

## Plantar pitted keratolysis: a study from non-risk groups

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### Abstract

Pitted keratolysis is an acquired, superficial bacterial infection of the skin which is characterized by typical malodor and pits in the hyperkeratotic areas of the soles. It is more common in barefooted people in tropical areas, or those who have to wear occlusive shoes, such as soldiers, sailors and athletes. In this study, we evaluated 41 patients who had been diagnosed with *plantar pitted keratolysis*. The patients were of high socioeconomic status, were office-workers, and most had a university degree. Malodor and plantar hyperhidrosis were the most frequently reported symptoms. The weight-bearing metatarsal parts of the feet were those most affected. Almost half the women in the study gave a history of regular pedicure and foot care in a spa salon. Mean treatment duration was 19 days. All patients were informed about the etiology of the disease, predisposing factors and preventive methods. Recurrences were observed in only 17% of patients during the one year follow-up period. This study emphasizes that even *malodorous feet* among non-risk city dwellers may be a sign of plantar pitted keratolysis. A study of the real incidence of the disease in a large population-based series is needed.

### Introduction

Pitted keratolysis is an acquired, superficial bacterial infection of the skin. The characteristic features of the disease are multiple crateriform pits (usually in the weight-bearing areas of the soles), maceration (mostly because of hyperhidrosis), a typical unpleasant smell, and sliminess of the feet. Pitted keratolysis has a worldwide distribution, but the disease is more common among barefooted people living in tropical regions. No race or sex predilection has been reported.<sup>1,3</sup> In this study, we documented clinical and demographic data of 41 plantar-pitted keratolysis patients who were admitted to a private hospital in Ankara, Turkey.

### Materials and Methods

The study included all patients diagnosed with plantar-pitted keratolysis in a 2-year period among the patients of the dermatology department of a private hospital in Ankara. An unproblematic clinical diagnosis of pitted keratolysis was made in almost all of the 41 patients with the help of the unique malodor of the disease. In 11 of the patients, Gram's staining was performed to show the rod like organisms confirming the diagnosis of pitted keratolysis. However, mycotic investigations and wood light examination were carried out in every patient to exclude tinea pedis and erythrasma. In some suspected patients, bacteriological cultures or histopathological examinations were carried out to exclude other bacteriological infections and some keratodermas. Patients with a diagnosis other than pitted keratolysis were excluded from the study, but 4 of the patients who concomitantly had both tinea pedis and pitted keratolysis were included. Patients were investigated with a special emphasis on the triggering factors and the results were recorded.

### Results

Of the 41 pitted keratolysis patients included in this study, 24 were male (58.6%) and 17 were female (41.4%). Patients were between 18-56 years of age (mean 38.95 years). Most of the patients were office workers of a high socioeconomic status and had a university degree (n=24, 58.6%). Thirteen patients (31.7%) had a high school degree and reported prolonged use of occlusive footwear for work. Three patients were students (7.3%) and one was not educated (2.4%).

Patients mostly complained about malodor (n=41, 100%), wet feet (n=27, 66%), sliminess of the feet (n=11, 26.8%), pain and burning sensation in the feet (n=11, 26.8%) and pruritus (n=1, 2.4%). None of the patients reported a seasonal change in their condition. None of the patients reported involvement of the palms of their hands. Weight-bearing metatarsal regions of the feet were most commonly involved areas (n=39, 95.1%).

Physical examination mostly revealed malodor (100%) and hyperkeratosis (58.6%) of the soles. Maceration due to hyperhidrosis was found in 31.7% of patients, whereas fissures and erythema were seen in 14.6% and 2.4% of cases, respectively.

Four of the patients had concomitant tinea pedis (9.7%). Plantar warts and corns were observed in 7.3% and 2.4% of cases, respectively. No corynebacterial triad (pitted keratolysis, erythrasma and trichomycosis) was seen in

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any of the patients in the present study.

As there is no system for scoring the severity of plantar pitted keratolysis, treatment was planned according to the clinical appearance of lesions, depending on the anatomic extension of lesions, the hyperkeratosis and depth of the pits. Only topical treatment with 4% erythromycin gel was applied in 9 patients (21.9%) who had malodor and slight pits. Patients (n=32, 78.1%) with more severe clinical appearance (malodor, hyperkeratosis deep pitted lesions and maceration) needed both systemic and topical treatment. Roxytromycine 300 mg/day was used as a systemic antibiotic. Patients (n=19, 46.4%) who had malodor, hyperkeratosis and deeper pitted lesions were treated with 10% salicylic acid, including creams in addition to erythromycin gel. In patients with severe maceration, 0.01% KMNO<sub>4</sub> solution was also used for its astringent and drying properties (Table 1). Patients were controlled weekly and topical treatments were continued until symptoms had completely disappeared. All patients reported strict adherence to treatment and kept their checkup appointments. Treatment lasted between one and eight weeks (mean 19 days).

During the treatment period, patients used cotton socks and followed suggestions for changes in their daily habits. They did not wear the same shoes for two consecutive days.

During the 1-year follow up, recurrence was observed in 7 (17%) patients. Time to recurrence was 4-12 months. The common feature of these patients was the highly hyperkeratotic tissue of the sole; one was in severe depression and one was deeply immunosuppressed.

### Discussion

Pitted keratolysis is a skin disorder charac-

Table 1. Treatment modalities according to clinical appearance.

Symptom	N (%)	Topical treatment	Systemic treatment
Malodor-pits	9 (21.9)	Erythromycine gel	-
Malodor-hyperkeratosis-deeper pits	19 (46.4) 10% salicylic acid cream	Erythromycine gel	Roxytromycine 300 mg/day
Malodor-hyperkeratosis-deeper pits-maceration	13 (31.7)	Erythromycine gel 10% salicylic acid cream 0.01% KMNO4 Solution	Roxytromycine 300 mg/day

terized by crateriform pits that primarily affect the pressure-bearing parts of the plantar surfaces of the feet and occasionally the palms of the hands. The manifestations are due to a superficial cutaneous bacterial infection. The causative agents are corynebacterium species, *kytocosus sedentarius* and *dermatophilus congolensis*.<sup>2-5</sup> Pitted keratolysis was first reported by Castellani in a Ceylonese patient in 1910, and was confirmed as a unique separate clinical entity in the 1930s. The current name, plantar pitted keratolysis, was used to define the clinical presentation.<sup>1</sup>

Diagnosis can easily be made by means of visual examination and recognition of the characteristic odor.<sup>2</sup> In our study, patients were aged between 18-56 years (mean 38.95 years), which correlated with the other reports.<sup>6</sup> Pitted keratolysis is observed in males more than females.<sup>6-9</sup> In our study, the male to female ratio was 6:4, showing an almost equal predilection. Pitted keratolysis is reported to be more common among barefooted laborers/farmers, sailors, soldiers and industrial workers wearing occluded wet shoes for prolonged periods.<sup>1</sup> Ramsey reported pitted keratolysis as a *common infection of active feet* as sporting activity makes the feet hot and wet.<sup>10</sup> In our study, there were no barefoot laborers, farmers, sailors or soldiers. Most of our cases were *office workers* and *well-educated* people who take care of their personal hygiene. Prolonged use of footwear could be the common factor in these subjects. Interestingly, more than the half of the female patients (58.8%) had a history of regular pedicure and foot care in a spa salon. Moisture and inappropriate hygiene may be the predisposing factors in such patients.

Pitted keratolysis is usually asymptomatic but patients may complain of hyperhidrosis, sliminess, malodor and occasionally soreness, itching and pain while walking.<sup>11,12</sup> In our study, malodor (100%) was the most commonly reported symptom. In one series, Naik and Singh reported malodor in 70% of patients.<sup>6</sup> Malodor could be the most important indication of disease because of its negative impact in office-working conditions. Pain and a burning sensation were reported by almost a quarter of the patients (26.8%). Sliminess of the skin was also a common complaint (26.8%).

Pruritus was present in only one patient (2.4%).

Interdigital intertrigo and paronychia may coexist with pitted keratolysis but these are reported to have no influence on the onset or course of the disease.<sup>11</sup> Associated dermatophyte infections were also evident in 17.1% of our patients. Associated plantar warts and corn was observed in 7.3 and 2.4% of the cases, respectively. Corynebacterial triad (pitted keratolysis, erythrasma and trichomycosis) was not seen in any of the patients in the present study. The other associated diseases were diabetes mellitus (9.75%), depression (2.4%), and immunosuppression (7.31%) due to chemotherapy for ovarian carcinoma, and interferon treatment for hepatitis B and C. The predisposing factors are known to be a humid climate, poor hygiene, hyperhidrosis, obesity, diabetes, advanced age and immunocompromised host.<sup>2</sup> In contrast with the literature, the city where the study took place does not have a hot and humid climate and patients showed a good standard of personal hygiene. However, the associated disorders, such as diabetes or immunosuppression, were correlated with the other reports.

Pitted keratolysis has been reported to have an excellent prognosis; effective treatment clears both the lesions and the odor in 3-4 weeks time. Topical antibiotics are reported to be effective, easy to use and acceptable by the patients. Recommendations include twice-daily application of erythromycin solution or gel, 1% clindamycin hydrochloride solution, fusidic acid cream and mupirocin cream. Use of systemic antibiotic may shorten the treatment period.<sup>1,3</sup> Koc *et al.* reported topically applied clindamycin and erythromycin to be both safe and effective.<sup>13</sup> In a case of Ertam *et al.*, three weeks of oral erythromycin treatment was reported to be effective.<sup>14</sup> In our study, only topical treatments were applied in 9 cases whereas 32 patients needed both topical and systemic treatments. Treatment duration was 1-8 weeks (mean 19 days) which was almost twice that reported by Koc *et al.*<sup>13</sup>

During the follow-up period, recurrence was observed in 7 (17%) of the patients after one year. Most of the patients (83%) had no recurrence after one year. This might be because of the increased awareness in avoiding the pre-

disposing factors, as well as applying the treatments correctly. The common feature of the 7 recurrent cases was the highly hyperkeratotic tissue of the soles. Patients should be warned about the importance of plantar hyperkeratosis in disease development, as under suitable conditions, like prolonged occlusion, hyperhidrosis, and increased skin surface pH, bacteria that cause the disease may proliferate and produce proteinases which in turn destroy the hyperkeratotic stratum corneum, creating pits and causing malodor. Maintenance treatment may be suggested to these high-risk patients. Preventive measures, such as avoiding occlusive footwear, not sharing shoes or towels with others, using absorbent cotton socks, and drying feet properly after washing should be recommended. Most of our patients maintained a good standard of personal hygiene and were careful about using shoes, socks or towels but they all prolonged use of occlusive footwear.

## Conclusions

Plantar pitted keratolysis is a disease mostly affecting the soles of the feet. It is a bacterial infection and usually occurs because of prolonged use of occlusive footwear. Although a lot of people have smelly feet there are not many reports about the real incidence of plantar pitted keratolysis. The only reports concern high-risk groups. Our study showed that the incidence of pitted keratolysis might be more common than suspected. Instead of seeking medical help, people with foot odor might be using over the counter products which mostly contain anti-fungals and anti-perspirants or sometimes ointments which may aggravate maceration.

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