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Review

Shoe dermatitis: A review of current concepts

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Abstract

A medical condition referred to as "shoe dermatitis" is a form of contact dermatitis caused by the contact of the foot with parts of the shoe due to these materials. Shoe dermatitis is a diagnostic and therapeutic challenge and is a common type of contact dermatitis. It is imperative the foot and ankle physician become familiar with recognizing signs and symptoms of shoe dermatitis so that their patients can be accurately diagnosis and appropriately treated to avoid secondary infections and disability. This review will first present causative factors for the etiology of shoe contact dermatitis supported by clinical-based evidence as found in the medical literature. Secondly, a description of the signs and symptoms of shoe contact dermatitis will be presented in a narrative fashion. Finally, both treatment options and preventative measures to avoid shoe dermatitis will be offered to the foot and ankle physician.

Keywords: Shoe; Dermatitis; Allergy; Contact; Patch test

Contents

1. Introduction

The foot and ankle physician has come to recognize that there is a variety of footwear styles: casual, formal, work, and athletic shoes made all over the world from leather, rubber, and other synthetic materials. For this reason, it is impossible to identify precisely all of their constituents. A vast variety of potentially sensitizing chemicals are used during shoe manufacturing and finishing. A medical condition referred to as "shoe dermatitis" is a form of contact dermatitis caused by the contact of the foot with parts of the shoe due to these chemicals [1–3]. Despite, a warm and humid environment inside shoes, shoe dermatitis is relatively uncommon. Shoe dermatitis is a diagnostic and therapeutic challenge and is a common type of contact dermatitis affecting children and adults regardless of race. For this reason, it is imperative the foot and ankle physician become familiar with recognizing signs and symptoms of shoe dermatitis so that their patients can be accurately diagnosed and appropriately treated to avoid secondary infections and disability. This review will first present causative factors for the etiology of shoe contact dermatitis supported by clinical based evidence as found in the medical literature [2,3]. Secondly, a description of the signs and symptoms of shoe contact dermatitis will be pre-

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sented in a narrative fashion [2,3]. Finally, both treatment options and preventative measures to avoid shoe dermatitis will be offered to the foot and ankle physician.

2. Causes of shoe "contact" dermatitis

Allergic contact dermatitis is caused by the body's reaction to something that directly contacts the skin. Many different substances can cause allergic contact dermatitis, which are called "allergens". Cronin reports that historically in the 1930s and 1940s leather and dyes caused most of the presenting cases of shoe contact dermatitis [4]. By the 1950s and 1960s, rubber allergens became the most common identifiable cause of foot dermatitis [3,4]. Today, shoe dermatitis may occur if a person is sensitive to the rubber or elastic compounds in shoes, form inserts, or elastic glues used to bind shoe components. The other identifiable causes of shoe dermatitis are cements, dichromates used in tanning, dyes, anti-mildew agents, formaldehyde, and nickel eyelets or nickel arch supports.

The allergen is usually a rubber accelerator or antioxidant used in the manufacture of rubber rather than rubber or latex. Rubber continues to be blamed as a common cause of shoe dermatitis, especially when the antioxidant monobenzyl hydroquinone is present [3,5]. This antioxidant may also cause hypopigmentation of the skin [5]. The paraphenylenediamine group of rubber additives are the important causes of industrial dermatitis. Shoe dermatitis is usually caused by the rubber adhesive used to glue the parts together. Moreover, adhesives, both rubber and non-rubber, can cause problems so much so that even leather shoes may contain products that cause shoe dermatitis. Chromates are compounds that contain chromium and are commonly responsible for allergic contact dermatitis from contact with cement, leather, some matches, paints and anti-rust compounds. Chromates are used to tan leather for shoes and clothing. Chromium is gradually liberated from leather collagen by the action of hydroxyl acids in sweat especially when shoes are worn without stockings [5].

Athletic running shoes as well as swim fins contain rubber accelerators, antioxidants, and other rubber additives that are common causes of foot dermatitis [6]. These compounds included: thioureas, thiurams, carbamates, *N*-isopropyl-*N*-phenyl-*p*-phenylenediamine and mercaptobenzothiazole [6]. As with other footwear the dye found in the insoles of certain running shoes has caused contact dermatitis in runners. Alternative options include shoes made mostly of polyurethane [6].

A review of the medical literature reveals a number of case reports, retrospective observations, random control trials, and practice guidelines that identify the potential antigens responsible for shoe dermatitis [6–23]. Shoe contact dermatitis resulting from shoe linings was first noted in 1877 and has appeared as a recent case report caused by *para-tert*-butylphenol formaldehyde [12,15,19]. The most common allergens responsible for causing shoe dermatitis as found in the literature over time are presented graphically as Table 1.

Saha et al. conducted a study to determine the prevalence and clinical patterns of footwear dermatitis [10]. Fifty patients with suspected shoe dermatitis and 30 control subjects were patch tested with 22 allergens [10]. While 70% of patients showed sensitivity to these footwear allergens both potassium dichromate and colophony were identified as the most common sensitizers [10]. The validity of this observational design study is strengthened by the investigators use of matched controls to avoid observer bias. These investigators stress that there should be footwear screening to detect responsible allergens and call upon both manufacturers and research institutions to assist with such screenings in order to provide non-allergenic footwear to the public [10].

Observational results reported by Freeman in 55 patients with chronic foot dermatitis revealed "rubber" as the most common allergen, followed by chromate, *p*-teritary-butylphenol-formaldehyde resin and colophony responsible for causing chronic footwear dermatitis [3,9]. In this study, the incidence of shoe dermatitis was almost equal in both genders. A hallmark observation identified by Freeman was that during a differential diagnosis that all parts of the foot were affected except the inter-digital areas and hyperhidrosis was found in all subjects [9]. At the center of this report is the foremost intention of the investigator to analysis interventional data from subjects retrospectively. Freeman's patient

Table 1
The most common allergens in shoe dermatitis found in literature

Study	Year	Patient #	Method	Common allergens
Saha et al.	1993	50	Patch test	Potassium dichromate, colophony
Freeman	1997	55	Interview	Rubber, chromate, *para-tert*-butylphenol formaldehyde, colphony
Shackelford and Belsito	2002	704	Patch test	Rubber components, chromated leather, adhesives
Rani et al.	2003	119	Patch test	*para-tert*-Butylphenol formaldehyde, cobalt chloride, glues
Lazzarini et al.	2004	53	Patch test	*para-tert*-Butylphenol formaldehyde, chromate, rubber chemicals, dyes
Holden and Gawkroder	2005	230	Patch test	Chromate, rubber chemicals, paraphenylenediamine
Nardelli et al.	2005	474	Patch test	Potassium dichromate, cobalt chloride, paraphenylenediamine, rubber components, colphony, *para-tert*-butylphenol formaldehyde
Chowdhuri and Ghosh	2007	640	Patch test	Potassium dichromate, cobalt chloride