

Shoe contact dermatitis

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The incidence of contact allergy was studied in a series of 165 patients with eczematous dermatitis of the feet correlated clinically with shoe contact. Positive reactions to one or more substances were recorded in 108 patients (65.4 %). Among the relevant sensitizers were chromium, paraphenylenediamine, paratertiary butylphenolformaldehyde resin and nickel, while the other allergens were benzocaine, neomycin, balsam of Peru, ethylenediamine and parabens. Allergic contact dermatitis of the feet can be prevented by recognition of the allergens responsible, control of hyperhidrosis and avoidance of topical allergens.

Key words: Chromium – hyperhidrosis – nickel – paraphenylenediamine – paratertiary butylphenolformaldehyde resin – rubber chemicals – shoe contact dermatitis.

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Allergic contact dermatitis attributable to shoes is quite common, but the fact that an etiological diagnosis is not always easy and the available preventive measures are few makes it a serious problem to the patient. Literature data on the incidence of shoe contact dermatitis are sparse: Shatin & Reisch (1954) identified the condition in 1.9 % of 2243 inpatients; the figure reported by Calnan & Sarkany (1959) was 3 %.

The most common sensitizers are rubber chemicals (Blank & Miller 1952, Shatin & Reisch 1954, Fisher 1959, Götz & Istvanovic 1963, De Vries 1964, Cronin 1966, Suurmond & Verspijck Mijnsen 1967, Epstein 1969), phenol resins contained in adhesives (Malten & van Aerssen 1962, De Vries 1964, Suurmond & Verspijck Mijnsen 1967, Foussereau et al. 1976), chromium used as tanning agent (Fisher 1959, 1973, Cronin 1966, Scutt 1966, Suurmond & Verspijck Mijnsen 1967), vegetable tans (Cronin 1966, Lynch & Rudolph 1969, Minikin et al. 1971, Calnan & Cronin 1978),

dyes (Fisher 1959, Suurmond & Verspijck Mijnsen 1967), nickel (Fisher 1959) and other resins, dodecyl mercaptan and polyurethanes (Grimalt & Romaguera 1975).

We present here the results of our clinico-allergological investigation in a series of selected patients with contact dermatitis of the feet.

Material and Methods

A total of 165 consecutive cases (98 men and 67 women) with contact dermatitis of the feet seen in the last 4½ years were investigated. The majority showed a fixed pattern or recurrent eruption of eczematous dermatitis of the dorsal aspect of the feet, with occasional keratotic involvement of the soles. The condition was very often associated with profuse sweating of the feet and in a few cases was unilateral. Secondary involvement of the legs and/or hands was rare. Cases of occupational allergic dermatitis of hands and feet have been excluded.

The patients were patch tested with several allergens including those most frequently implicated in shoe dermatitis and with active medicaments, bases, additives and preservatives used in topical preparations. Most of the allergens employed in our study were supplied by Trolab (Gentofte, Denmark), but some were prepared by ourselves by dissolving or dispersing pure chemicals in white vaseline (Carlo Erba, Milan, Italy). The application technique was that described by Fregert et al. (1969).

Results

Of 2607 consecutive cases of occupational and nonoccupational contact dermatitis seen in the last 4½ years, 165 had contact dermatitis of the feet (6.3 %) and 108 (or 65.4 %) of those demonstrated the presence of sensitivity to one or more substances. The distribution of sensitivities is shown in Tables 1 and 2.

Patch testing with shoe diagnostic screening series

The highest incidence of positive reactions (29.7 %) was obtained with potassium dichromate. These reactions seemed relevant, inasmuch as trivalent chromium salts whose skin penetrating capacity is low (Fregert 1974) but which are also endowed with allergenic potential, have been used in the leather tanning process. Chromates are also being used in dyeing of some leathers and nonleather synthetic uppers of the shoes. Calnan & Sarkany (1959) and Cronin (1966) found that chromium is not very often implicated in shoe contact dermatitis. The latter author emphasizes that in England the vegetable-tanned rather than chromium-tanned leather is the most common cause of the condition. Of 65 patients with shoe dermatitis investigated by Fisher (1959), 26 % had positive reactions to

Table 1. Patch test results to shoe test battery in patients with contact dermatitis of the feet (TL = Trolle Lassen)

Allergens	Concentration (%) in pct.	Positive patch tests
Formaldehyde (Merck) aqueous	2	0
Mercaptobenzothiazole (TL)	1	8 (4.8%)
Nickel sulfate (TL)	5	12 (7.3%)
Paraphenylenediamine (TL)	1	41(24.8%)
Paratertiary butylphenol formal . resin (TL)	1	9 (5.5%)
Potassium dichromate (TL)	0.5	49(29.7%)
Tetramethylthiuram-disulfide (TL)	1	4 (2.4%)
Turpentine (Sigma)	10	1 (0.6%)

chromium. Scutt (1966) reported many cases of sensitization to chromium due to chrome-tanned sandals.

Paraphenylenediamine produced positive reactions in 24.8 % of cases. It is a well-known fact that this substance is not used as a shoe dye and that in a few cases it may cross-react with certain rubber additives. In these patients a positive reaction to this allergen may suggest sensitivity to rubber rather than to dye. Fisher (1973) met with positive reactions to paraphenylenediamine in subjects wearing fabric or plastic shoes and in patients with dermatitis of the feet due to redyed shoes. These are frequent findings in Southern Italy because of climatic and economic reasons. It is also very likely that a proportion of our positive reactions to paraphenylenediamine were in fact due to stocking dyes.

Nickel plays only a relatively minor role in shoe contact dermatitis and in our series

Table 2. Patch test results to medicaments, bases, additives and preservatives of topical preparations in patients with contact dermatitis of the feet (TL = Trolle Lassen)

Allergens	Con- cen- tra- tion (%) in pet.	Posi- tive patch tests
Balsam of Peru (TL)	25	6(3.6%)
Benzocaine (TL)	5	9(5.5%)
Chloramphenicol (Sigma)	5	3(1.8%)
Ethylenediamine HCl (TL)	1	5(3.0%)
Neomycin (TL)	20	8(4.8%)
Parabens (TL)	15	4(2.4%)
Penicillin (Squibb)		2(1.2%)
Promethazine (Farmitalia)	2	2(1.2%)
Sulfonamide (Sigma)	5	1(0.6%)
Tetrachlorsalicylanilide (TL)	0.1	0
Vioform (Ciba)	3	0
Wool alcohols (TL)	30	2(1.2%)

positive reactions to this metal were obtained in 7.3 % of cases. Fisher (1959) also observed patients with contact dermatitis of the feet and allergy to nickel. In Italy most shoes have nickel ornaments, especially buckles. Also, especially in the South, open shoes and sandals are worn largely without socks or stockings for at least 6 months a year. The possibility that some of the positive reactions to nickel were connected with contact at sites other than feet could not be excluded.

Paratertiary butylphenolformaldehyde resin may cause occupational (Malten 1958, Calnan & Harman 1959, Foussereau et al. 1976) and nonoccupational eczema. The various literature reports on allergy to watch straps (Malten 1975, Mobacken & Hersle 1976, Foussereau et al. 1976) and footwear belong to the latter group. Malten & van Aerssen (1962) state that phenolic resins added to neoprene adhesives are one of the most common causes of shoe derma-

titis. Other cases of shoe dermatitis due to paratertiary butylphenolformaldehyde resins were reported by De Vries (1964), Suurmond & Verspijck Mijnsen (1967) and Foussereau et al. (1976). In our series paratertiary butylphenolformaldehyde resin produced positive reactions in 5.5 % of patients, none of whom were sensitive to formaldehyde.

According to many published studies (Blank & Miller 1952, Shatin & Reisch 1954, De Vries 1964, Cronin 1966, Epstein 1969) rubber chemicals are the most frequent cause of shoe contact dermatitis. We succeeded in demonstrating sensitivity to mercaptobenzothiazole and to tetramethylthiuramdisulphide in 4.8 % and 2.8 % of cases, respectively. Rubber footwear is less popular in Italy than in other countries. However, in addition to the possibility that some of the positive reactions to paraphenylenediamine might be cross-reactions with certain rubber additives, we must take into account the absence from our screening series of some of the most commonly employed rubber antioxidants.

In one case of contact dermatitis of the dorsal surfaces of the feet we obtained a positive reaction to turpentine, attributable perhaps to shoe polish or to use of ointments containing this substance.

Patch testing with active medicaments, bases, additives and preservatives contained in topical preparations

In several subjects with contact dermatitis of the feet we found allergy to certain constituents of local applications. The highest percentages of positive reactions were obtained with benzocaine (5.5 %), neomycin (4.8 %), ethylenediamine HCl (3.0 %), balsam of Peru (3.6 %) and the parabens (2.5 %). In all those cases the reactions were associated with positive patch tests to one or more of the substances mentioned before but nevertheless were interpreted as

superimposed allergies unrelated to shoe sensitivity.

Discussion

Shoe contact dermatitis is a rather common condition, associated with the use of several potentially allergenic substances in the manufacture of footwear and with the operation of certain local factors particularly favorable to the development of allergy, such as friction, sweating, pressure and occlusion.

Among patients with occupational and nonoccupational eczematous contact dermatitis seen in the last 4½ years, the incidence of shoe contact dermatitis was 6.3 %, and of the patients with this condition 65.4 % showed evidence of sensitivity to one or more test substances. In patients with negative reactions we carried out patch tests with pieces of material from the shoes themselves as advocated by certain authors (Calnan & Sarkany 1959, Epstein 1969). The main offenders in our series were chromium and paraphenylenediamine, i.e. substances likely to be released by perspiration, respectively from chrome-tanned leather and from fabric or redyed shoes (Fisher 1973). A frequent finding in our series was profuse sweating which together with the hot climate may explain the high incidence of shoe contact dermatitis. Consequently, as already reported by other authors (Gaul & Underwood 1950, Fisher 1973), control of sweating assumes a role of prime importance in the prevention of shoe dermatitis. An important measure other than the wearing, whenever possible, of made-to-order shoes free from specific sensitizers, is the use of cotton socks and stockings. In the treatment of contact dermatitis of the feet the use of potential sensitizers in topical applications must obviously be avoided, as it can contribute to chronicity and spread of the dermatitis.

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