

10 years' experience of patch testing with a shoe series in 230 patients: which allergens are important?

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Over a 10-year period, 230 patients with foot dermatitis were patch tested to a shoe series of allergens. About 54 (23%) had relevant allergic positive reactions to one or more allergens. The commonest relevant allergens groups were, in order, chromate, medicaments, rubber chemicals, dyes and cosmetic constituents, with the most frequent individual allergens being chromate (4%), neomycin (3%), rubber chemicals (>3%), paraphenylenediamine (2%) and tixocortyl pivate (2%). Some allergens previously thought to be important, e.g. certain plastic and adhesive chemicals, did not show any positives over the period of study. In addition, *para*-tertiary butyl phenol formaldehyde resin was a relatively unimportant allergen in this series. The main practical points to emerge from this study are that, in patients with foot dermatitis, chromate is still the principal allergen, and that medicament and cosmetic allergens may be prominent.

Key words: chromate; cosmetics; dyes; medicaments; patch test; rubber chemicals; shoe dermatitis.

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Foot dermatitis, sometime combined with hand dermatitis, is a common indication for patch testing, and series have been devised in the past to look specifically for allergy to constituents of footwear or of stockings or shoes. The common allergens in shoes and socks or stockings are well recognized (1–4). However, casual observation in our clinic suggested that allergic positive readings from the shoe series appeared infrequent. In view of this, it was determined to undertake an audit of results against the following standard: 'If an allergen in the shoe or additional series has not been positive at least once over the 10-year period, then it should be discontinued.'

Materials and Methods

Computerized patch test data have been kept since 1994. These data were reviewed and then supplemented by patient records and clinic letters to assess the relevance of positive results. From 1994 to 2003, 3337 patients were patch tested to the British Contact Dermatitis Society's (BCDS) standard series, of which 230 were tested to the shoe series and other series as appropriate. The 230 represent the majority of patients who have had a persistent eruption on the feet, as it is the policy in our department to patch test patients with a persistent foot eruption. Nonetheless,

there will be some selection and this may lead to an overestimate of the proportion of cases in whom allergic contact dermatitis is concluded to be the cause of the eruption. Relevance of a patch test reaction was determined from knowledge of an individual patient's environmental exposure, in terms of their use of personal cosmetics, toiletries and prescribed products, their history of clinical reactions and the types of footwear that they wore.

All patients were patch tested to a standard series (the exact constituents of which varied a little from time to time) and to a shoe series (for which there was also minor variation). Of the 230 tested to the BCDS standard and the shoe series, 153 were additionally tested to the medicament series (including topical steroids), 77 were also tested to the clothing and dye series and 43 received the preservative/vehicle series as well.

Results

Of the 230 patients tested to the shoe series, 44 (19%) showed relevant allergic positive reactions to allergens in the BCDS standard series, to which they were all tested (Table 1). 13 patients (6%) had relevant positive results to one or more allergens from the shoe series, with 15 positive

Table 1. Relevant allergic reactions on patch testing in 230 patients with suspected shoe dermatitis

Series tested/allergen	Number positive (%)
British Contact Dermatitis Society standard	(n = 230)
Potassium dichromate	9 (4%)
Neomycin	7 (3%)
Mercapto mix	8 (3%)
Thiuram mix	6 (3%)
Paraphenylenediamine	5 (2%)
Tixocortyl pivalate	5 (2%)
Colophonium	1 (0.5%)
Carba mix	5 (2%)
Ethylenediamine	3 (1%)
Wool alcohols	2 (1%)
Fragrance mix	2 (1%)
Cetyl stearyl alcohol	2 (1%)
Nickel sulphate	1 (0.5%)
Cobalt chloride	1 (0.5%)
<i>p</i> -tert-butylphenol F resin	1 (0.5%)
Chlorocresol	1 (0.5%)
Shoe series	(n = 230)
<i>N,N</i> -dibutyl thiourea	3 (1%)
Disperse yellow 3	3 (1%)
1,3-diphenyl guanidine	3 (1%)
Dioctyl gallate	2 (1%)
Disperse orange 3	2 (1%)
Toluene sulf F resin	1 (0.5%)
2 <i>n</i> -octyl-4-isothiazolin-one	1 (0.5%)
Urea formaldehyde resin	1 (0.5%)
4-aminoazobenzene	1 (0.5%)
Medicament series	(n = 153)
Triamcinolone acetoneide	2 (1.3%)
Metosyn ointment	2 (1.3%)
Alcomethasone	1 (0.7%)
Clobetasol dipropionate	1 (0.7%)
Hydrocortisone butyrate	1 (0.7%)
Propaderm ointment	1 (0.7%)
Elocon ointment	1 (0.7%)
Gentamicin	1 (0.7%)
Other series	
Butyl hydroxyanisole	1 (2.3%, n = 43)
Butyl hydroxytoluene	1 (2.3%, n = 43)
Disperse orange 3	1 (1.3%, n = 77)
Disperse red 1	1 (1.3%, n = 77)
Disperse blue 106/124 mix	1 (1.3%, n = 77)

results. However, in only 10 patients (4%) did the extended shoe series demonstrated an allergen not identified by the BCDS standard series.

Allergens in the shoe series that never showed a positive over the 10-year period were diaminodiphenylmethane, 2,2,4-tri-methyl-1,2-dihydroquinone, 1 H-benzotriazole, *N*-dodecylmercaptan, glutaraldehyde, acid yellow 36, diethylthiourea and diphenylthiourea.

Of the 43 tested to the preservative/vehicle series, 2 (4.6%) had a relevant positive result that would not have been found using only the BCDS standard and the shoe series (Table 1). Likewise, 10 (7%) of the 153 tested to the medicament series, and 1 (1.3%) of the 77 tested to the clothing and dye series, had relevant positives

that would have been missed if tested only to the BCDS standard and shoe series (Table 1).

Discussion

In a recent series of patients with suspected allergic contact dermatitis to shoes, only one-third were shown to have a relevant contact allergen on patch testing, with 30 of 70 patients having psoriasis (6). In another study of 119 patients with presumed shoe dermatitis, reported from Pakistan, 73% had positives on patch testing (6). The most common allergens in this series were *para*-tertiary butyl phenol formaldehyde resin (in 29% of those that had a positive patch test), chromate (16%), rubber chemicals (8%) and dyes (7%), with 10% positive to neomycin (6). Lazzarini and colleagues (3) from Brazil found that 70% of cases of foot dermatitis had a positive allergens on patch testing, the most common being rubber chemicals, metals and medicaments.

In a study from Israel, 24 of 58 patients with suspected foot dermatitis had positive patch tests, the most frequent allergens being chromate (27%), nickel (12%), Kathon CG (11%) and *para*-tertiary butyl phenol formaldehyde resin (9%) (7). The proportion of patients with relevant allergic positive reactions on patch testing from our series was lower than the above reported series at 54/230 (23%). An eruption on the dorsal aspect of the foot is more likely to be associated with a positive result on patch testing (3).

Our top allergens were, in order, chromate, medicaments (neomycin, tixocortil, triamcinolone), rubber chemicals, dyes (e.g. PPD, disperse yellow 3, disperse orange 3) and cosmetic constituents (e.g. wool alcohols, fragrance mix, cetyl stearyl alcohol). In this, our series shows some similarity to those reported except that *para*-tertiary butyl phenol formaldehyde resin was not prominent, being positive in only one person, and medicament or cosmetic constituents were more important in our patients than in those of other recent authors. In our view, nickel is rarely a relevant allergen for foot dermatitis, unless there is an obvious source such as metal buckles. However, some other authors regard nickel as being more relevant than we do (3).

The current shoe series consists of 17 allergens, including two from the rubber series. 5 allergens were positive in at least 1% of the 230 cases. We would propose to keep these allergens in the shoe series. 4 allergens were positive in 0.4% of cases. We propose keeping these in the shoe series for further audit. It does not seem worthwhile to test

routinely with a clothing and dye series for all patients with foot or hand and foot dermatitis.

When constructing a shoe series for use in Britain, it may be worth removing the 8 allergens from the shoe series to which there were no positive reactions in all 230 patients tested over 10 years. These were diaminodiphenylmethane, 2,2,4-trimethyl-1,2-dihydroquinoline, 1*H*-benzotriazole, *N*-dodecylmercaptan, glutaraldehyde, acid yellow 36, diethylthiourea and diphenylthiourea. Belsito advocated testing with mixed dialkyl thioureas but this would not seem necessary, as we did not find them to be important allergens. There may be differences between countries in the use of allergens to construct shoes, as has been observed already when comparing reports from Pakistan, Brazil, Israel and the USA, and our advice may only apply to a British or perhaps European setting.

A new shoe series has been included in the BCDS database. Some of the allergens deleted from the series include 4 to which we had at least one positive result over the 10 years. These were toluene sulphonamide formaldehyde resin, disperse yellow 3, dioctyl phalate and urea formaldehyde resin. These allergens might deserve being re-instated. Our data suggest that disperse red 1 might be added, and that it is worthwhile testing for additional corticosteroids.

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