

Foot Bacterial Intertrigo Mimicking Interdigital Tinea Pedis

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Background: Itchy maceration of the toe webs is common in warm and humid weather. Some cases do not respond to treatment for tinea or eczema.

Methods: Patients with foot intertrigo with a poor response to antifungal or anti-inflammatory treatment from 2004 to 2009 were included in this study. Their general characteristics were recorded. Bacterial and fungal cultures as well as potassium hydroxide preparations were performed.

Results: We recorded 32 episodes of foot bacterial intertrigo in 17 patients. The disease was more common in men (82%) and the mean age of the patients was 59 years. The main clinical finding was maceration of the toe webs. The majority of bacterial cultures grew mixed pathogens (93%). *Pseudomonas aeruginosa*, *Enterococcus faecalis* and *Staphylococcus aureus* were the most common pathogens. Autoeczematization was present in 50% of the 32 disease episodes.

Conclusion: Foot bacterial intertrigo is not a rare condition and can easily be confused with interdigital tinea or eczematous dermatitis. Proper identification of bacterial organisms is critical for early effective antibiotic therapy. Patients should be instructed about proper foot hygiene, which is important to prevent recurrent infections.

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Key words: foot intertrigo, gram-negative interdigital infection, *Pseudomonas aeruginosa*, toe webs infection

Intertrigo is a condition created by friction of opposing skin surfaces in conjunction with moisture trapped in deep skin folds. Foot intertrigo is a relatively common and troubling disorder in hot weather or occluded conditions. Although it may present as a chronic erythematous desquamative eruption, it is commonly characterized by malodorous maceration and mainly affects the interdigital regions of the feet. These interdigital lesions are often diagnosed as tinea pedis or eczematous dermatitis. However, in some patients, the macerated eruption is unresponsive to treatment with antifungal

agents or anti-inflammatory agents such as topical steroids. In addition to eczematous dermatitis and interdigital tinea pedis, the etiologies of foot intertrigo are varied and include candidosis intertrigo and bacterial intertrigo.⁽¹⁻³⁾ This report presents our experience with seventeen cases of foot intertrigo, all of which had been treated as tinea infection or eczematous dermatitis with no improvement. The aim of this study was to evaluate the main clinical features of bacterial toe web infections, causative organisms, and effective treatment.

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METHODS

Between 2004 and 2009 in one outpatient clinic, we collected 17 cases of foot intertrigo that had a poor response to therapy for fungus or eczematous dermatitis. The duration of therapy failure prior to visiting our clinic ranged from 11 days to 6 months. We performed bacterial cultures and sensitivity on all patients. All patients were treated with systemic and/or topical antibiotics on the basis of an antibiogram. Potassium hydroxide preparations and fungal cultures were performed thereafter if there was a suspected fungal infection component.

RESULTS

Seventeen patients affected by foot intertrigo were studied. The mean age of the patients was 59 years (range, 36-81 years). Fourteen (82%) of them were men. Fourteen had initially been treated with topical or systemic antifungal medication and 5 with anti-inflammatory agents, such as topical or systemic steroids.

The main clinical features were erythema, vesiculopustules, erosion, maceration, and malodorous discharge. The lesions affected the interdigital spaces of the feet, and some extended toward the sole or the dorsal area of the feet (Fig. 1, 2). These patients frequently reported a burning, painful, pruritic sensation.

Nine patients (53%) had recurrent toe web

infections during this study; six patients had 2 disease episodes, one patient had 3, one patient had 4, and another patient had 5. Therefore, a total of 32 disease episodes were recorded.

Twenty-nine cultures were isolated from the 32 disease episodes. Twenty-seven bacterial cultures (93%) grew more than one organism. Eighty-six percent of our cultures grew gram-negative bacteria. *Pseudomonas aeruginosa* (16/29, 55%), *Enterococcus faecalis* (12/29, 41%), and *Staphylococcus aureus* (12/29, 41%) were the most frequently isolated pathogens. Coagulase-negative staphylococci were isolated from 6 of the 29 samples (21%). The other pathogens isolated are shown in the Table 1. The two single-pathogen cultures grew *Enterococcus faecalis* and *Acinetobacter baumannii*.

After one to two weeks of treatment with systemic antibiotics and local application of antiseptic agents, all patients experienced significant reduction in pruritus and pain. The infection in all patients improved markedly with rapid resolution of maceration. The topical therapy included aluminum chloride solution, potassium permanganate solution, gentamycin cream, and povidone iodine ointment or solution. Systemic antibiotics were used in twenty-eight of 32 episodes. The antibiotics used included penicillin, oxacillin, ampicillin, sulfamethoxazole-trimethoprim, cephalosporine, ciprofloxacin, and gentamycin. *Pseudomonas* isolated from these patients was sensitive to ciprofloxacin, gentamycin, ceftazidime, and cefepime but was resistant to oxacillin.



Fig. 1 Maceration of the second, third and fourth interdigital spaces.



Fig. 2 Maceration of the toe web.

Table 1. Main Pathogens Isolated in Foot Intertrigo

Isolated pathogens	Number of cultures with positive pathogens (total number of cultures: 29)
<i>Pseudomonas aeruginosa</i>	16
<i>Enterococcus faecalis</i>	12
<i>Staphylococcus aureus</i>	12
Coagulase-negative staphylococci	6
<i>Escherichia coli</i>	4
Group A β -hemolytic streptococci	3
Group B β -hemolytic streptococci	3
<i>Acinetobacter baumannii</i>	3
<i>Proteus mirabilis</i>	3
<i>Corynebacterium</i> sp.	2
<i>Staphylococcus saprophyticus</i>	1
<i>Acinetobacter lowffii</i>	1
Viridans streptococcus	1
<i>Stenotrophomonas maltophilia</i>	1
<i>Klebsiella pneumonia</i>	1
<i>Peptostrepto. magnus</i>	1
<i>Morganella morganii</i>	1

Enterococcus faecalis and *Staphylococcus aureus* were usually found to be associated with *Pseudomonas aeruginosa* or other gram-negative bacteria. Systemic antibiotic treatment based on the antibiogram also appeared to be successful.

Ten patients had both tinea pedis and onychomycosis of the toes. Two patients had tinea pedis without toenail infection. Potassium hydroxide preparations (KOH) and fungal cultures were performed in the eight patients who did not have complete improvement after systemic antibiotic therapy. Five patients had both KOH and fungus culture. Two patients had fungus culture alone and the other one had KOH alone. One of the six KOH studies revealed positive results, and six of the seven cultures grew fungus. The types of fungi isolated were *Candida albicans* in two patients, *Candida parapsilosis* in two, *Trichophyton terrestre* in one, and *Trichosporon* sp. in one. These ten patients accepted antifungal treatment.

In addition to foot intertrigo, some patients had itchy red papules, papulovesicles and plaques on their extremities and/or the trunk, so-called autoeczematization dermatitis. (Fig. 3) Itchy lesions developed in 16 of the 32 recorded disease episodes (50%).



Fig. 3 Autoeczematization: pruritic red papules and vesicles on the dorsal foot.

DISCUSSION

Gram-negative bacterial toe web infections were first described as a distinct disorder by Amonette and Rosenburg in 1973.⁽⁴⁾ They reported twelve patients with maceration of the toe webs. The maceration was induced by gram-negative bacteria and was more severe than that induced by *Candida albicans*. In the literature, gram-negative bacterial toe web infections are relatively common, troublesome disorders.⁽⁴⁻¹⁰⁾ The infection involves the toe web space and extends to the adjacent plantar surface. The clinical features include vesiculopustules, macerations, malodorous discharge, and marked edema and erythema of the surrounding tissues. Patients usually feel a burning sensation or pruritus. In some severe cases, patients are unable to walk. Men appear to be more frequently affected than women, as in our study.^(5,7) Promoting factors include hot weather, closed-toe or tight-fitting shoes, hyperhidrotic toe webs, athletic or recreational activities, and use of germicidal soaps, as well as previous prolonged antibiotic or antifungal therapy.^(5,6,9)

In the 1973 study of gram-negative toe web infection by Amonette and Rosenburg, *Pseudomonas aeruginosa* and *Proteus mirabilis* were the most commonly isolated organisms.⁽⁴⁾ Those two organisms, along with enterococcus species, were the most commonly isolated in a study by Eaglstein et al.⁽¹¹⁾ In a study of foot bacterial intertrigo by Aste et al, *pseudomonas aeruginosa*, often together with other

gram-negative bacteria, was the most common etiologic agent.⁽⁵⁾ In the study by Karaca et al, the most common pathogen was coagulase-negative staphylococci, followed by *Pseudomonas aeruginosa*.⁽⁷⁾ In our study, we found a frequency of 55% for *Pseudomonas aeruginosa*, 41% for *Enterococcus faecalis*, 41% for *Staphylococcus aureus*, and 29% for coagulase-negative staphylococci. The mixed infection rate is around 22.6% to 75% in the literature and was 93% in our series.^(4,7,11,12) The most common concomitant pathogens were dermatophytes and coagulase-negative staphylococci in the Karaca et al study.⁽⁷⁾ There was a higher mixed infection rate in our study, and this might be related to the disease duration and severity. *Pseudomonas aeruginosa* combined with other gram-negative bacteria or gram-positive bacteria was the most common concomitant pathogen.

The interdigital space is typically colonized by polymicrobial flora. Dermatophytes may damage the stratum corneum and produce substances with antibiotic properties. Gram-negative bacteria may resist antibiotic-like substances and proliferate. This process may progress to gram-negative foot intertrigo.

Several pathogens and factors might play a role in toe web infections. Maceration is seen in gram-negative, gram-positive, and *Candida albicans* infections, severe tinea pedis, and eczematous dermatitis. Although this symptom is frequently seen in bacterial foot infections, especially in gram-negative infections, the clinical appearance is not helpful in diagnosing the nature of the causative organism. However, physicians should be reminded of bacterial foot intertrigo, especially if the foot maceration is severe or combined with cellulitis.

In 1973, Amonette and Rosenberg reported difficulty in the treatment of foot intertrigo. The systemic antibiotics available had significant side effects and topical therapeutic modalities failed to provide satisfactory improvement.⁽⁴⁾ In two series, a third generation cephalosporin and ciprofloxacin were much more effective and provided excellent results in gram-negative bacterial toe web infection.^(5,11)

In our study, topical therapy alone was found inadequate for treatment in some cases. Systemic antibiotics should be considered in these patients if topical treatment fails or there is extensive disease.

Oral ciprofloxacin 250-500 mg twice daily for 2 weeks was effective against *Pseudomonas aeruginosa* in our study. Westmoreland et al. presented a patient with presumed tinea pedis, whose culture grew *Pseudomonas*. The infection resolved with oral ciprofloxacin.⁽¹³⁾

As polymicrobial infections are common, it is advisable to combine topical antibiotics that act on gram-positive and gram-negative microorganisms. Topical antimicrobial therapy should be broad-spectrum, because dermatophytes select bacteria by producing penicillin and streptomycin-like substances.⁽¹⁴⁾ Antiseptic and astringent agents, such as aluminum chloride and Castellani's paint, are helpful in severely macerated, bacterially infected interspaces.⁽¹⁵⁾ Local application of aluminum chloride and gentamycin cream or povidone-iodine twice daily was an effective option in our study.

In addition to the pharmacological approach, debridement may be helpful.⁽¹⁶⁾ Superficial debridement is performed with application of moistened 1% povidone-iodine dressings (10% povidone-iodine: saline = 1:9). Debridement may remove the necrotic tissue and allow topical agents to reach the infected area faster. Other important measures include good hygiene, keeping the toe webs dry, avoidance of occlusive footwear, and avoidance of water-related activities.^(10,17)

In our study, there was a higher recurrence rate of foot bacterial intertrigo than that in the literature (53% vs. 7%).⁽⁵⁾ There was no significant difference in seasons, occupation, or incidence of diabetes mellitus in our study. This might be explained by underlying dermatophyte infection of the soles or toe nails, or eczema with disruption of the cutaneous barrier. Patients who have fungal infection of the soles and toenails have reservoirs of spores that can spread to the interdigital area. These patients require prolonged therapy to eradicate fungi from toenails and soles. The antifungal agents econazole nitrate cream and ciclopirox olamine both exhibit broad-spectrum activity against many gram-negative organisms.^(18,19) Econazole nitrate has been demonstrated effective for the treatment of severe interdigital bacterial infections.

Patients with uncontrolled or flaring foot bacterial intertrigo can have autoeczematization on the trunk and extremities.⁽⁴⁾ However, there is little data related to foot intertrigo with autoeczematization in

the literature. We observed a high frequency (50%) of autoeczematization in disease episodes in this study. The autoeczematization progressed when toe web infections persisted and resolved rapidly when the infection was under control. In this study, systemic steroids were given to patients with severe autoeczematization (75%). Autoeczematization is likely due to a hyperirritability of the skin induced by either immunologic or nonimmunologic stimuli. Infection and wounding have been reported to release a variety of epidermal cytokines. These cytokines can heighten the sensitivity of the skin to stimuli and cause autoeczematization.⁽²⁰⁾

The course of disease of bacterial intertrigo is very favorable if there is an early, accurate diagnosis and appropriate treatment. It is also important to instruct patients in appropriate hygiene measures to avoid heat and moisture in their feet.

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擬似趾縫間足癬之足部細菌性對磨疹之研究

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- 背景：** 在溫暖、潮溼的氣候下，趾縫間有癢感、糜爛是很常見的。然而部分病例對於足癬或溼疹的治療沒有反應。本研究目的為評估趾縫間細菌感染的主要臨床表現、致病菌和有效治療方法。
- 方法：** 從 2004 至 2009 中，足部對磨疹且對抗黴菌或是抗發炎治療沒有效果的病人皆納入此研究，所作的檢查包括細菌培養、黴菌培養以及 KOH 檢查。
- 結果：** 17 個病人，共發生 32 次的足部細菌性對磨疹；以男性為主 (82%)，平均年齡為 59 歲，主要的臨床表現為趾縫間皮膚糜爛；細菌培養的結果，大部份是混合性的致病菌所引起的。其中最常見的是：*Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Staphylococcus aureus* 這三種細菌。而 32 次的足部細菌性對磨疹中，有 50% 會發生自體過敏的反應。
- 結論：** 足部細菌性對磨疹不是一種少見的疾病，而且很容易和趾縫間足癬或溼疹混淆，給予有效的抗生素治療最關鍵的步驟是確認致病的細菌；病人必須被指示有好的足部衛生，如此才可以預防反覆發作。
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關鍵詞： 足部對磨疹，格蘭氏陰性細菌趾縫間感染，綠膿桿菌，趾縫間感染

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