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Shoe dermatitis in India

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105 patients with foot dermatitis, seen over a period of 18 months, were patch tested with various shoe allergens. 47 showed a positive reaction to 1 or more allergens. The majority of the cases (37–47) were chrome-positive. Positivity to plastic material was observed in 8, whereas rubber and rubber chemicals accounted for 5 cases. Of special interest were positive reactions to 1,3-diphenylguanidine in 3 and N-cyclohexyl-2-benzothiazolesulfenamide in 2 cases.

Key words: shoe dermatitis; chrome sensitivity; rubber chemicals; 1,3-diphenylguanidine; N-cyclohexyl-2-benzothiazolesulfenamide; plastics; India.

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Shoe dermatitis is not an uncommon entity. The hot and humid environment within a shoe, combined with the presence of hundreds of chemicals create an ideal situation for the development of allergic or irritant contact dermatitis (1). Bloch (2) was the first to describe a case of dermatitis of the feet due to sensitivity to shoe leather. A patch test to the leather was positive and recovery followed when the shoes were changed. Lewis (3) reported 2 men who reacted to patch tests with pieces of leather from their shoes. Since then, many reports have appeared in the literature implicating leather as a cause of dermatitis of the feet (4, 5).

Rubber has also been implicated as a sensitizer in producing shoe dermatitis (6–8). Calnan & Sarkany (9) analysed 102 cases of shoe dermatitis and observed that 63% reacted to leather and 36% to rubber chemicals. Later on, Cronin (10) reported 213 patients with shoe dermatitis, of whom 100 were sensitive to rubber and 96 to leather, thereby concluding that there was a shift from leather to rubber allergy in the early 60s in the UK.

Recently, rubber has been found to be a common sensitizer in the UK and the USA whereas leather is reported to be the common sensitizer in Italy and Greece (11, 12). These reports bring out clearly that what is common in one country may not hold true for another country. This prompted us to investigate hypersensitivity to shoe antigens in India; a tropical country.

Material and Methods

105 patients having primarily dermatitis of the feet were included in the study. The period of study extended from October 1986 to March 1988. The patients were tested with various antigens (Table 1) prepared in plastibase. Plastibase was used as a vehicle because petrolatum was found to be unsuitable for tropical countries, as observed in a study reported earlier (13). The allergens were placed on 2 cm^2 pieces of gauze and applied to the back. Occlusion was achieved with 4 cm^2 pieces of Johnson plast. Thin pieces of leather, rubber and plastic, along with pieces of the patients' footwear material less than 1 cm in diameter were also used for patch testing. The patches were removed after 48 h. The readings were taken after 48 h and 96 h in the majority of patients. An effort was made to clinically correlate the positive results obtained.

Table 1. Hypersensitivity to various shoe allergens

Antigens	No. of positive cases
leather	30
potassium dichromate (0.5%)	37
formaldehyde (2% aqueous)	01
plastic	08
rubber and rubber chemicals	05

Results

105 patients were patch tested with shoe allergens and 47 showed positive reactions to various substances. The duration of dermatitis varied from 2 months to 17 years. There were 12 cases of duration less than 1 year and 6 with duration of more than 10 years. The dorsa of the feet were involved in all cases except one, where there was involvement of the soles only.

In 2 patients, the sides of the soles, and in 1 patient the plantar aspects of the toes, were also affected along with the dorsa of the feet. Single-foot involvement was observed in 1 patient only. Other sites like hands (5), forearms (3), legs (4) and waist (1) were also affected.

The hypersensitivity to various shoe allergens is shown in Table 1. Potassium dichromate positivity was observed in 37 cases while leather was positive in 30 cases. Out of 30 leather-positive cases, 18 were positive after 48 h and 12 after 96 h. 29 leather-positive cases also showed chrome positivity. 1 patient, who was negative to potassium dichromate but positive to leather, had dermatitis of the waist corresponding to the leather straps of a support jacket which the patient was wearing. She also had dermatitis of the feet corresponding to sandal straps. Both were made of the same material.

Plastic positivity was observed in 8 cases. 5 were positive only to plastic, 2 to plastic and leather, 1 to plastic, leather and rubber. 2 patients who showed a positive reaction to plastic after 48 h became negative after 96 h. These 2 cases were therefore considered to be negative.

Rubber and rubber chemicals showed positivity in 5 cases (Table 2), out of which 2 were also positive to leather. Mercaptobenzothiazole and 1,3-diphenylguanidine, each produced positive reactions in 3 cases. N-cyclohexyl-2-benzothiazolesulfenamide was positive in 2 cases and so was rosin. Tetramethylthiuram disulfide showed positivity in 1 patient only, who was also positive to mercaptobenzothiazole, rosin and N-cyclohexyl-2-benzothiazolesulfenamide. No positive reactions were observed with monobenzyl ether of hydroquinone and para-tertiary-butylphenol. Sensitivity to formaldehyde was observed only in 1 case. This patient was not sensitive to any other antigen used in this study. Para-phenylenediamine (2%) and phenylmercuric nitrate (0.05%) did not produce any positive reactions.

Discussion

Shoe dermatitis appears to be a fairly common entity in India as is evident from 47 proven

Table 2. Hypersensitivity to rubber and rubber chemicals

Antigen	Concentration (1%)	Case nos. 1	2	3	4	5	Total positive
1. rubber		+	−	−	−	−	1
2. mercaptobenzothiazole	1&2	+	+	+	−	−	3
3. 1,3-diphenylguanidine	1	−	−	+	+	+	3
4. N-cyclohexyl-2-benzothiazolesulfenamide	1	−	+	−	+	−	2
5. rosin (colophony)	10&20	−	+	+	−	−	2
6. tetramethylthiuram disulfide	2	−	+	−	−	−	1
7. monobenzyl ether of hydroquinone	2	−	−	−	−	−	0
8. para-tertiary-butylphenol	2	−	−	−	−	−	0

cases of shoe allergy seen over a period of just 18 months. This works out to almost 1 new patients in less than 2 weeks. Jordan (14) estimated 1 new case every 6 weeks and Epstein (15) documented 43 proven cases of shoe dermatitis over a period of 5 years. Angelini et al. (11) reported 108 cases over a period of 44 years. Lynde et al. (16) suspected 119 cases over a period of 4 years but only 32 patients had relevant positive patch test reactions. The apparent reason for such a high positivity in India is the fact that throughout the summer and rainy season, people do not wear socks, leading to direct contact between the footwear and the skin. The hot and humid climate acts as a precipitating factor for the development of contact hypersensitivity.

In the present study, chromium has been found to be the main culprit. Out of 37 chromium-positive individuals, 29 showed positivity to leather as well. The site affected was the dorsa of the feet. In a large number of cases, the pattern of dermatitis corresponded with the straps of sandals worn by the patients. A similar pattern has been reported by Scutt (17). He patch tested 100 consecutive ratings invalided home from the tropics because of skin disease, and 67% of the sandal strap eczema cases were found to be chrome sensitive, as compared to only 6% of the rest of the skin patients who served as controls. A high positivity to chrome has also been reported by Angelini et al. (11) and Verelzides et al. (12), from Italy and Greece, respectively.

On the other hand, in 1959, Calnan & Sarkany (9) reviewed 102 cases of shoe dermatitis. They observed that 63% of the subjects reacted to leather. Of those sensitive to leather only, 9 reacted to potassium dichromate. They implicated vegetable tannins as the likely sensitizer in leather. Similar cases have been reported by Cronin (10), Lynch & Rudolph (18), Calnan & Cronin (19) and Minkin et al. (20). In the present series, only 1 case who was allergic to leather and negative to chrome could be explained on the basis of vegetable tannin hypersensitivity.

Rubber and rubber chemicals have been reported to be the most common sensitizers by various workers. Cronin (10) analysed 100 rubber-sensitive patients, of whom 45% were sensitive to mercaptobenzothiazole, 12% to tetramethylthiuram disulfide and 37% to both. Similarly, out of 35 patients reported by Adams (21), 15 were allergic to mercaptobenzothiazole and 3 to tetramethylthiuram disulfide. In Lynde et al.'s (16) series of 32 positive cases, 20% were sensitive to mercaptobenzothiazole and 11% to tetramethylthiuram disulfide. In Jordan's (14) 25 cases, 9 were positive to mercaptobenzothiazole and 5 to tetramethylthiurma disulfide. However, out of 108 positive cases of Angelini et al. (11), only 8 were positive to mercaptobenzothiazole and 4 to tetramethylthiuram disulfide. In the present series, only 3 were positive to mercaptobenzothiazole and 1 to tetramethylthiuram disulfide. The lower incidence of positivity to rubber chemicals is similar to that in Italy and Greece. It could be due to the fact that the rubber chemicals do not leach out as easily as chrome. The interesting finding in this series has been 3 positive reactions to 1,3-diphenylguanidine and 2 to N-cyclohexyl-2-benzothiazolesulfenamide. Adams' (21) series of 35 cases had 2 cases each positive to 1,3-diphenylguanidine and N-cyclohexyl-2-benzothiazolesulfenamide.

In the present series, 8 cases were positive to plastic material. In 2 other cases, the patch tests became negative after 96 h and also no clinical correlation could be established; hence, these patients were considered to be non-sensitive. In 3 patients, the dermatitis corresponded to plastic sandal straps. Cronin (22) had also described several patients sensitized to PVC shoe linings, but the allergen was not identified.

Though the present study brings out clearly that chrome and leather are the most common sensitizers at present, a larger study incorporating vegetable tannins and plastic chemicals may give further insight into footwear dermatitis in India.

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