

A multicentre review of the footwear allergens tested in the UK

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Footwear allergens used for patch testing vary between dermatology centres in the UK. The aim of our study is to ascertain the footwear allergens currently in use and their test results in several dermatology centres in the UK. Data were obtained from databases in 9 dermatology departments. A new footwear series consisting of 19 allergens including those with positive results and current/past relevance in this study based on collective experience is proposed for wider use and further evaluation.

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The majority of allergies to footwear are detected by patch testing to the British Contact Dermatitis Society (BCDS) Standard Series. Further important information is derived from testing to samples obtained from patient's own footwear. Many centres also test patients to additional footwear allergens based on published evidence and local experience. There is, however, no standardization of these additional allergens. In order to obtain reliable data on these allergens, it is necessary to adopt a standardized approach to the investigation of patients with foot dermatitis in multiple UK contact dermatitis centres. The present study was designed to ascertain data on currently tested allergens and formulate a battery of footwear allergens for further evaluation based on these data and collective experience.

Materials and Methods

Patch test data to footwear allergens over the last 2–6 years were collected from databases in 9 dermatology centres in the UK. All the participating clinicians were members of the BCDS.

The data collected from each centre were as follows:

(1) Name of allergens tested.

(2) Number of tests performed for each allergen.

(3) Number of positive reactions that were of current or past relevance for each allergen according to the International Contact Dermatitis Research Group (1).

The relevance of the positive reactions was based on a combination of factors: location of the rash, improvement in the skin complaint after withdrawal of the suspected item of footwear and, where possible, a positive patch test to samples from the item of footwear.

Results

The results of the survey have been summarized in Table 1. Irritant reactions were seen for aminobenzene (1/1117 = 0.08%), diphenyl guanidine (1/610 = 0.16%), disperse red 1 (1/496 = 0.2%) and dibutyl thiourea (1/1149 = 0.08%). Cross-reactions were seen only for gum rosin (1/340 = 0.29%). Doubtful reactions were seen for aminobenzene (6/1117 = 0.53%), diphenyl guanidine (1/610 = 0.16%), urea formaldehyde resin (1/499 = 0.2%), disperse red 1 (1/496 = 0.2%), octylisothiazolinone (1/1121 = 0.08%), diamino phenyl methane (1/767 = 0.13%), diphenyl

Table 1. Summary of commonly tested footwear allergens, results and the proposed British Contact Dermatitis Society footwear series

Reagent	Number of testing centres	Number of tests	Current/past relevance <i>n</i> (%)	Concentration (%)‡	Description
Aminobenzene*	8	1117	31 (2.78)	0.25	Pigment
Diphenyl guanidine*	7	610	11 (1.80)	1.0	Rubber accelerator
Urea formaldehyde resin*	2	499	6 (1.20)	10.0	Heat setting resin
Gum rosin*	1	340	4 (1.18)	As is	Adhesive
Disperse orange 3*	9	1117	14 (1.25)	1.0	Textile & leather dye
Me/Cl isothiazolinone†	4	116	1 (0.86)		Biocide
Disperse red 1*	1	496	2 (0.40)	1.0	Dye
Toluene sulphonamide formaldehyde resin*	2	501	2 (0.40)	10.0	Adhesive
Disperse yellow 3*	3	520	2 (0.38)	1.0	Dye
Glutaraldehyde*	9	1297	4 (0.31)	0.2	Leather tanning
Octylisothiazolinone*	9	1121	4 (0.36)	0.1	Biocide
Diaminophenylmethane*	4	767	2 (0.26)	0.5	Rubber additive
Acid yellow 36*	8	1210	3 (0.25)	1.0	Textile & leather dye
Benzo triazole*	3	731	1 (0.14)	1.0	UV stabilizer
Diphenyl thiourea*	6	919	1 (0.11)	1.0	Rubber accelerator
Hydroquinone monobenzylether*	9	1122	2 (0.18)	1.0	Anti-degrent in rubber
Diethyl thiourea*	8	1236	2 (0.16)	1.0	Rubber accelerator
Dodecyl captan†	9	1281	0		Polymerization inhibitor
Dibutyl thiourea†	7	1149	0		Rubber accelerator
Diethylphthalate†	2	500	0		
Disperse red 17†	1	486	0		Dye
Disperse blue 3†	1	484	0		Dye

*The allergens which form the new BCDS footwear series in addition to direct orange 34 (5.0% in petroleum), basic red 46 (1.0% in pet.) and dithiomorpholine (1.0% in pet.).

†Omitted from the proposed BCDS footwear series.

‡Concentrations given in pet. (chemotechnique).

thiourea (1/919 = 0.1%), diethyl thiourea (1/1236 = 0.08%), disperse red 17 (1/486 = 0.2%) and disperse blue 3 (1/484 = 0.2%).

Discussion

The multicentre data in Table 1 clearly show the varied practice in the different centres. However, it has enabled us to formulate a new footwear allergen series as showed in Table 1 for future use and further evaluation. The new footwear series consists of allergens with positive (current/past) test results in the current survey. In addition, basic red 46 (2), dithiomorpholine (3, 4) and direct orange 34 (5) were included in the new footwear series as supported by previous studies. Basic red 46 is a textile dye (socks), direct orange 34 a textile and leather dye and dithiomorpholine in rubber in footwear. Preliminary data from one centre participating in the current study showed positive results to direct orange 34 in patients with foot dermatitis. Although test positive in the current survey, Me/Cl isothiazolinone was excluded as it is already tested on the standard series.

In a previous single-centre study, over a 4-year period, 120 patients were tested to the footwear series or the patient's own footwear (6). In that study, 5 patients tested positive to diphenyl

guanidine, 2 to disperse orange 2, 2 to aminoazobenzene and 7 to materials in their own shoes. All 5 test positive to diphenyl guanidine were negative to rubbers in the standard series and all were clinically relevant. However, in the current study, current/past relevant as well as irritant and doubtful reactions were seen for both diphenyl guanidine and aminoazobenzene. Disperse orange 2 was not tested in the dermatology centres included in our study.

It is evident from the current data that some allergens produced no positive results despite a high number of tests being performed. A single-centre study of patch testing for the footwear series in 230 patients over a 10-year period showed no positive results for the following 8 allergens: 2,2,4-trimethyl-1,2-dihydroquinoline, *n*-dodecylmercaptan, diphenylthiourea, glutaraldehyde, acid yellow 36, diethyl thiourea, 1 *H*-benzotriazole and diaminophenylmethane (7). However, in our multicentre study, the latter 5 allergens did give positive results and therefore we have included them in our proposed footwear series.

Foot dermatitis is common and the BCDS standard series will pick up most relevant reactions to rubber, chromate and adhesives (para-tertiarybutylphenol formaldehyde resin). The proposed footwear series has rare allergens and therefore the incidence of relevant positive

reactions may be low. Some allergens such as gum rosin may not be readily available in which case this can be tested using granuflex as a separate chamber, as colophony commonly cross-reacts with gum rosin.

In conclusion, we propose a battery of 19 allergens for wider evaluation in patients with suspected contact allergy to footwear. However, no battery of allergens can be expected to identify all cases of allergic contact dermatitis. It remains important to test patients with samples of their own footwear. Regrettably, the outsourcing of footwear manufacture makes it increasingly difficult to know what allergens are likely to be found in any article of footwear and hence to give guidance on suitable alternatives.

The proposed footwear battery will be carefully evaluated in a prospective study that will be reported in due course.

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