

Original Research Article

Clinical correlation of foot eczema and patch test: a cross sectional study from South India

Sharim Fathima¹, Kunnummal Muhammed^{2*}, Gopalapillai Nandakumar³

¹Department of Dermatology, Karothukuzhi Hospital, Aluva, Kerala, India

²Department of Dermatology, MES Medical College, Perintalmanna, Malappuram, Kerala, India

³Department of Dermatology, Malabar Medical College, Ulliyeri, Kerala, India

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*Correspondence:

Dr. Kunnummal Muhammed,

E-mail: drmuhammedk@rediffmail.com

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ABSTRACT

Background: Foot eczema is caused by several exogenous or endogenous factors acting alone or in combination. Leather, rubber and adhesive components are the most common allergens. Patch test is performed to find out the allergen which helps clinician in subsequent patient management and improving the prognosis.

Methods: Total 50 patients with foot eczema were evaluated and patch test was performed with Indian standard series over 18 months period in a tertiary hospital in South India.

Results: Out of 50 patients 32 (64%) were females and 18 (36%) were males. Younger age group was mainly involved (second decade). An atopic back ground and seasonal exacerbation were contributory in many. Patch test was positive in 39 (78%) patients. The forefoot was predominantly involved part in 56% followed by dorsal aspect alone of the foot. Scaly plaque was the predominant morphological pattern seen in 25 (50%). Maximum number of patients (24%) showed positive reactions to potassium dichromate and the minimum (2%) to neomycin sulphate.

Conclusions: Though rubber and rubber chemicals were the common sensitizers causing foot eczema worldwide, our study found potassium dichromate to be the most common sensitizer which is one the components used in leather tanning and is a constituent of cement, soaps and detergents.

Keywords: Shoe dermatitis, Patch test, Foot eczema, Potassium dichromate

INTRODUCTION

Foot eczema is one of the commonest problems seen by a dermatologist. It causes discomfort and embarrassment to the patient because of its location and interferes significantly with routine daily activities. Endogenous cause such as atopy or exogenous causes such as contact dermatitis are important contributing factors. Patch test is fundamental for identification of causative allergen and educating patient about the avoidance of allergen and providing suitable alternatives are crucial for a good outcome.

Leather, rubber and adhesive component have been reported to be the most common allergen.¹ There are 4 major factors that may influence footwear eczema: allergy, atopy, friction and occlusion (including hyperhidrosis).² Due to the variety of materials used in the manufacturing of footwear identifying the specific allergen can be challenging and patch test is performed to find out the cause.

The diagnosis of contact allergies by patch testing gives the clinician a distinct advantage in the subsequent management of the patient and frequently does improve the prognosis.³

METHODS

It was a cross sectional study conducted in Dermatology Outpatient Department from March 2016 to September 2017.

Inclusion criteria

Inclusion criteria were age >6 yrs, all cases of foot eczema not resolving in a short time, persistent or recurrent disease, all consenting patients, both sexes, patients not on any oral steroids or antihistamines and negative KOH smear.

Exclusion criteria

Exclusion criteria were pregnancy, active eczema over other sites, children <6 yrs, non consenting patients and positive KOH smear.

During this period a total number of fifty patients with foot eczema were included in this study. After taking an informed consent a complete clinical examination was carried out and the nature, extent and morphology of the lesions were carefully noted down. Patients with active eczema were first treated and then subjected to patch test so as to avoid false positivity and excited skin syndrome (angry back syndrome).

The age of onset, site of initial lesion, progression, relation to occupation, seasonal variation, recurrences, aggravating factors, association with atopy, associated symptoms like pain, pruritus, dryness, scaling, fissuring, redness, oozing were also noted. Skin scrapings for fungus was done to exclude fungal infections in all the cases. Patch test was done using standard screening tray of 20 antigens (Indian standard series) approved by the Contact and Occupational Dermatoses Forum of India (CODFI), manufactured and supplied by systopic.

The back of the patient was cleaned with spirit and excessive hair if any was shaved before applying the patch test units. The antigens were placed in aluminum chambers with a diameter of 9 mm and a depth of 0.5 mm in the prescribed sequence and applied on the upper back of the patient. The patients were instructed not to have bath or wet the area, avoid physical activity which could result in profuse sweating, avoid tight clothing, friction, rubbing or scratching and to avoid exposure to sunlight or UV light and also to be free from any medications. After 48 hours, the patches were removed and reading was taken 1 hour after removal.

The observations were graded according to ICDRG recommendations (International Contact Dermatitis Research Group Guidelines) (Table 1).

A second reading was taken at 96 hours; the observations were noted as above.

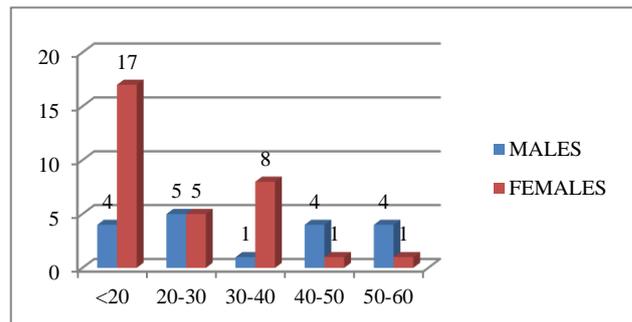
Table 1: International Contact Dermatitis Research Group Guidelines (ICDRG) grading.

Faint erythema	Doubtful reaction	± or ?
Erythema, papules infiltration	Weak positive reaction	+
Erythema, papules vesicles and infiltration	Strong positive reaction	++
Erythema, oedema, vesicles ulceration	Extreme positive reaction	+++
No changes	Negative reaction	-
Sharply demarcated erythema or epidermal necrosis	Irritant reaction	IR

RESULTS

Age and sex

A total of 50 patients completed the study of which 32 (64%) were females and 18 (36%) males. The female to male ratio was 1.78:1. The peak age of onset was found to be between 10-20 years (Figure 1).



Females: Mean±SD = 23.75±11.0, Males: Mean±SD = 34.44±15.52, Combined Mean±SD = 27.6±13.8

Figure 1: Age and sex.

Site of initial lesion

Dorsal aspect of the foot was the most common site of involvement (50%) followed by forefoot (34%), heel (6%), instep area in 2% (Table 2).

Duration of disease

In 44% of the patients, the duration of the disease was between 3-4 years followed by 30% between 0-2 years and 6% between 9-10 years (Table 3).

Seasonal variation

Seasonal variation was observed in 39(78%) of the patients. The condition deteriorated more commonly during winter seen in 46% of the patients. It was followed

by monsoon season (24%) and summer (8%). No seasonal variation was observed in 22% (Table 4).

Table 2: Site of initial lesion.

Site	Frequency	Percentage
Dorsal aspect of foot	25	50.0
Plantar aspect of foot	4	8.0
Fore foot	17	34.0
Heel	3	6.0
Instep	1	2.0
Total	50	100.0

Table 3: Duration of disease.

Duration (in years)	No. of patients	Percentage
0-2	15	30.0
3-4	22	44.0
5-6	4	8.0
7-8	6	12.0
9-10	3	6.0
Total	50	100.0

Mean ±SD=3.9±2.34

Table 4: Seasonal variation.

Seasonal	No. of patients	Percentage
Winter	23	46.0
Summer	4	8.0
Monsoon	12	24.0
No changes	11	22.0
Total	50	100.0

Table 5: Signs and symptoms.

Signs and symptoms	No. of patients	Percentage
Pruritus	44	88.0
Pain	38	76.0
Dryness	24	48.0
Scaling	15	30.0
Redness	19	38.0
Oozing	5	10.0
Fissuring	23	46.0

Table 8: Patch test report with Indian Standard Series.

Antigen	No. of patients	±	+	++	+++
Potassium dichromate	12	3	7	2	-
Neomycin sulphate	1	-	1	-	-
Paraphenylenediamine	7	4	2	1	-
Nickel sulphate	6	1	4	1	-
Colophony	5	1	4	-	-
Cobalt sulphate	4	2	2	-	-
Mercaptobenzothiazole	10	2	7	1	-
Black rubber mix	8	3	5	-	-
Thiuram mix	10	2	8	-	-
Parabens	3	2	1	-	-

Continued.

Signs and symptoms

Pruritus was the most common symptom which was seen in 88% of the patients followed by pain (76%), dryness (48%), fissuring (46%), scaling (30%) and (10%) had oozing (Table 5).

Aggravating factors

Thirty-two (64%) patients gave history of aggravation of itching and worsening of lesions with the use of plastics, rubber & leather foot wear and synthetic socks. 20% with detergent, 10% cement, prolonged contact with water and other irritants. (Table 6)

Table 6: Aggravating factors.

Aggravating factors	No. of patients	Percentage
Footwear/socks	32	64.0
Plants	2	4.0
Detergents	10	20.0
Cement	5	10.0
Medications	1	2.0
Total	50	100.0

Table 7: Extent of dermatitis.

Extent	Unilateral	Bilateral
Plantar surface only	-	3
Dorsal aspect only	-	12
Forefoot both dorsum & plantar	3	28
Heel	1	2
Instep	1	0
Total	5	45

Extent of dermatitis

Bilateral involvement was seen in 90% of the patients, commonest site being forefoot 56%, dorsal aspect of foot alone constituting 24%, followed by plantar surface alone in 6%, heel in 2% and rarely instep (Table 7)

Antigen	No. of patients	±	+	++	+++
Nitrofurazone	2	1	1	-	-
Parthenium	5	1	4	-	-
Chlorocresol	2	1	1	-	-
Fragrance mix	7	2	5	-	-
Lanolin	2	1	1	-	-
Benzocaine	2	2	-	-	-

History of atopy

Personal history of atopy was seen in 24% of the patients and 16% had family history atopy with an overall atopic background seen in 40% (Figure 2).

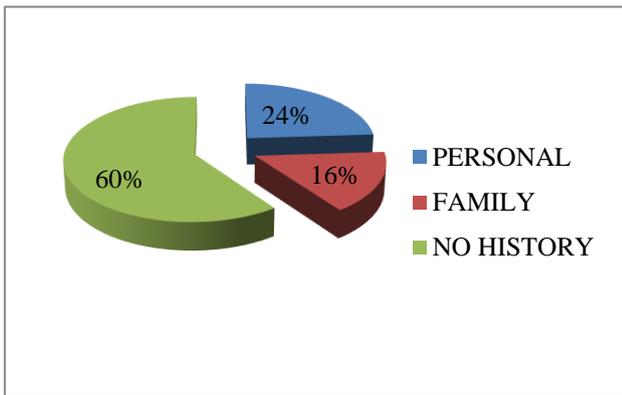


Figure 2: History of atopy.

Family history

Family history of similar illness was present in 48% on patients. 6% had unrelated skin disease while 46% had no significant illness in family (Figure 3).

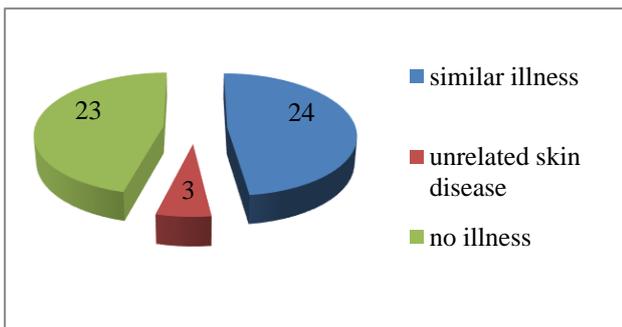


Figure 3: Family history.

Patch test report with Indian standard series

Potassium dichromate was the commonest sensitizer with 12 (24%) patients testing positive out of which two had strong positive reaction. Mercaptobenzothiazole was found to be the second commonest sensitizer comprising 10 (20%) patients where again one patient had strong positive reaction. Thiuram mix also showed positive reaction in 10 (20%) patients followed by black rubber

mix 8 (16%), paraphenylenediamine 7 (15%), fragrance mix 7 (15%), nickel sulphate 6 (12%), colophony 5 (10%), parthenium 5 (10%), cobalt sulphate 4(8%) & parabens 3 (6%). Among topical medication neomycin sulphate sensitivity was seen in 1 (2%) patients. Most of our patients showed weak positive and faint erythema or doubtful reaction and a few showed strong positive reaction. Irritant reaction was not seen in any of our patients (Table 8).

DISCUSSION

Foot eczema is one of the most common eczemas encountered among the out patients presenting to Dermatology department. Allergic Contact Dermatitis (ACD) accounts for at least 20% or more of the new incident cases in the subgroup of contact dermatitis and is a leading cause of foot eczema along with others like forefoot eczema (Figure 4), atopic dermatitis, pompholyx and nummular eczema. Hands and feet are more vulnerable to eczema due to repeated contact with exogenous agents. The causative factors are constantly changing just as the footwear industry is continually changing. These range from the leather itself to rubber accelerators and from dyes to even metal rim. The incidence of footwear dermatitis and newer antigens with allergenic potential has shown an upsurge in the recent years. Indians are particularly prone to develop footwear allergies (Figure 4) as it is a common practice to wear shoes and sandals on bare feet without socks. Moreover, the quality control of shoe production industry in India is not strictly regulated. Educating about the avoidance of allergen and providing suitable alternatives are crucial to good outcome. Patch test is fundamental for identification of causative allergen and is indicated in persistent and recurrent dermatitis.

The current study was undertaken to know the clinical pattern of foot eczema and to determine the causative agent based upon the result of patch testing is compared with other similar studies. 50 patients who presented with foot eczema were studied by means of detailed history, clinical examination and subjected to patch testing using Indian Standard Series of allergens. The results obtained were analysed and interpreted vide infra.

The most common age group of presentation of foot eczema in our study was between 10-20 years and 21 (42%) patients presented in this age group. It was followed by the groups between 20-30 years and 30-40

years with 20% and 18% respectively. The further older age group constituted only 10% of the study population. Our study showed that foot eczema presented predominantly among the adolescent age group. While other studies with similar background by Priya et al Hand et al showed higher incidence in the 3rd and 4th decade.^{4,5} The probable reason for a younger age of involvement might be the fact that this age group is the most active phase of one's life where the chances of exposure to allergens of all kinds is at the maximum risk. With more outdoor activities, games, frequent contact with dust and water, increased sweating and including the use of a variety of trendy or fancy footwears, use of socks made of varied material etc which are common concerns among the young new generation, all of which predispose to the existing condition. Our study also had forefoot eczema being more common than allergic contact dermatitis which starts presenting at a younger age while compared to other eczemas and is influenced by many of the above factors together with a roleplay of atopy.



Figure 4: (A) Forefoot eczema (B, C) ACD to footwear, (D) 2+ reaction to PPD.

In our study of which 64% were females and 36% were males. Foot dermatitis occurs in an equal incidence in either sex, although some studies have reported a slight male preponderance. But the present study shows a significant female preponderance (ratio 1.78:1) which was similar to the results obtained in studies conducted by Chougule and Thappa and Brar et al on forefoot eczema.^{6,7} This significant female predominance may be attributed to the fact that women come in contact with irritants and water with indulgence in wet work more when compared to males resulting in impaired epidermal barrier function eventually leading to higher frequency of penetration by allergens. Nowadays, females are exposed to a variety of designer footwear that matches with their wardrobes which is seen only to a lesser extent in males. Most Indian women are engaged in household work involving washing clothes and utensils. As many of them squat on the ground, their feet are exposed to water and detergents thus leading to chronic low grade irritant dermatitis. In this part of Kerala females are also at par

with males in doing the laborious work apart from the routine household work and also work with barefoot which may also contribute to the action of various allergens directly leading to the dermatoses.

In the present study, majority of the patients (44%) presented with disease duration of 3-4 years. In the studies done by Handa et al and Sravani Sandhya et al the mean duration of illness was 2.5 years and 19.48 months respectively.^{5,8} In this study the long duration of illness probably reflects the chronic nature of the illness which in most cases are recurrent or persisting and are recalcitrant to treatment.

Most common site of initial lesion in our study was on the dorsal aspect of feet seen in 25(50%) patients followed by forefoot 17 (34%), plantar aspect (8%), heel (6%) and instep (2%). This results were comparable with earlier studies by Handa et al and Garg et al lesions on dorsum of the feet corresponding to the type of the footwear ('V' shaped chappals, slippers) were observed which is usually worn without socks and is preferred by people living in warm and humid tropical climates as in this part of Kerala.^{5,9}

Of the factors implicated in aggravating foot eczemas, the background of atopic disease has been stated to be important. In this present study 24% of the patients had personal history of atopy and 16% had family history of atopy. This is in par with the results observed in the studies by Ortiz-Salvador et al, Rahima et al and Clayton et al.¹⁰⁻¹² This is due to the damaged epidermal barrier in atopics increasing the penetration of the allergen. 48% of patients in our study had family history of similar illness especially forefoot eczema. This finding was at par with results obtained in other studies.⁷ Thus a strong positive genetic factor plays a role together with a background of atopy may be the reason for the more prevalence of this condition in this part of Kerala.

In the present study 23 (46%) patients gave history of deterioration during winter and improvement in summer. This may be associated with xerosis and atopy which gets aggravated during winter leading to further compromise of the barrier function. Monsoon season showed aggravation in 24% of the patients. Most of such patients had history of contact with mud, use of open sandals, slippers and damp socks worn to educational institutions. Though forefoot eczema was predominant in our study which has shown be worse in summer and improvement in winter, only 4 (8%) patients showed aggravation during summer in this study. Our results were in accordance with the results obtained by Brar et al.^{7,13}

Itch and swelling are key components that give a clue to contact allergy while in forefoot eczema main complaints are redness, irritation, cracking and soreness, pruritus is seldom reported.⁷ In our study pruritus was most common, seen in 88% of patients followed by pain in 76%, dryness in 48%, fissuring in 46%, scaling in 30%

and oozing in 10%. As in our study most cases showed allergic contact dermatitis, pruritus was the common symptom while fissuring and pain was mostly seen in those presenting as forefoot eczema. Our results were at par with the study done by Garg et al.⁹ 64% of the patients reported aggravation of itching with the use of leather, plastic or rubber footwear. As leather goods contain high levels of chromium in the form of potassium dichromate used for its tanning and dyeing, it was an important sensitizer in our study too. Others are rubber chemicals and plastic content in footwears. Further the use of socks which are mostly made of synthetic material add to the cause or can even predispose to increased hydration contributing to leaching out of chrome from leather.¹¹ 10% had aggravation with cement and 20% with detergents and 2% with medications. It is now well understood that an individual's use of soap and other bathing products (shower gels, bubble baths) along with baby wipes are all linked to both the development and flare ups associated with eczema. Use of antibiotics on large scale, antibacterial soaps, creams and cleaners produce an environment whereby the immune system does not receive adequate exposure to develop normally to an antigen resulting in the overall immune become hyperactive.

Several authors have reported that rubber based adhesives which are universally used in the shoe industry are apparently the cause of shoe dermatitis.^{3,14} Contact dermatitis to chappals and sandals is seen more commonly in tropics due to footwear habits than closed types of shoes as confirmed in our study. Soaps and detergents have been implicated as predisposing factors in various studies.¹⁵

The disease involvement was bilateral in 90% of patients. Unilateral distribution was not seen in the following types of eczema: juvenile plantar dermatosis, cumulative irritant contact dermatitis (CICD) and hyperkeratotic eczema. Forefoot being the most common site of involvement predominantly was seen in 56% which was followed by involvement of dorsal aspect of foot alone and little involvement of plantar surface alone, heel and instep areas. Involvement of forefoot area mostly in our study along with an involvement of younger age group reinforces forefoot eczema as the most common type of foot eczema involved in this part of Kerala. It was followed by the involvement of dorsal aspect of feet in eczematous process pointing towards allergic contact dermatitis to various agents coming across like footwear, cement, detergents which was similar to the results obtained in other studies.^{6,16}

Positive patch test reactions are the best objective evidence for shoe and other contact allergy. In our study 78% of the patients gave positive patch test results which is much higher than the positivity rate of 32.3% that was reported in a study from Turkey.¹⁷ However prior studies from other parts of India have reported similar patch test positivity rates comparable to that seen in our study.^{18,19}

Our tropical climate may be partly responsible for this phenomenon. Potassium dichromate was the commonest sensitizer in our study with 12(24%) patients testing positive. It is used as a tanning agent in leather shoe, present in soaps and detergents and the presence of it in the unpolished cement flooring of the houses and educational institutions as well as concrete tiling of the area surrounding their houses may be the contributing factor. In India, chrome-free leather is not much in use due to its non-availability and high cost. At present, the leather used in India leads to more cases of footwear dermatitis than in western countries where rubber chemicals are the more common sensitizers. Our result was consistent with findings of other studies done by Ortiz-Salvador et al, Sravani Sandhya Bellam et al, Choudhary et al and Bajaj et al.^{4,8,20,21}

In our study also MBT was the second most common sensitizer (20%), finding is also consistent with result of studies by Suryanarayan et al, Epan et al.^{22,23} Mercaptobenzothiazole is one of the major component of rubber foot wear. Thiuram mix was positive in 20% of the patients. It is another common allergen causing rubber dermatitis. Black rubber mix was positive in 16%. Foot dermatitis particularly in children is due to use of rubber in shoes and in construction workers due to use of rubber boots.

The most commonly used dyes in leather shoes are azo aniline group dyes eg. 4-phenylcne diamine base. This study had it positive in 10 (20%) patients out of which one patient showed extreme positive reaction (Figure 4). As black color is the preferred color in shoes and socks; hence, paraphenylenediamine is a common allergen even in our study. Saha et al has documented a case report of paraphenylenediamine sensitivity in footwear dermatitis.²⁴

Nickel sulphate was the commonest metal positive, in 6 (12%) patients. Nickel is a common content of shoe buckles or metal rims of footwear which might be the reason for its sensitivity. In the study by Goh et al showed that nickel and cobalt are also constituents of Asian cements with concentrations ranging from 14.9 to 28.5 µg and 8.1 to 14.2 µg respectively.²⁵

Topical medicaments (Neomycin sulphate) gave a positive patch test in 2% cases. Sidi et al reported that neomycin was the most common sensitizer among topical medicaments.²⁶

Total 48% of our patients were sensitive to single antigens, 20% to two antigens, 12% to three antigens and 8% to more than three. In 11 (22%) patients no positive patch test results were obtained. It may be substantiated by the fact that apart from contact dermatitis, forefoot eczema also occurred in a higher percentage (56%) and atopy might have contributed to the eczema in them.^{27,7}

Limitations

Limitation was a small sample size, no histopathological confirmation of cases, entire footwear series antigens and patient's shoe material was not patch tested.

CONCLUSION

Foot eczemas are one among the many common dermatological disorders that is seen in a dermatology outpatient department and are common in allergic contact dermatitis group. Footwear allergy and forefoot eczema are the most common causes of foot eczema. The most common morphological pattern is dry scaly plaque type with fissuring. People having personal or family history of atopy are predisposed to develop foot eczema. Seasonal exacerbation is common. Patch testing has a major role to play in finding out the causative allergen and as footwear is the main cause, most of our patients were tested positive to one of the various compounds that are found in footwear namely Potassium dichromate, MBT & thiuram mix being the most common among them.

The lack of product information released from shoe manufacturers and the continually changing trends in footwear present a challenge in treating this condition. As information and knowledge regarding the chemical allergens present in a particular footwear is not available, the selection of a proper footwear becomes difficult and if made possible could be of great help to these patients suffering from foot eczema which can reduce their morbidity by decreasing the frequencies of recurrences and can improve their quality of life.

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