



AN EPIDEMIOLOGICAL STUDY ON THE CAUSATIVE AGENTS OF FOOTWEAR DERMATITIS IN 90 PATIENTS

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ABSTRACT

Background: Footwear dermatitis may be defined as skin manifestations on the feet precipitated by the wearing of shoes, boots or sandals. It is a CD4-T lymphocyte mediated type-4 hypersensitivity reaction eventually culminating in cutaneous inflammatory changes. Patch test provides precise and simple means for diagnosis and helps the physician to initiate appropriate management at the earliest. An attempt was made to study the common causative allergens of Footwear dermatitis and its epidemiological relevance as it would prove beneficial in the treatment.

Materials and methods: Patients with the signs and symptoms of footwear dermatitis were selected, detailed history and presenting complaints were taken and recorded in a prepared case record form. Patch test kit recommended by the Contact and Occupational Dermatoses Forum of India (CODFI) which contains 20 antigens of standard footwear series was used. Results were graded and statistical analysis was done.

Results: The common allergens found on analyzing the patch test result was found to be Nickel Sulphate (63.3 %), Black rubber mix (61.1%), Cobalt Sulphate (60.1%) Potassium bichromate (61.0%), Chlorocresol (54%) and Paraphenyldiamine (28.9%).

Discussion and Conclusion: Footwear dermatitis is one of the most misdiagnosed or empirically diagnosed skin ailment in majority of dermatological OPD's. Employment of patch test will provide a resolution for this delinquent. Most common allergens found in the study were Nickel Sulphate and Black rubber mix.

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INTRODUCTION

Footwear dermatitis may be defined as skin manifestations on the feet precipitated by the wearing of shoes, boots or sandals. This often occurs as the skin on the feet reacts to particular antigenic substances found in footwear, leading to the CD4-T lymphocyte mediated type-4 hypersensitivity reaction eventually culminating in cutaneous inflammatory changes.¹ The overall prevalence of Footwear dermatitis is 3-11.7%^{2,14}. The common sensitizers includes Nickel sulphate, cobalt sulphate, Potassium dichromate, Colophony, Formaldehyde, 2-MBT, Disperse orange, Disperse blue etc. Many other clinical conditions can also give rise to lower extremity dermatitis such as Psoriasis, Atopic dermatitis, Cellulitis, Chronic superficial folliculitis, Prurigo, Dermatophytosis, Insect bite and hypertrophic Lichen Planus. The correct identification of this condition is necessary to avoid the misdiagnosis and further management of this condition.

Patch test⁵ is a method used to determine whether a specific substance causes allergic inflammation of a patient's skin.

Any individual suspected of having Allergic contact dermatitis or Atopic dermatitis needs Patch testing.

An attempt was made to study the common causative allergens of Footwear dermatitis as it would prove beneficial for a practitioner to render appropriate instructions regarding the type of footwear to be adopted and those to be rejected along with the prescriptions.

MATERIALS AND METHODS

A cross sectional survey was conducted to find out the prevalence and percentage of common allergy causing antigens in Out Patient unit of *Agadanttra* department, VPSV Ayurveda college, Kottakkal from March 2018 – December 2018. Ninety patients with signs and symptoms similar to that of Footwear dermatitis who were positively patch tested were selected and the data was obtained. Ethical committee clearance IEC approval (No. IEC / CL / 03 / 17) dated 27/04/2018. Prior consent was obtained from the patients before the procedure. Detailed case history was taken including the chief complaints, with atopic history, history of past illness, previous medications, exposure to temperature variations and any previous skin ailments and was recorded in a case record form. Site of lesion and occupational history was

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also noted. Detailed clinical examination was done to find out substantial clinico- allergological correlation. The type of footwear which triggered the disease was inspected in detail and assessed to find out the probable allergen before doing the patch test. Participants were selected according to the inclusion criteria which were as enlisted

- Patients who shared a history of footwear allergy.
- Patients with symptoms of Footwear dermatitis, which includes inflammation, exudation, vesicle formation, numbness and itching
- Age group of 18 – 70

Patients with serious systemic disorders including Diabetes and Hypertension and Lactating and pregnant mothers were excluded from the study.

Patchtest kit was purchased from Systopic Laboratories Private limited, 305, Pragati chambers, commercial complex, Ranjit Nagar, New Delhi-110008. Each kit contains 20 antigens and 60 finn chamber slips as recommended by the Contact and Occupational Dermatoses Forum Of India (CODFI). The kit contained 20 allergens, where 18 were in ointment form and two were in liquid form. The Aluminium patch test chambers prefixed on micropore tape and filter paper covering, 10 on each strip.

Consent was obtained from each patient in prescribed form which was duly filled and signed by the patient. Detailed instructions were given to the patient regarding the patch test and doubts raised by the participants were cleared. Directions to be followed before, during and after the patch test was explained. A post-patch test counselling was given on the basis of the result.

Procedure³

The strip of Finn chambers was numbered and the allergens were placed in individual wells of Finn chambers. The upperback of the subject was wiped with clean cotton to take away the sweat and moisture. The strip of Finn chambers loaded with the allergens was applied to the skin under occlusion over the upperback, for two days (48 hours).

The subject was given clear instructions to avoid bath and excessive sweating. The subject was also asked to contact the concerned doctor, (a copy of the consent form with the contact details of concerned doctors was given to every subject) on experiencing any discomfort over the area of patch testing. Before the removal of the strip, the numbering of the four corners of the strip was noted subjects skin adjacent to the strip, so that after the removal of the strip, the allergens can be traced out. The reading was taken after 15-30 minutes on the removal of occlusive strips to allow the transient erythema caused by the occlusive effects of antigens and antibodies to subside. The grading of the patch test is given below.

Table no 1 Grading of patch test³

Sl no	Grade	Criteria	Significance
1	0	Mild erythema, no oedema	Doubtful
2	1+	Erythema, oedema and induration	Positive
3	2+	Erythema, odema isolated vesicles	Positive
4	3+	Erythema, oedema and confluent vesicles	Positive

Table no 2 Standard footwear series¹⁸

STANDARD FOOTWEAR SERIES		
Category	Name	Concentration
LEATHER CHEMICALS	Potassium bichromate	0.1%
	Formaldehyde-	2%
	Glutaraldehyde-	0.2%
RUBBER CHEMICALS	Thiuram mix	1%
	Black rubber mix	0.6% pet
	Mercaptobenzothiazole	1%
	Parabens mix	9%
	Mercapto mix	2%
PLASTICS	Paraphenylenediamine	1%
	Epoxy resin-	1%
DYES	Vaseline	100%
	Fragrance mix-	
	Chlorocresol-	1%
GLUES AND NEOPREN	Colophony	10%
	Benzocaine	5%
CEMENTS		
	Wool alcohol(lanolin)	30%
ANTIMICROBIALS	Neomycin sulphate	20%pet
OTHERS	Nickel sulphate	5% pet
	Balsam of peru	10%
	Cobalt sulphate	5%



Fig 1 Twenty antigens in the patch test kit



Fig 2 Finn chambers pasted over the back

RESULTS

Statistical analysis of the results was done. There were 90 participants in the study of age group-17-70 and maximum participants was between 18-23 age group (50 %). 25% of the patients were included in 24 – 35 years. 18 % in the age group of 35-60 years. Out of the 90 participants, 27.8% were male (n=25) and 72.2% were female (n=65). 51% of the research participants were house wives and students were 22.2 % and manual workers amounted to about 25.6%.

On patch testing majority of the patients showed grade 1 or grade 2 reaction. No adverse reactions were noted on performing the test. Itching at the site of application was observed in a few patients (n=10). Isolated vesicles were noted at the site of application of patch test strip. When patch test to cobalt, one may see a particular reaction named as “poral”, that appears as erythematous to violaceous dots. Polysensitivity, allergic reactions to more than 1 chemicals were found in many participants.

The common allergens found on analyzing the patch test result was found to be Nickel sulphate (63.3 %), Cobalt sulphate (60.1%), Black rubber mix (61.1%), Potassium bichromate (61.0%), Chlorocresol (54%) and Paraphenyldiamine (28.9%).

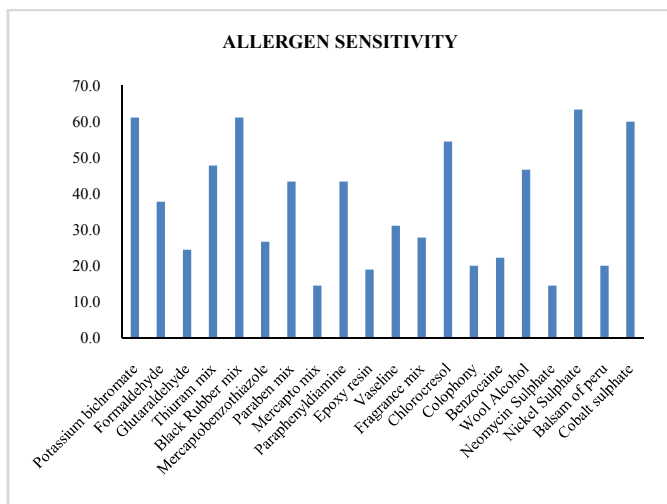


Fig 3 Graph showing allergen sensitivity.

DISCUSSION

Contact dermatitis is an inflammatory skin condition induced by exposure to an environmental agent². Substances accountable for contact dermatitis after single or multiple exposure are non-protein chemicals, i.e. the haptens, which induces skin inflammation through activation of innate skin immunity [Irritant contact dermatitis] or both innate and acquired specific immunity [Allergic contact dermatitis].³ Allergens are substances with physico-chemical properties which allows them to cross the skin barrier, such as molecular weight less than 500 Da and lipophilicity, which allows them to stimulate the immune system of vulnerable individuals. Once in interaction with the internal medium, allergens are able to bond with the endogenous proteins constituting the protein- hapten complexes, thus leading to skin immune responses.⁵ Disruption of the integrity of epidermal barrier appears to be the first step in the events following the contact with the allergen.⁶

There were 90 participants in the study of age group-17-70 and maximum participants was between 18-23 age group (50 %). According to a previous study by Romaguera C¹⁵, Footwaer dermatitis may occur at any age. Teenagers and young adults frequently change their foot wears and they walk long distances and play more in outdoors, they may be more exposed to dust and humidity this may increase the incidence of footwear dermatitis. Females are more exposed to external allergens like detergents, cleansing agents, water that may cause irritation to the foot resulting in impaired epidermal barrier function which leads to increased penetration of the shoe allergens leading to increased incidence of footwear

dermatitis in the female population. Economic status implies that the incidence of footwear dermatitis is more in poor and middle class females who are more prone to substandard detergent and foot wears.

In Patch test clinics world -wide nickel is the most common allergen as proven in the previous studies^{8,9}. In a study conducted by Handa *et al*¹⁶, rubber chemicals were the commonest allergens (17.3%). Study conducted by Sreejesh *et al*¹⁴, Black rubber mix proved to be the commonest allergen (18%). In a study conducted by Garg *et al*⁷, the most common allergen detected was hydroquinone monobenzyl ether which is used as a rubber additive. In a study conducted by SanjibChaudhari *et al*¹⁷, Potassium dichromate and cobalt chloride were the common allergens. In our study, Nickel sulphate, Black rubber mix, Cobalt sulphate were identified as the most common allergens. Nickel is a strong silver colored metal which is used in jewelry, buckles and snaps and other metal containing objects¹⁰. In foot wear nickel is commonly used in buckles, zib etc. This justifies the high incidence of Nickel sulphate allergy obtained on performing Patch test (63.3%). Maximum percentage of participants included in the study comes under the age group of 17-23 years who uses the ornamental shoes and sandals which uses nickel more in buckles and zips. Cobalt sulphate is also used like wise¹¹.

Black rubber mix or its components are used to make black or dark grey rubber products such as shoes, tires, goggles and sporting equipment's¹³. They leave a black color to the rubber. They are commonly used as antioxidants in the production of rubber, they prevent rubber from drying or cracking. Most of the female participants of the study were house wives and constantly used sandals made of black rubber. The black rubber sandals were cheap and long lasting which lead to their acceptance among the house wives community. Chlorocresol is a phenol compound which is chlorinated and used as a disinfectant and preservative in range of products including footwear¹². Paraphenyldiamine are allergenic dyes which are used to dye the textiles and leathers.¹⁸ It can also be found as an additive to black rubber. The footwear materials most likely to contain formaldehyde are textiles (where it may be used as stiffeners) and leathers where it may be present in some synthetic tanagers or finishes.¹⁹

CONCLUSION

Footwear dermatitis is one of the most misdiagnosed or empirically diagnosed skin ailment in majority of dermatological OPD's. Employment of patch test will provide a resolution for this delinquent. Awareness and avoidance of footwear dermatitis producing allergens helps the practitioner and the patient to attain more results. A higher incidence among age group of 17- 23 and a preponderance of females in the study may be due to their exposure to extremes of temperatures and frequent change in footwears. Nickel sulphate and Black rubber mix were the common allergens found in the study where nickel sulphate is commonly used in ornamental type of footwear while Black rubber mix is mostly employed in sandals used by housewives.

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