

CASE IN POINT

## Pitted Keratolysis

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A 17-year-old boy presented with a 6-month history of malodorous lesions on the soles of both feet. Soaking of the feet in water tended to exacerbate the appearance of the lesions. The patient was very active in sports activities, especially jogging, but there was no history of trauma to the site. His past health was unremarkable, and he was not on any medication. His family history was also unremarkable.

Physical examination revealed multiple macerated areas, crateriform pits, and superficial erosions on the plantar surface of both feet. The feet were hyperhidrotic and malodorous, and examination with a Wood light showed no fluorescence. The rest of the physical examination results were unremarkable.

Based on the history and clinical findings, the boy was diagnosed as having pitted keratolysis. The patient was treated with topical application of a benzoyl peroxide-clindamycin combination product once a day, coupled with proper foot hygiene. Follow-up examination 2 weeks later showed significant improvement of the lesions and resolution of the odor.



## **PITTED KERATOLYSIS: AN OVERVIEW**

Pitted keratolysis is a superficial skin infection limited to the stratum corneum and is characterized clinically by malodor and crateriform pitting primarily affecting the pressure-bearing areas of the soles.<sup>1,2</sup> The condition was first described by Castellani in 1910 as a disease affecting barefooted people during the rainy season in Sri Lanka.<sup>3</sup> The term "pitted keratolysis" was coined by Zaias and colleagues in 1965.<sup>4</sup>

## **EPIDEMIOLOGY**

Although the condition occurs worldwide, it is more commonly seen in tropical countries with higher humidity levels.<sup>5</sup> The prevalence is estimated to be approximately 1.5% among residents in Japan and 2.6% among Turkish male adolescents.<sup>6,7</sup> The prevalence is conceivably greater in high risk groups such as athletes, industrial workers, farmers, miners, and soldiers.<sup>8</sup> There is no racial predilection.<sup>9</sup> Pitted keratolysis can affect patients of any age, but it is more common in adolescents and young adults.<sup>10,11</sup> There is a male predominance, presumably because of males' widespread use of occlusive footwear.<sup>8,10</sup>

## **ETIOPATHOGENESIS**

Pitted keratolysis is caused most frequently by *Kytococcus sedentarius* (formerly known as *Micrococcus sedentarius*), *Corynebacterium* species, *Dermatophilus congolensis*, *Actinomyces keratolytica*, and *Streptomyces*.<sup>1,2,8,12</sup> These microorganisms produce protease enzymes that enable them to digest the keratin and dissolve the stratum corneum, thereby producing the characteristic pits or craters.<sup>1,2,10,12</sup> The malodor is due to sulfur compounds such as thiole

characteristic pits or craters. The malodor is due to sulfur compounds such as thiols, sulfides, and thioesters produced by these microorganisms.<sup>1,9,13</sup> Predisposing factors include hyperhidrosis, prolonged use of occlusive footwear, increase in skin pH, humid climate, poor foot hygiene, obesity, and immunodeficiency.<sup>1,8,9</sup>

## **HISTOPATHOLOGY**

Histologic examination shows that the pits are confined to the stratum corneum.<sup>14</sup> Gram-positive microorganisms with coccoid and filamentous forms can be seen.<sup>15</sup> Electronic microscopy demonstrates microorganisms intercellularly at the upper level of involvement and intracellularly at lower levels.<sup>14</sup>

## **CLINICAL MANIFESTATIONS**

Typically, pitted keratolysis presents as multiple, discrete, white-to-yellow, superficial crateriform pits primarily affecting the weight-bearing areas of the foot, such as the toe pads, the ball of the foot, and the heel.<sup>14,15</sup> These "punched out" pits range from 0.5 to 7 mm in diameter and 1 to 2 mm in depth.<sup>1,2,12,16</sup> Lesions become more prominent when they are water-soaked.<sup>11,17,18</sup> The pits may coalesce into bigger, irregular erosions, sulci, and plaques.<sup>13,19</sup> "Rotten" odor and sliminess of the skin on the feet are characteristic features.<sup>8,9</sup> Hyperhidrosis and maceration are often noted on the feet.<sup>2,17</sup> Most lesions are asymptomatic, but itching, irritation, burning sensation, and pain while walking may occur.<sup>8,12</sup> Rarely, pitted keratolysis can occur in non-weight-bearing areas such as the arch of the foot and the palm.<sup>5,15</sup> On the palms, the lesion tends to present as collarettes rather than pits.<sup>13,18</sup>

## **DIAGNOSIS**

The diagnosis is mainly clinical, based on the distinctive features of the lesions and the malodor. Dermoscopy usually reveals pits with well-marked walls.<sup>12</sup> Laboratory investigations and skin biopsy are usually not necessary. Referral to a dermatologist should be considered if the diagnosis is in doubt.

## **DIFFERENTIAL DIAGNOSIS**

Differential diagnosis includes tinea pedis, eczema, plantar verruca, keratolysis exfoliativa, punctate palmoplantar keratoderma, porokeratosis, focal acral hyperkeratosis, circumscribed acral hypokeratosis, arsenical keratosis, yaws, and basal cell nevus syndrome.<sup>9,12,17</sup>

## **COMPLICATIONS AND PROGNOSIS**

The foot malodor may be socially unacceptable and may impair quality of life. Interdigital intertrigo and paronychia may coexist with pitted keratolysis.<sup>8</sup> A corynebacterial triad of pitted keratolysis, erythrasma, and trichomycosis axillaris has been reported.<sup>11,20</sup>

The prognosis for pitted keratolysis is good. With proper treatment, the condition usually resolves in 2 to 4 weeks.<sup>9,12</sup>

## MANAGEMENT

Preventative measures include the use of cotton or absorbent synthetic socks, frequent sock changes, cleaning and drying of the feet after exercise or bathing, avoidance of prolonged use of occlusive shoes, and use of non-occlusive shoes if possible.<sup>10,16</sup> Mainstays of treatment include topical antibiotics such as clindamycin, erythromycin, mupirocin, and fusidic acid twice a day.<sup>8,12,19,21,22</sup> Topical applications of benzoyl peroxide once or twice a day are also effective; the medication has antimicrobial and keratolytic properties.<sup>2,11</sup> Some authors recommend the use of a combination of clindamycin and benzoyl peroxide.<sup>9</sup> Oral antibiotics such as clindamycin and erythromycin may be prescribed for resistant cases.<sup>11</sup> If there is associated hyperhidrosis, aluminum chloride hexahydrate can be applied at night on the plantar surface to block the hyperactive sweat glands.<sup>2,17</sup> If hyperhidrosis persists, subcutaneous injections of botulinum toxin, oral anticholinergics, or iontophoresis may be considered.<sup>5,12</sup>

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