

CORE CURRICULUM

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Footwear Dermatitis: Diagnosis and Management—Part III

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Footwear dermatitis is an entity with clear clinical features, and the confirmation of its diagnosis is vital. The authors review several tools used for its diagnosis to facilitate appropriate and timely management. (*SKINmed*. 2016;14:281–286)

Footwear dermatitis is a time-old entity that was relegated to the background for many years. Its revival, therefore, is considered relevant to comprehend the various facets of the disorder, which have been discussed in parts I and II of this three-part series.^{1,2} Accordingly, we define the tools used to establish its etiology and ultimately alleviate its symptoms and signs through appropriate management.

DIAGNOSIS

Diagnosis of footwear dermatitis involves a detailed history, examination, and patch testing to identify the offending allergens.

History taking is an important step towards diagnosis. It is used to enquire in detail about the types of footwear used by the patient and duration of their use. Exacerbation of dermatitis coinciding with the wearing of shoes and remission induced by the removing of the shoes favor the clinical diagnosis of contact allergy.^{3,4} A history of recurrence of dermatitis is often noted in the summer and rainy seasons.^{5,6} It is often helpful to inquire about use of any topical medications on the feet as they may cause sensitization.^{7,8}

The pattern of dermatitis that corresponds with footwear, characteristic morphology, and relative sparing of insoles and interdigital space suggest footwear allergy.

Patch testing is a well-established procedure for the diagnosis of contact allergic dermatitis.⁹ If used properly, it can be of great value both in the diagnosis and management of contact dermatitis.¹⁰ With patch testing, the contact sensitivity to suspected allergens is elicited by exposure to the allergens under controlled conditions.¹⁰ During the past few decades, much effort has been put into standardization of allergens, vehicles, concentrations, patch test materials, tapes, and scoring of test reactions, with the method considered reliable and accurate.¹¹ A series of studies have demonstrated good reproducibility of patch testing.^{12–14} Special types of units are available for patch testing such as the Al-test, Finn Chambers, and thin-layer rapid-use epicutaneous (TRUE) test.¹⁵

AL-TEST PATCH

The Al-test patch consists of a cellulose disc, fastened onto a polythene-coated aluminum backing, available in rolls.¹⁰ The allergens used can either be aqueous- or petroleum-based. The patches are fixed with adhesive tape to the skin. The disadvantage of the Al-test unit is that a relatively small number of patches can be applied at one time because of the large size of these patches.¹⁰

FINN CHAMBERS

The Finn Chambers patch is made of stiff aluminum and has a diameter of 80 mm and a depth of 0.5 mm mounted on a scan-

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por tape.¹⁰ Petroleum-based allergens are applied onto the disc (~15 µl) and liquid-based allergens are applied with the help of a filter paper on the disc.¹⁵ The advantage of these chambers is the tight apposition to the skin, which localizes the reaction to the test site and allows the use of porous hypoallergenic tape.

The above test methods are perceived to be time-consuming, and their accuracy is adequate only in the hands of dermatologists trained in patch testing.¹⁶

TRUE TEST

The True test is a ready-to-use patch test system and represents a new generation of patch test.^{16,17} In this system, allergens are incorporated in hydrophilic gels, coated on water-impermeable sheet of polyester, and dried to a thin film. The gel occluded with plastic ensures optimal contact with the skin, and subsequent permeation enables high allergen bio-availability. The advantage of the TRUE test system is offers consistent panel-to-panel quality and stability, which ensures reproducibility of the test. Consistent location of each test in the panel also ensures correct identification of the allergens. The disadvantage of this test is that it is available only as a standard series of 24 allergens.¹⁶ The back is the most preferred site of application as both allergic and irritant reactions are most easily provoked on the upper back, possibly because of additional effects of pressure on the back¹⁸ and stronger percutaneous absorption.¹⁹

The patches should be removed after 48 hours and readings should be observed 1 hour after removal.²⁰ A single second-day reading may not only lead to labeling of some marginal irritants as allergens but poorly absorbed allergens may also be missed.²¹ Therefore, all patients should be evaluated for delayed reactions on the seventh day.²² If only one reading is possible, then reading on the fourth day is optimal.²³ Interpretation of results requires experience and expertise and it is often not possible to distinguish between allergic and irritant reactions on clinical grounds alone²⁰; however, no infiltration, lack of itching, and a sharp delineation corresponding to the margin of the test patch points to an irritant reaction. Some irritants provoke a “soap effect,” a spot of red, brownish, or normal-colored skin with a glistening finely wrinkled surface.^{9,20} Patch test with metals may provoke a papular or pustular reaction, especially in patients with atopic dermatitis.²⁴ Difficulties in evaluation are particularly common with substances brought in by the patient for testing.²⁵

Reactions of an allergic nature are erythematous and commonly infiltrated with minute papules or vesicles, which, in severe re-

actions, may coalesce into bullae. The infiltration causes a thickening in the dermis that is palpable and can be distinguished from surface changes in the epidermis.²⁰ The reaction may extend beyond the margin of the patch test and there is usually some itching. Once they have developed, positive allergic reactions persist for several days.⁹ The strength of the reaction depends on various factors such as barrier function of the epidermis, the presence or absence of sweating, the atmospheric humidity, test materials employed, proper technique, and reactivity of the individual.¹⁵

Grading may be performed according to the following criteria of the International Contact Dermatitis Research Group:

- Doubtful reactions (+/-)
- Weak positive reaction (+)
- Strong positive reaction (++)
- Extreme positive reaction (+++)
- Irritant reaction

Fisher and Rystedt²⁴ found that doubtful reactions were relevant in 1% to 5%, 1+ were relevant in 20%, 2+ were relevant in 80% to 90%, and 3+ were relevant in 95% to 100% of cases. Rietschel²⁵ proposed that nonpapulovesicular patch test reactions consisting of slightly palpable erythema and edema be called Janus or double-faced reactions, and stated that these reactions may or may not be relevant. Mitchell^{26,27} used the term *angry back* to describe a regional phenomenon caused by the presence of a strongly positive reaction, a state of hyperreactivity in which other patch test sites become reactive, especially marginal irritants. Calnan²⁸ used the term *status eczematous* to describe the same phenomenon. Mitchell and Maibach²⁹ broadened the term *angry back* to *excited skin syndrome*, suggesting entire skin hyperactivity, not just the back. This phenomenon was extensively studied by researchers who noted an increase in the number of positive reactions of challenges in close proximity to strong reactions, wherein 44.3% of these reactions were lost on retesting.³⁰ Investigators³¹ noted that skin which is repeatedly inflamed or is extensively involved in dermatitis often becomes hyperactive; however, other investigators³² did not find any such reactions while patch testing nickel-sensitive patients. These reactions are often nonreproducible, suggesting a false-positive result. Causes of false-positive reactions may be caused by excessive concentration of the test substance, impure substance (contaminants), irritant vehicles, excess allergen applied, uneven dispersion, current or recent dermatitis at patch test site, current dermatitis at

distant sites, pressure effect of hard materials, adhesive tape reactions, or “angry back” reaction.^{20,25} A negative result, however, does not exclude the possibility of contact dermatitis.²⁵ Standard screening series include only statistically common allergens and it is possible that the patient may be sensitive to certain rare or new sensitizers. Reasons for false-negative reactions may be inadequate concentration of the test substance, inappropriate vehicle or degradation of the patch test substance, poor adhesion of patches, brief duration of contact, failure to perform delayed readings, and influence of topical or systemic corticosteroids.^{20,33}

PATCH TEST ALLERGENS FOR SHOE DERMATITIS

Patch testing with standard screening series may detect up to 80% of cases of footwear dermatitis caused by different allergens.³⁴ Adding shoe allergens in the series will increase the yield.^{5,6,35} The following is a list of relevant antigens associated with footwear dermatitis.

Leather chemicals

Potassium dichromate
Formaldehyde
Glutaraldehyde

Rubber chemicals

2-Mercaptobenzothiazole
Mercapto mix
Thiuram mix
Black rubber mix
Dibutylthiourea
Diphenylguanidine
N-Cyclohexyl-2-benzothiazyl sulfenamide

Plastics

Hydroquinone monobenzylether
Diocetyl phthalate

Dyes

4-Phenyldiamine base
4-Aminobenzene

Glues

Para-tertiary butylphenol
Colophony
Dodecyl mercaptan

Metals

Nickel sulphate
Cobalt chloride

MANAGEMENT AND PREVENTION OF FOOTWEAR DERMATITIS

THERAPEUTIC MEASURES

Treatment of acute episodes of footwear dermatitis does not differ from treatment of contact dermatitis on other parts of the body.^{36,60} Wet compresses with Burow's solution, application of steroid-containing lotions and creams, oral antihistamines, and occasional short courses of systemic steroids are usually effective.³⁶ Systemic antibiotics may need to be administered for secondary bacterial infection. Chronic lichenified dermatitis is best treated by application of steroid-containing creams under thin plastic film occlusion at night.³⁷

Patient empowerment through education to assist in avoidance of the implicated allergens and the type of footwear causing the dermatitis is the primary goal and the cornerstone of management.^{6,7,38,39} Avoidance of these allergens, however, is often difficult to implement, which ultimately results in presentation of shoe dermatitis.⁷ Once a diagnosis of footwear dermatitis has been confirmed, management goals include alleviation of pruritus and treating the inflammation. Treatment should begin by applying moist compresses to enhance the drying of well-localized, acute weeping lesions.³⁷ Cool moist soaks applied for 5 to 10 minutes, followed by air drying may significantly reduce drainage from the affected foot.³⁷

Moisturizing emollients have been prescribed to treat shoe dermatitis, providing both occlusion and humectance.³⁷ The occlusive effects of emollients provides a sealant layer on the surface of the skin to reduce water loss. On the other hand, the humectant effect is one of increasing the “water-holding capacity” of the stratum corneum and therefore increasing skin hydration. The prescribing and application of topical steroids is a medical standard of care in the treatment of shoe dermatitis.⁴⁰ Corticosteroids are known to interfere with inflammatory response. Once the selection of a topical corticosteroid agent is considered, the clinician must decide on the most appropriate delivery system. Thus, the choice of vehicle in a topical formulation is important.⁴¹ An advantage of using creams or oil-in-water emulsions is that they are absorbable and may facilitate drying of oozing.⁴⁰ Water-miscible creams may be more appropriate for moist or weeping lesions. An ointment is a water-in-oil emulsion and is considered to be the most effective hydrating agent.³⁷ Ointments are the most effective vehicle for treating thick, fissured, lichenified, and dry, scaly eruptions.³⁶ Gels are most effective when applied to hairy areas.⁴⁰ Although topical corticosteroids are well tolerated for short-term use, long-term widespread use can result in adverse effects grouped into four

categories: cutaneous changes, cutaneous infections and infestations, eye effects, and systemic effects.⁴⁰ Therefore, alternative therapeutic interventions for treating shoe dermatitis may be considered. Topical immune modulators have been investigated as a treatment option for inflammatory skin disorders.⁴¹ Both tacrolimus ointment and pimecrolimus cream act by inhibiting the protein calcineurin, which subsequently prevents the dephosphorylation of the nuclear factor of activated transcription factor.⁴¹ This causes signal transduction pathways to be blocked and inflammatory cytokine production inhibition. These agents should be considered when conventional therapies have failed.⁴¹ Systemic therapy may be reserved for severe and chronic allergic contact shoe dermatitis. Systemic treatment may include the use of the following oral agents: H1 antihistamines, systemic corticosteroids, azathioprine, methotrexate, and mycophenolate mofetil.³⁷

Oral antihistamines have an effect on severe pruritus by competing with free antihistamines for binding H1 receptor sites. The most common antihistamines used to treat allergic contact dermatitis include cetirizine, hydroxyzine, diphenhydramine, chlorpheniramine, and loratadine. Systemic corticosteroid therapy has demonstrated high efficacy in the treatment of acute allergic dermatitis by dramatically improving skin inflammation; however, it also causes the same adverse effects as topical steroids. In an attempt to avoid adverse effects from repeated dosing of corticosteroids in patients with chronic dermatitis, steroid-sparing systemic immunosuppressant therapy has been investigated.^{37,40}

PREVENTIVE MEASURES

The foremost part of treatment of shoe dermatitis is the avoidance of the sensitizer (allergen) once it is known. The dermatologist can offer expertise in footwear by providing education to their patients regarding the selection of footwear without materials that may cause shoe dermatitis. Substitute products made of different materials that do not cause allergic reaction may lessen the likelihood of future episodes of shoe dermatitis. Investigators⁴² treated a 54-year-old man, a sugar refinery worker experiencing severe and incapacitating dermatitis of both feet caused by protective rubber boots, by recommending a protective polyvinyl chloride work boot along with a heavy-duty sock to absorb sweat and reduce friction inside the boot. Within 3 weeks it was noted that the dermatitis had completely resolved and there was no recurrence during the follow-up period of 6 months.

Therapeutic goals can be achieved by offering an educational initiative to patients to avoid redyed shoes.^{5,7,39,43} Patients with

shoe dermatitis can use special types of shoes prepared from nonsensitizing substances.^{44–46} For adults and older adolescents, hypoallergic shoes made of vegetable-tanned leather or that contain no rubber or formaldehyde can be offered.⁴⁴ The use of hypoallergic shoes is limited by the fact that they must be made to order and take 6 to 8 weeks for delivery. Moreover, the price of these shoes is higher than that for ordinary footwear. Measures to control sweating may also be helpful for the patients who have shoe dermatitis.⁴⁷ Medicated powders such as tannic acid powder administered either once or twice a day can help control foot perspiration and may prevent shoe dermatitis.⁴⁸

Changing socks two or three times a day and wearing different shoes for work and home may prove beneficial in preventing footwear dermatitis.⁴⁷ Investigators⁴⁹ described successful treatment of allergic contact dermatitis in a 50-year-old construction worker with “barrier socks.” They reported an improvement in their patient’s quality of life as well as a comparative reduction in costs. These findings were further validated by a more recent study⁵⁰ in which the therapeutic efficacy of allergen-proof fabric socks (a three-layer fabric designed to provide a physical barrier to allergens and irritants as well as high perspirability) in patients who were sensitized to shoe allergens was demonstrated. Good clinical results showing improvement in symptoms and recovery from foot eczema after 2 months of treatment was remarkable. The best results were observed in patients (6 of 9 patients) who followed the protocol strictly, wearing the socks every time they wore shoes. Finally, a light application of a steroid-containing aerosol spray each morning is also beneficial.⁵⁰

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