

**STUDY OF PATCH TESTING IN ALLERGIC CONTACT DERMATITIS IN HANDS AND FEET**A. Venkata Krishna<sup>1</sup>, N. Sudheer<sup>2</sup>, P. Padmaja<sup>3</sup>, M. Gopinath<sup>4</sup>, Gautham Krishna Reddy<sup>5</sup><sup>1</sup>Associate Professor, Department of DVL, Osmania Medical College/Hospital.<sup>2</sup>Assistant Professor, Department of DVL, Osmania Medical College/Hospital.<sup>3</sup>Associate Professor, Department of DVL, Osmania Medical College/Hospital.<sup>4</sup>Junior Resident, Department of DVL, Osmania Medical College/Hospital.<sup>5</sup>Junior Resident, Department of DVL, Osmania Medical College/Hospital.**ABSTRACT**

Contact Dermatitis (CD) is an altered state of skin reactivity induced by exposure to an external agent. According to the mechanism of elicitation, the following types of contact reactions may be distinguished: Allergic Contact Dermatitis (ACD), Irritant Contact Dermatitis (ICD), Phototoxic and Photo Allergic Contact Dermatitis and Immediate Type Contact Reactions or Immune Contact Urticaria. ACD is a delayed-type hypersensitivity reaction that is elicited when the skin comes in contact with a chemical to which an individual has previously been sensitised. Patch testing remains the gold standard for diagnosing ACD. This study focuses on identifying the allergens causing ACD of hands and feet.

**METHOD**

Study was conducted in Osmania General Hospital, Hyderabad, over a period of 12 months' duration. Patients suspected to have contact dermatitis were subjected to patch testing. Based on the history, clinical signs and symptoms, a total of 50 patients were shortlisted in 12 months' duration.

**RESULT**

Our study showed that the most common allergen showing patch test positivity in both males and females were metals like chromates followed by cosmetics and others. Patients showed significant improvement in their dermatitis after avoidance of the offending agent.

**CONCLUSION**

Patch test is the method of choice and the "gold standard" in the detection of contact allergy and allergic contact dermatitis.

**KEYWORDS**

Contact Dermatitis, Allergen, Patch Test.

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**INTRODUCTION**

Contact Dermatitis (CD) is an altered state of skin reactivity induced by exposure to an external agent. According to the mechanism of elicitation, the following types of contact reactions may be distinguished.

1. Allergic Contact Dermatitis (ACD).
2. Irritant Contact Dermatitis (ICD).
3. Phototoxic and Photo Allergic Contact Dermatitis.
4. Immediate Type Contact Reactions or Immune Contact Urticaria.<sup>1</sup>

ACD is a delayed-type hypersensitivity reaction that is elicited when the skin comes in contact with a chemical to which an individual has previously been sensitised. Because ICD and ACD are not always distinguishable clinically, patch testing is required to help identify an allergen or exclude an allergy to a suspected allergen. Patch testing remains the gold standard for diagnosing ACD.<sup>2</sup> This study focuses on identifying the allergens causing ACD of hands and feet.

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**AIMS AND OBJECTIVES**

To evaluate all clinically suspected Allergic Contact Dermatitis cases of the Hands and Feet by patch tests using the Indian standard series and to identify the causative allergen.

**MATERIAL AND METHODS**

Study comprised of 50 clinically suspected cases of Allergic Contact Dermatitis of Hand, Feet or Both, attending the Dermatology OPD, DVL Department, Osmania General Hospital, over 12 months' period.

**Inclusion Criteria**

- All patients presenting with dermatitis of the Hands or Feet, either as an isolated dermatitis or a more widespread dermatitis predominantly or partly involving the hands and feet. This group of patients were scrutinised to exclude the non-allergic conditions as far as possible.
- Age group between 1-80 years.
- Both sexes.
- Patients who gave consent for patch testing.

**Exclusion Criteria**

- Infants and age group more than 80 years.
- Pregnant mothers.
- Patients presenting with active dermatitis.
- Patients on systemic corticosteroids, immunosuppressants, PUVA therapy for at least 2 weeks prior to patch test.

- If topical steroids are being used on the back, patch test should be delayed for 3 days.

## TEST MATERIALS

### Antigens

All cases were patch tested with all the 20 antigens of the Indian Standard Series comprising:

Sl. No.	Compound	Concentration (%)
1	Control	100
2	Wool alcohols	30.0
3	Balsam of Peru	10.0
4	Formaldehyde	2.0
5	Mercaptobenzothiazole (MBT)	1.0
6	Potassium Dichromate	0.5
7	Nickel sulphate	5.0
8	Cobalt sulphate	5.0
9	Colophony	10.0
10	Epoxy resin	1.0
11	Parabens mix	9.0
12	Paraphenylenediamine base (PPD)	1.0
13	Parthenium	15%
14	Neomycin sulphate	20.0
15	Benzocaine	5.0
16	Chlorocresol	1.0
17	Fragrance mix	8.0
	Cinnamic alcohol	1.0
	Cinnamic aldehyde	1.0
	Hydroxycitronellal	1.0
	Amyl cinnamaldehyde	1.0
	Geraniol	1.0
	Eugenol	1.0
	Isoeugenol	1.0
	Oakmoss absolute	1.0
18	Thiuram Mix	1.0
	Tetramethylthiuram monosulfide	0.25
	Tetramethylthiuram disulfide (TMTD)	0.25
	Tetraethylthiuram disulfide	0.25
	Dipentamethylenethiuram disulfide (DPTD)	0.25
19	Nitrofurazone	1.0
20	Black rubber mix	0.6
	N-isopropyl-n-phenyl-4-phenylenediamine	0.1
	N-cyclohexyl-N-phenylenediamine	0.25
	N, N-diphenyl-4-phenylenediamine	0.25

**Table 1: Indian Standard Battery of Patch Test Allergens**

These antigens were supplied as: - Antigen-petrolatum mixtures in syringe.

## METHODOLOGY

Of total 50 patients, 33 male and 17 female were enrolled in the study. Data were obtained using a questionnaire. Patient was prepared by gentle cleaning with spirit avoiding excess rubbing, then Patch testing was done. Patients were asked to avoid oral prednisone or other immunosuppressive medications for at least a week prior to testing, as this may suppress positive reactions. The patches were removed on day 2, i.e. after 48 hours and reading was taken 1 hour later

to allow erythema from the stripping action of the tape to settle. Grooves at the chamber site were indicative of good occlusive effect. Second reading was taken on day 4, i.e. at 96 hours.

The Patch test reactions were graded according to the recommendations of the International Contact Dermatitis Research Group (ICDRG).

Symbol	Morphology	Interpretation
-	No change	Negative reaction
?+	Faint erythema only	Doubtful reaction
+	Erythema, infiltration, possibly discrete papules	Weak positive reaction
++	Erythema, infiltration, papules, vesicles	Strong positive reaction
+++	Intense erythema and infiltration and coalescing vesicles	Extreme positive reaction
IR	Different types of reactions	Irritant Reaction
NT		Not tested

**Table 2: Patch Test Interpretation based on ICDRG**

### The Following were considered as True Allergic Reaction in my Study

Erythematous and/or infiltrated lesions

Positive (+) after 48 hours and Positive (+) after 96 hours.

Or Negative (-) 48 hours and Positive (+) 96 hours.

Where reactions were doubtful even on day 4, a further 'late' reading was taken 7-10 days later. Those Positive (+) 48 hours and Negative (-) 96 hours were not considered as positive.

## RESULTS

Allergic contact dermatitis accounted for 4.9% of the total dermatology outpatient cases attending the DVL Department, Osmania General Hospital, Hyderabad, during this period. Hand and Foot Dermatitis accounted for 33.5% of the ACD cases and 1.64% of the total outpatient cases.

Of the 50 patients tested, 29 were positive to one or more antigens of the standard series reflecting a positivity rate of 58% to the Indian standard series; 54% of the patients belongs to 3<sup>rd</sup> and 4<sup>th</sup> decades, that is 21 to 40 years' age group. The youngest patient was aged about 11 years and the oldest aged about 65 years. In the positively tested group of patients, mean age of the males 36.37 years and females 34.17 years (average: 35.27 years). Of the total patients 33 were male and 17 were female, ratio of 1.94:1. While 23 of the 33 male patients (69.67%) tested positive, 6 of the 17 female patients (35.29%) were tested positive. Occupational background of the positive cases revealed 86.96% of the positive males and 66.67% positive females were semi-skilled workers. Of the total positive cases, the semiskilled group accounted for 82.76% of the cases, Housewives for 6.90%, skilled, unskilled and students accounted for 3.45% each.

Hand and feet dermatitis accounted for 41.38%, isolated hand dermatitis for 27.59% in total positive cases. Isolated hand dermatitis in positive female patients was 33.33%, which is commoner than males (26.09%). Hand and/or Foot Dermatitis elsewhere on the body was seen in 20.67% of the cases; 37.93% of the positively tested cases presented with a Chronic dermatitis. Sub-acute dermatitis and Acute

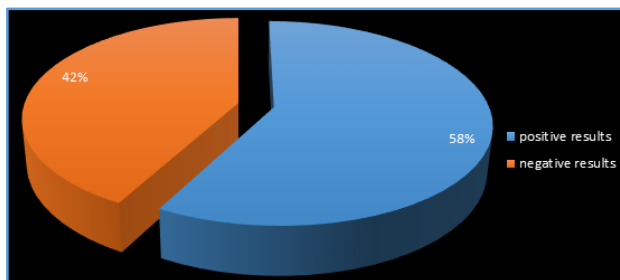
dermatitis accounted for 31.03% each. The mean duration of the disease was 1.9 years. A personal or family history of Atopy as hay fever, asthma or atopic dermatitis was present in 9 patients (18%) of whom 7 (14%) were tested positive.



**Fig. 1: Patch Test Placed on Upper Back**



**Fig. 2: Extreme Positive (+++) Reaction to Allergen (Thiuram Mix)**



**Fig. 3: Patch Test Results**

Allergen	Incidence in Males	Incidence in Females	Total Incidence
<b>Metals</b>			
Potassium dichromate	12	1	13(27.08%)
Nickel sulphate	1	1	2(4.17%)
Cobalt sulphate	6	2	8(16.67%)
<b>Cosmetic Ingredients</b>			
Balsam of Peru	-	-	5(10.47%)
Fragrance mix	3	2	-
Formaldehyde	-	-	-
Paraphenylenediamine	3	-	3(6.25%)
<b>Antibiotics &amp; Medicaments</b>			
Neomycin sulphate	1	-	1(2.08%)
Nitrofurazone	4	-	4(8.33%)
Benzocaine	-	-	-
<b>Pharmaceuticals used in Both Medicaments &amp; Cosmetics</b>			
Paraben mix	-	-	-
Colophony	2	-	2(4.17%)
Chlorocresol	-	2	2(4.17%)
Wool alcohol	-	-	-
<b>Rubbers</b>			
Mercaptobenzothiazole	-	1	1(2.08%)
Thiuram mix	2	-	2(4.17%)
Black rubber mix	1	-	1(2.08%)
<b>Plant Antigens</b>			
Parthenium	3	-	3(6.25%)
<b>Miscellaneous</b>			
Epoxy resin	1	-	1(2.08%)
Control	-	-	-

**Table 3: Master Chart of the Individual Patch Test Results**

The metals ranked first (47.92%) followed by the cosmetic ingredients (16.67%), medicaments (10.42%), rubbers (8.33%), pharmaceuticals (8.33%), plant antigens (6.25%) and finally miscellaneous antigens (2.08%). In Males, highest positivity was seen to the metals group of antigens (48.72%) followed by cosmetic ingredients (15.38%), medicaments (12.82%). Least positivity was to plant antigens (2.56%). In Females, the highest positivity was to metals (44.44%) followed by pharmaceuticals and cosmetics (22.22% each) and finally to rubbers (11.11%). Potassium dichromate showed the highest incidence (27.08%). Similarly in males potassium dichromate was the commonest antigen, whereas in females Cobalt, Fragrance mix and Wool alcohol are the commonest antigens. Maximum sensitivity were seen in the 31-40 years' age group. The majority (58.62) were positive to a single allergen, 20.69% were positive to 2 allergens, 17.24% were positive to 3 allergens; 43.75% of the reactions were 1+ (weakly positive), 33.33% of the reactions are 2+ (strongly positive); 18.75% of the reactions were doubtfully positive and their positivity was correlated clinically. No irritant reactions persisted at final reading (Day 4). In total 29 positive cases, current relevance to the antigen exposure was found in 18 cases (62.07%), past relevance to the antigen was found in 5 (17.24%) and there is no relevance to antigen found in 6 patients.

**DISCUSSION**

In our study, Allergic Contact Dermatitis cases accounted for 4.9% of the total dermatology outpatient attendance. A similar incidence (4-7%) was reported by Christophersen from Denmark<sup>3</sup> and Mendenhall et al from USA.<sup>4</sup>

In our study, Hand and Foot Dermatitis accounted for 33.5% of the ACD cases and 1.64% of the total outpatient

cases. Hand involvement was seen in 23.3% of the ACD cases with 9% having an isolated hand dermatitis. Warsha E M et al<sup>5</sup> reported 31.57% of hand involvement in a cross sectional analysis of all patch tested ACD cases between 1994 to 2004 in North America contact dermatitis group. Isolated foot dermatitis accounted for 8% of the ACD cases in our study, which is corroboratory with the incidence reported by Dhurandhar<sup>6</sup> and Pasricha<sup>7</sup> (7.6-10.8%), Huda and Paul<sup>8</sup> (6.2%) and Angelini<sup>9</sup> et al (3 to 6.3%) from footwear dermatitis. The dermatitis mainly affected patients between 11-70 years of age. A similar age distribution was reported by Handa et al<sup>10</sup> (13-70 years). There were no patients under the 10 years of age probably because of a simpler environment in children. In a study by Strauss,<sup>11</sup> who was able to sensitise 35 of 48 infants (1 to 4 years old) to toxicodendron oleoresin, he suggested that the apparent hypo-responsiveness of children may be due to limited exposure and not to deficit immunity as was believed in the past. Also none of our patients were about 70 years. The reason could be a declining inflammatory response and simpler environment again. Average mean age of our patients was 34.15 years, which is close to mean ages in studies reported by A.K. Bajaj et al<sup>12</sup> (35.9 years), Singhal V et al<sup>13</sup> (36.63 +/- 5.6 yrs). In our study majority of the patients (54%) were from the 21-40 years' age group; 28% of them from 31-40 years' and 26% from 21-30 years' age group. In the study by Kishore N.B et al<sup>14</sup> 64% of patients from 3<sup>rd</sup> and 4<sup>th</sup> decade. A majority (68.97%) of total positive reactions were seen in the 21-40 years' age group. A similar occurrence, i.e. maximum number of positive reactions (49.6%) were recorded in the A.K. Bajaj et al<sup>12</sup> study. Males were found to be predominantly affected by Hand and Foot dermatitis with Male-to-Female ratio being 1.94:1. A similar predominance in males was seen by A.K. Bajaj et al<sup>12</sup> (1.32:1).

In our study, more number of positive patch test reactions were seen in the male (69.70%) compared to females (35.29%). The study by Gurmohan Singh and K.K. Singh<sup>15</sup> revealed a higher rate of positivity in females (58.8%) as compared to 57.8% in males. Such apparent difference between places, men and women could be due to various confounding factors such as occupation and house work, though the age and sex are not risk factors for contact dermatitis but often reflect exposure.

In our study majority (64%) were semiskilled workers and 18% were housewives. Students accounted for 10% and unskilled manual labourers for 6%. A similar occupational distribution was seen by Sharma and Kaur.<sup>16</sup> Involvement of Hands and Feet was seen in a total of 51.72% of positively tested cases. Hand involvement was seen in 37.39%. Among females, involvement of hands in positively tested was 50% and in males it was 34.79%. Higher positivity in females with hand dermatitis was also seen in studies by Gurmohan Singh and K.K. Singh<sup>15</sup> (58.8% in females and 57.8% in males).

Majority of the positively tested cases presented with chronic dermatitis accounting for 37.93%. Acute and sub-acute dermatitis accounted for 31.03% each. Singhal V et al<sup>13</sup> also observed chronic dermatitis as the predominant morphologic pattern of the lesions in their study. Recurrent dermatitis was present for a mean of 1.9 years, which correlates with studies by Sharma and Kaur<sup>16</sup> (1.7 years) and Handa et al<sup>10</sup> (2.5 years).

A personal or familial atopic predisposition was present in 18% of the patients. Among these, 77.78% were presented

with positive patch test reactions. Study by Niebuhr M et al<sup>17</sup> and study conducted by Ponyai G<sup>18</sup> et al suggests the prevalence of skin sensitisation does not significantly differ between atopic and non-atopic patients. A study conducted by Sharma AD<sup>19</sup> also suggests ACD is not uncommon (23%) amongst atopic individuals.

The patch test results with the Indian standard series of antigens were positive in 58% of our study patients, which is close to the reported sensitivity of the Indian standard series in 1000 ACD cases by A.K. Bajaj et al<sup>12</sup> (59%) in 2007. In S. Handa and RashmiJindal<sup>20</sup> study, 63% patients showed sensitivity to one or more allergens. The positivity rate in our study as discussed earlier was 69.7% in males and 35.29% in females. In our study, 46 of the 50 patients (92%) presented with Hand dermatitis occurring either as an isolated dermatitis or along with a foot dermatitis. Metals were found to be the commonest sensitizers in hand dermatitis. In hand dermatitis metal sensitivity was seen in 16 patients (69.57%), cosmetics in 7 (30.43%), rubbers and medicaments in 4 (17.39%) each, plant antigens 2 (8.70%). Comparable with Sharma and Kaur<sup>16</sup> where they have reported an incidence of 53.1% for metals, 40.6% for medicaments, 20.3% for rubbers; 4 patients of the 50 patients (8%) in our study presented with isolated foot dermatitis. Metals (66.67%) are the common allergens in isolated foot dermatitis. Similar incidence of Metal sensitivity in majority of foot dermatitis cases was found in a study by Chowdhuri S, et al<sup>21</sup> (45%).

Among the various groups of hand and foot dermatitis in our study, metals are the commonest sensitizers (47.92%) followed by cosmetics (16.67%), medicaments (10.42%), rubbers (8.33%), pharmaceuticals (8.33%), plant antigens (6.25%) and miscellaneous 1 (2.08%). However, in the hand-foot dermatitis by the Huda and Paul<sup>8</sup> (Assam) soaps and detergents (30%) and vegetables and spices (26.2%) were the commonest sensitizers with rubbers accounting for 20%, pesticides (10%), industrial oil (7.5%), metals for only 3.75% and medicaments 2.5%. The reason could be the large number of housewives and tea plantation workers involved in pesticides spaying in their study, thus a regional variation is evident here.

In our study a combined incidence of cosmetic, medicaments and pharmaceuticals was 35.42%. This reflects the importance of cosmetics in causing ACD as well as the physician's prescription aggravating the existing problem. The commonest individual sensitizers in our study were potassium dichromate (27.08%), cobalt (16.67%) and fragrance mix (10.47%). Chromium was the commonest sensitizer among males with 12 of the males (30.77%) reacting to it. Only 1 of the female patients (11.11%) showed sensitivity to potassium dichromate. Kishore N.B. et al<sup>14</sup> have reported potassium dichromate as common sensitizer testing positive in 26% of the patients of Hand eczema. Cobalt sensitivity was seen in 6 (15.38%) of the male patients and 2 (22.22%) female patients. Incidence of cobalt sensitivity in Sharma and Kaur's<sup>16</sup> study was 40% in males and 16.6% in females.

Among cosmetics Fragrance mix sensitivity was commonest and seen in 5 patients (10.47%) followed by paraphenylenediamine in 3 patients (7.69%). There was no sensitivity found to Balsam of Peru and Formaldehyde. Patch testing with Indian standard series in ACD patients by G

Narendra, CR Srinivas<sup>22</sup> revealed 7.5% of sensitivity to fragrance mix. Similar study by Sheno et al<sup>23</sup> also revealed 6% sensitivity to fragrance mix.

In footwear dermatitis study by Handa et al,<sup>10</sup> Thiuram mix was the commonest (87%) followed by Carba mix (70%), Mercaptobenzothiazole (33%), Tetramethylthiuram disulphide (27%) and N-cyclohexyl benzyl sulfenamide (27%). The higher values reflect the high incidence of rubber sensitivity (87%) seen in their study.

Of the total 29 positively tested cases in our study, current relevance to the antigen exposure was found in 18 patients (62%), past relevance was found in 5 patients (17%), no relevance found in 6 patients (21%). In A.K. Bajaj et al<sup>12</sup> study current relevance was found in 79% cases, past relevance in 10.48%, Probable and No relevance in 10.48%.

There were no side effects seen in the entire study. No irritant reactions were seen to the standardised antigens of the Indian series.

Thus patch testing was helpful in finding the incriminating cause of the dermatitis and was basis for suggesting alternate advice and at the same time a very safe 'in vivo' test independent of any laboratory procedure.

### CONCLUSION

Patch testing helped to establish the allergic aetiology in more than half of the cases investigated by us (58%). Once the allergen is identified by patch tests, avoidance of the allergen is the one and only single factor in preventing relapses, which makes patch testing of great value in the management of ACD and of course prevention is always better than cure. To emphasise this in the words of Calnan - "The greatest hazard is the omission of the patch testing procedures in the management of patients who have certain dermatoses, such omission dooms these patients to repeated attacks of avoidable contact dermatitis."

And all the more, it is a simple and easy test provided the technique is followed properly.

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