benzoyl peroxide. Additionally, this combination also lowers the risk of resistance of causative microorganisms to clindamycin.

Skin infections are an important aspect of sports-related adverse events. Due to the interdisciplinary nature, dermatologists are not the only ones who should be aware of the disease, but also family medicine doctors, sports medicine specialists, and occupational health doctors who should educate patients about the etiology of the skin disorder, adequate prevention, and treatment. Athletes must enforce the disinfecting and sanitary cleaning of the tatami mats and other practice areas. Keeping up with these measures could significantly limit the spread of skin infections that can infect athletes indirectly, leading to significant morbidity, time loss from competition, and social anxiety as well.

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