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Original Research Article

Role of patch testing with foot wear series in children with foot dermatoses in a tertiary centre in north Kerala, India

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ABSTRACT

Background: Foot dermatoses are a common malady in children. It has a varied presentation ranging from patchy fissured scaly lesions to disabling highly inflammatory vesicular eruption. A role for foot wear exacerbating these dermatoses is a possibility, which could be confirmed by patch testing. To evaluate the role of patch testing in determining the allergen either causing or exacerbating various foot dermatoses in children.
Methods: Patch testing was done in 40 children with various foot dermatoses using the standard footwear series and the results were read after 48 hours, 96 hours and again after 7 days. Also, skin biopsy was done in 10 cases from the representative lesions.
Results: Patch test was positive in 24(60%) patients to different antigens. Disperse orange (25%) was found to be the commonest allergen followed by epoxy resin (15%), neomycin sulphate (12.5%) and black rubber mix (10%).
Conclusions: Patch testing has a major role in finding out the causative agent or at least the exacerbating footwear in various foot dermatoses. Disperse orange was found to be the most common allergen. The diagnosis of acrodermatitis or JPD should not deter doing a patch testing.

Keywords: Foot dermatoses, Patch tesing, Foot wear series

INTRODUCTION

Foot dermatoses are one of the most bewildering problems encountered in school children leading to abstinence from school. Foot dermatoses would comprise of an array of conditions including plantar psoriasis, Juvenile plantar dermatoses, and contact dermatitis. The prevalence of allergic contact dermatitis in children has been reported at between 13.3% and 24.5% in several studies.[1] Patch testing is more difficult to undertake in children than adults as there are more chance of irritant reactions and thereby, more false positive reactions. Still, patch testing could be of value in identifying the allergen either causing or exacerbating various foot dermatoses.

METHODS

A total of 40 children who attended our OPD at govt. medical college, Kozhikode during the period October 2011 to September 2012 with foot dermatoses were patch tested using the foot wear series obtained from Systopic laboratories approved by the contact and occupational dermatoses forum of India (CODFI). Detailed evaluation was done using a structured pre tested questionnaire regarding age, sex, seasonal variations, type of footwear, aggravating factors and history of atopy. Patients were thoroughly examined clinically to know the extent of involvement and the type of lesions. All the children were patch tested once the acute condition subsided. Patients with acute dermatitis, dermatoses at the site of patch test

application, *Tinea pedis*, and patients on systemic steroids were excluded from the study. After getting an informed consent, antigen was applied over the back of the patients using the aluminium patch test chamber with a diameter of 9 mm and a depth of 0.5 mm. Readings were taken at 48 hours, 96 hours and again on the 7th day. Results were interpreted using criteria laid down by International contact dermatitis research group (ICDRG). Frequency and percentage were used for summarizing skin biopsy was done in 10 (25%) cases from representative lesions.

RESULTS

Of the 40 children patch tested, 12 (30%) were boys and 28(70%) girls aged 5-18 years. Peak age was in the 9-12 years group. Most of the children presented with scaling (75%) and fissuring. Exacerbation with foot wear was noted by most of them. Thirty three (82.5%) had used black colored footwear, 14 (35%) used plastic, 10 (25%) used black rubber and another 16 had used footwear made of rubber other than black color. Exacerbation while using soap was noted by 10 (25%) patients. It was more with green and red colored soaps. Twelve (30%) had exacerbation on contact with cement. Six of them had contact with red oxide floorings. There was also exacerbation on contact with mud and slush in 31 patients. Twenty five patients had exacerbation in rainy season, 23 in winter and 16 in summer. Thirteen (32.5%) had similar illness in their siblings. Predominant site of involvement was the dorsum and sides of toes in 32(70%) patients. Instep was involved in 17(42.5%) patients. Erythematous and glazed appearance over the sole was seen in 3 patients. Predominant involvement at the 'V' strap area of the foot was noticed in 3 patients. Beau's lines over the great toe nail were noted in 22 (55%) patients. The diagnosis was plantar psoriasis in 35 (87.5 %), juvenile plantar dermatoses in 4 (10%) and contact dermatitis to foot wear in 1 (2.5%).

Patch test was positive in 24 (60%) patients. Twelve (30%) had positivity to multiple allergens and 12 (30%) of them showed positivity to single antigen. Disperse orange was the commonest allergen noticed in 10 (25%) patients. This was followed by epoxy resin in 6 (15%), neomycin sulphate in 5(12.5%) and black rubber mix in 4(10%) patients. Positivity to other antigens is depicted in Table 1. There was positivity to white soft paraffin in 3 (7.5%) patients. Patch testing was negative in 3 patients with juvenile plantar dermatoses and 13 patients with plantar psoriasis. Of the two pairs of siblings tested, all of them were patch test positive. One patient who was suspected to have contact dermatitis to footwear was found to be positive to white soft paraffin. There was sparing of instep in 23 (57.5%) patients, of whom 17 (42.5%) were patch test positive. In patients who were patch test positive to disperse orange, there was history of using orange to red colored soaps in 3(7.5%) patients, red colored footwear in 2(5%) and contact with red oxide floorings in 2(5%) patients. There were no side effects to patch testing except for plaster reaction in 2 (5%) patients.

Skin biopsy was done in 10 (25%) patients. Of these, seven were patch test positive. All of them showed features suggestive of chronic dermatitis with spongiosis and perivascular lymphocytic infiltrate.

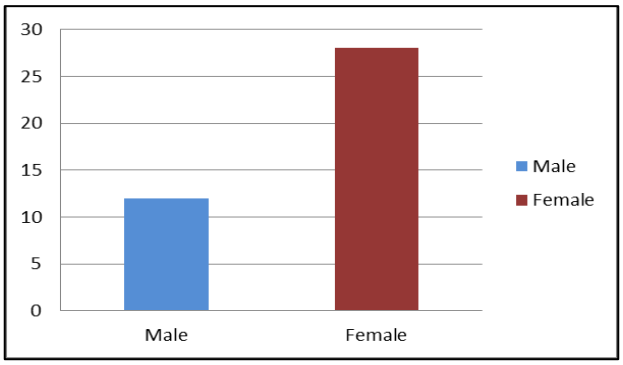

Figure 1: Sex ratio.

Figure 2: Showing patch test positivity to disperse orange.

Figure 3: Revealing patch test positivity to neomycin.

Figure 3: Showing patch test positivity to black rubber mix.

Figure 4: Showing patch test positivity to colophony.

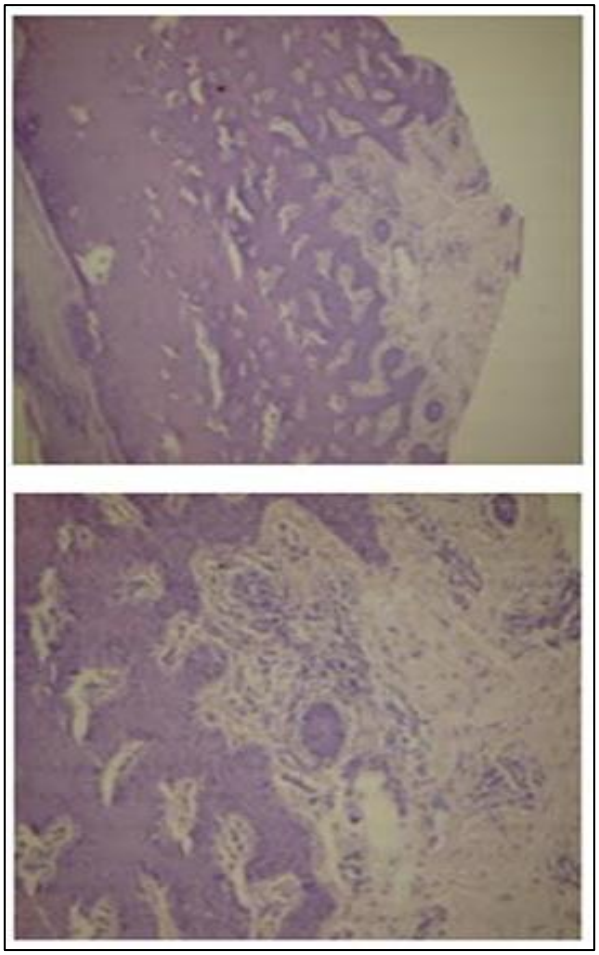

Figure 5: Histopathology showing hyperkeratoses, spongioses and perivascular lymphocytic infiltrate suggestive of chronic dermatitis on H&E 100 X.

Table 1: Showing number and percentage of children with patch test positivity to various allergens.

	Antigen	No. of patients	Percentage
Leather	Pottassium dichromate 0.5%	1	2.5
	Formaldehyde 1%	2	5
	Glutaraldehyde 0.2%	3	7.5
Rubber	Thiuram mix 1%	1	2.5
	Black rubber mix 0.6%	4	10
	Mercapto benzathiazole 2%	1	2.5
	Hydroquinone monobenzyl ether 2%	-	-
Plastic	Dioctyl phthalates 5%	2	5
	Epoxy resin 1%	6	15
Dyes	Disperse orange 3(1%)	10	25
	Disperse blue 124 (1%)	-	-
Glues	Colophony (20%)	1	2.5
Antimicrobials	Neomycin sulphate 20%	5	12.5
	Kathon cg (0.2%)	4	10
	Nickel so_4 (5%)	1	2.5
	Plaster	2	5
	White soft paraffin	3	7.5

? - Faint erythema; + - erythema, papules; ++ - erythema, papules, vesicles; +++ - erythema, papules, vesicles, pustules, ulceration; -- negative; ir – irritant reaction; nt – not tested;

DISCUSSION

Foot is most often the victim of environmental tortures. Further, friction and occlusion makes it the favorable site for various dermatoses. Sweat hydrates the skin and leaches out chrome from leather, further contributing to the problem. Dermatoses affecting the foot in children include acrodermatitis continua, juvenile plantar dermatoses (JPD), allergic contact dermatitis to footwear, tinea pedis and pustular bacterid. It is often very difficult to differentiate these conditions.

Acrodermatitis continua is a sterile pustular eruption of fingers and toes which breakdown to leave an erythematous shiny area coalescing to form lakes of pus which is histologically characterized by sub corneal cavity with polymorphonuclear cells and spongiform pustule of Kogoj, all pointing to a form of localized pustular psoriasis.[2] It is seen more common in females. juvenile plantar dermatoses (JPD) which is also known as atopic winter feet, sweaty sock dermatitis or Moon Boot syndrome presents as symmetrical shiny glazed and dry fissured areas over the weight bearing ball of great toe and toe pads. Instep and toe clefts are spared. Palms and finger tips are also shiny and fissured.[3] It is seen more in males. JPD could be a part of atopy or could be due to friction.[3] It is worsened by the use of less porous synthetic foot wear with repellant coatings as the sweat produced by foot escapes through pores in footwear and by absorption by the materials of the shoe.[3] Sweat retention and frequent change in microenvironment also contribute. Ashton et al found an inflammation of sweat ducts by micrococci and staphylococci further inhibiting sweat secretion.[4]

Allergic contact dermatitis usually affects the dorsum of foot and flexural creases with sparing of instep. It is usually symmetrical, but could be patchy or unilateral. Tinea pedis usually presents as interdigital or subdigital scaling or as a diffuse hyperkeratosis. Instep is rarely involved. Examination with 10% KOH reveals septate and branching hyphae. Pustular bacterid is an acute monomorphic sterile pustular eruption due to a remote bacterial infection.

The most common age group in our study was 9-12 years range which indicates the exposure to sensitising antigen is more as age advances.[1,7] Also, most of them were females again attributing to the use of wide variety of footwear by girls compared to boys which was also noticed by others .[7] Scaling and fissuring was the most common presentation . Typical V- strap area involvement of contact dermatitis was seen in 3 patients but only one patient was patch test positive, explaining the fact that strap area involvement could be a part of koebnerisation in psoriasis. Sparing of instep was seen in 23 (57.5%) patients. Sparing is usually seen in allergic contact dermatitis and JPD. Of these, patch testing was positive in 17 patients indicating that there is a role of foot wear in exacerbating the disease and it is likely that if instep is spared, patch testing should definitely be done. Shiny and glazed appearance typical of JPD was seen in 4 patients. Also, there was hyperhidrosis in 3 (7.5%) patients. This is due to the fact that sweat retention in a non-porous occlusive foot wear causes odema of horny layer and displaces eccrine sweat coils causing blockage and secondary hyperhidrosis.[5] Most of our patients had either a personal (32.5%) or family(37.5%) history of atopy which was in par with studies by Freeman.[6] Clayton et al found a strong relation between history of atopy and prevalence of allergic contact dermatitis.[7] This is due to the damaged epidermal barrier in atopics increasing the penetration of the allergen.[6,7]

Patch test with foot wear series was positive in 60% of our patients. Patch test positivity and the common allergens identified in various studies are depicted in Table 2.[6-12] Chowdhuri et al found potassium dichromate to be the commonest allergen in his series of 155 patients.[11] This was also noted by others.[8,14] Rani et al also noticed 73% of her patients with patch test positivity.[12] She also had noted polysensitivity in 48% of her patients which was also noticed in 30% of our patients. Disperse orange was the commonest allergen seen in 25% of our patients. Sensitisation with dyes can occur from the use of colured socks, dress, footwear linings and soaps. There was history of using orange to red soaps in 3 of our patients and red foot wear in two patients and contact with red oxide floorings in another two patients. Opie et al found 17 of his patients with patch test positivity to basic red 46.[15] Chromatographic analysis of socks of two affected patients confirmed the

Table 2: Showing comparison of our study with similar studies.

	Total No	Patch test +ve	Most Common allergen
Our Study	40	24(60%)	Disperse orange (25%)
Freeman[6]	55	43.1%	Rubber
Clayton et al[7]	500	133(26.6%)	Nickel SO4 (33%)
Darling MI[8]	41	17(41%)	Rubber , Pottassium dichromate
Suhail M[9]	50	33(66%)	Carbamix (26%), Pottassium dichromate (22%)
Priya et al[10]	50	44(88%)	Mercaptobenzathiazole (36%)
Chowdhuri S[11]	640	24.22%	Pottassium dichromate (45.8%)
Rani Z et al[12]	119	87(73%)	PTBP (26.9%)

presence of basic red 46. Re-dyed shoes and dress do not adhere firmly and can cause contact dermatitis. [16]

We had 4 patients with patch test positivity to black rubber mix comprising of amines which acts as an antioxidant and is used to prevent drying and cracking of rubber. Ironically, it can cause fissuring and drying of the feet. Ten (25%) patients had noted exacerbation with black rubber chappals. The characteristic purpuric lesion produced by the amine, N-isopropyl-N-phenyl-4-phenylenediamine (IPPD) in black rubber was not seen in our patients. Mercaptobenzathiazole is the most frequent shoe allergen especially when lesions are localized to sole. It was also noted by others.[8,10] We also had patch test positivity to epoxy resin in 6 (15%) of our patients. Srinivas et al also have identified Bisphenol as sensitiser in his series of patients.[17] Allergy to white soft paraffin was also noted in 3 of our patients. One patient had presented with contact dermatitis like presentation involving the strap area. This could be due to the contamination of the foot wear with topically applied white soft paraffin causing sensitization and recurrent contact dermatitis. Sensitiser identified is polycyclic aromatic hydrocarbon. There were two pair of siblings in our study with one pair having sparing of instep but all of them had patch test positivity, again pointing to an additional environmental antigen rather than purely an endogenous origin of these foot dermatoses.

Histopathological examination of 10 (25%) patients had revealed features suggestive of chronic dermatitis. Of these, seven patients were patch test positive. Biopsy from patient with JPD also showed spongiosis with perivascular lymphocytic infiltrate. Typical finding of JPD with dermal infiltrate around acrosyringium with vesiculation and paranuclear vacuolization of keratinocyte was not seen in our patient.[18] Nannini et al studied the histopathology and immuno cytochemistry of 42 patients and concluded that contact dermatitis can be differentiated from psoriasis by the irregular epidermal hyperplasia and S100 +ve dendritic cells. Also, in psoriasis, there would be spongiform pustule of Kogoj.[1]

To conclude, patch testing with foot wear series is the only useful and reliable method to identify the allergen either causing or exacerbating various foot dermatoses. Sparing of instep should prompt us to do a patch testing. The diagnosis of acrodermatitis or JPD should not deter from doing a patch testing. Disperse orange was the commonest allergen identified followed by epoxy resin. By knowing the allergen, we could recommend correct non allergenic footwear and reduce the morbidity of these children.

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