

# **COMMON ALLERGENS IN FOOT DERMATITIS ATTRIBUTABLE TO FOOTWEAR**

*Dissertation Submitted to*

**THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY**

*In fulfilment of the regulations for the award of the degree*

**M.D.**

**DERMATOLOGY, VENEREOLOGY AND LEPROLOGY**



**DEPARTMENT OF DERMATOLOGY, VENEROLOGY  
AND LEPROLOGY**

**PSG INSTITUTE OF MEDICAL SCIENCE AND RESEARCH  
THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY  
CHENNAI, TAMILNADU**

**APRIL 2015**

# **COMMON ALLERGENS IN FOOT DERMATITIS ATTRIBUTABLE TO FOOTWEAR**

*In fulfilment of the regulations for the award of the degree*

**M.D.**

**DERMATOLOGY, VENEREOLOGY AND LEPROLOGY**



**GUIDE**

**DR. CHEMBOLLI LAKSHMI, MD, DVD, DNB (D&V)**

**DEPARTMENT OF DERMATOLOGY,  
VENEREOLOGY AND LEPROLOGY**

**PSG INSTITUTE OF MEDICAL SCIENCE AND RESEARCH**

**THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY  
CHENNAI, TAMILNADU**

**APRIL 2015**

## **CERTIFICATE**

This is certify that the thesis entitled “**COMMON ALLERGENS IN FOOT DERMATITIS ATTRIBUTABLE TO FOOTWEAR**” is a bonafide work of **Dr. SWARNALAKSHIMI S.** done under the direct guidance and supervision of **DR. CHEMBOLLI LAKSHMI, MD, DVD, DNB (D&V)** in the department of Dermatology, Venereology and Leprology, PSG Institute of Medical Sciences and Research, Coimbatore in fulfillment of the regulations of Dr.MGR Medical University for the award of MD degree in Dermatology, Venereology and Leprology.

**DR. CHEMBOLLI LAKSHMI**  
Professor  
Dept. of DVL

**DR. C. R. SRINIVAS**  
Professor & Head of Dept.  
Dept. of DVL

**DR.RAMALINGAM**  
Principal

## **DECLARATION**

I hereby declare that this dissertation entitled **“COMMON ALLERGENS IN FOOT DERMATITIS ATTRIBUTABLE TO FOOTWEAR”** was prepared by me under the direct guidance and supervision of **DR. CHEMBOLLI LAKSHMI, MD, DVD, DNB (D&V)**, PSG Institute of Medical Sciences and Research, Coimbatore.

The dissertation is submitted to the Tamilnadu Dr.MGR Medical University in fulfillment of the University regulation for the award of MD degree in Dermatology, Venereology and Leprology. This dissertation has not been submitted for the award of any other Degree or Diploma.

**DR. SWARNALAKSHIMI S.**

## **CERTIFICATE BY THE GUIDE**

This is certify that the thesis entitled “**COMMON ALLERGENS IN FOOT DERMATITIS ATTRIBUTABLE TO FOOTWEAR**” is a bonafide work of **DR. SWARNALAKSHIMI** done under my direct guidance and supervision in the department of Dermatology, Venereology and Leprology, PSG Institute of Medical Sciences and Research, Coimbatore in fulfillment of the regulations of Dr.MGR Medical University for the award of MD degree in Dermatology, Venereology and Leprology.

**DR. CHEMBOLLI LAKSHMI**  
**Professor**  
**Dept. of DVL**



# PSG Institute of Medical Sciences & Research

## Institutional Human Ethics Committee

Recognized by The Strategic Initiative for Developing Capacity in Ethical Review (SIDCER)  
POST BOX NO. 1674, PEELAMEDU, COIMBATORE 641 004, TAMIL NADU, INDIA  
Phone : 91 422 - 2598822, 2570170, Fax : 91 422 - 2594400, Email : ihec@psgimsr.ac.in

June 27, 2014

To  
Dr S Swarnalakshimi  
Postgraduate  
Department of Dermatology  
PSG IMS & R  
Coimbatore

**Ref.:** Proposal titled: *"Common allergens in foot dermatitis attributable to footwear"*

**Sub.:** Ethics Committee Approval for the study

The Institutional Human Ethics Committee, PSG IMS & R, Coimbatore -4, has reviewed your proposal on 10<sup>th</sup> June, 2014 in its full board review meeting held at Research Conference Room, PSG IMS&R, between 9.30 am and 12.30 pm, and discussed your application to conduct the study entitled:

*"Common allergens in foot dermatitis attributable to footwear"*

The following documents were received for review:

1. Duly filled application form
2. Proposal
3. Informed consent forms
4. Assent form
5. Parental consent form
6. Data collection tool
7. CV
8. Budget

The members who attended the meeting at which your study proposal was discussed are as follows:

Sl. No.	Name of the Member of IHEC	Qualification	Area of Expertise	Gender	Affiliation to the Institution Yes/No	Present at the meeting Yes/No
1	Dr. S. Bhuvaneshwari (Member-Secretary, IHEC)	MD	Clinical Pharmacology	Female	Yes	Yes
2	Mrs. Geetha S Kannan	+ 2	Lay person	Female	No	Yes
3	Mr Gowpathy Velappan	BA., BL	Legal Advisor	Male	No	Yes
4	Mrs G Malarvizhi	M Sc	Nursing	Female	Yes	No
5	Mr. R. Nandakumar (Vice-Chairperson, IHEC)	BA., BL	Legal Expert	Male	No	Yes
6	Dr. G. Rajendiran	DM	Clinician (Cardiology)	Male	Yes	Yes
7	Dr. V. Ramamurthy	Ph D	Biotechnology	Male	Yes	No





# PSG Institute of Medical Sciences & Research

## Institutional Human Ethics Committee

Recognized by The Strategic Initiative for Developing Capacity in Ethical Review (SIDCER)

POST BOX NO. 1674, PEELAMEDU, COIMBATORE 641 004, TAMIL NADU, INDIA

Phone : 91 422 - 2598822, 2570170, Fax : 91 422 - 2594400, Email : ihec@psgimsr.ac.in

8	Dr. M. Ramanathan	M Pharm, Ph D	Non-Medical (Pharmacy)	Male	Yes	Yes
9	Dr. P. Sathyan (Chairperson, IHEC)	DO, DNB	Clinician (Ophthalmology)	Male	No	Yes
10	Dr. Seetha Panicker	MD	Clinician (Obstetrics & Gynaecology)	Female	Yes	No
11	Dr. S. Shanthakumari	MD	Pathology, Ethicist	Female	Yes	Yes
12	Dr. Y.S. Sivan	Ph D	Social Scientist (Sociology)	Male	Yes	Yes
13	Dr. Sudha Ramalingam (Alternate Member-Secretary, IHEC)	MD	Public Health, Epidemiology, Genetics, Ethicist	Female	Yes	Yes
14	Mrs. K. Uma Maheswari	M Sc, M Phil. B Ed	Botany	Female	No	No
15	Dr. D. Vijaya	M Sc, Ph D	Basic Medical Sciences (Biochemistry)	Female	Yes	Yes

After due consideration, the committee has decided to approve the above proposal.

The approval is valid for one year.

**We request you to intimate the date of initiation of the study to IHEC, PSG IMS&R and also, after completion of the project, please submit completion report to IHEC.**


We hereby confirm that neither you nor any of your study team members have participated in the voting/ decision making procedure of the committee. The members of the committee who have participated in the voting/ decision making procedure of the committee do not have any conflict of interest in the referenced study.

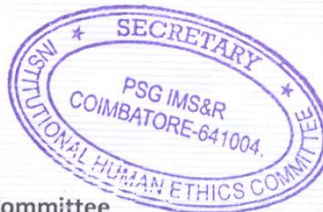
This Ethics Committee is organized and operates according to Good Clinical Practice and Schedule Y requirements.

Non-adherence to the Standard Operating Procedures (SOP) of the Institutional Human Ethics Committee (IHEC) and national and international ethical guidelines shall result in withdrawal of approval (suspension or termination of the study). SOP will be revised from time to time and revisions are applicable prospectively to ongoing studies approved prior to such revisions.

PIs are required to send progress reports (in the form of an extended abstract with publications if any) to the IHEC every six months (and a month before expiry of approval date, if renewal of approval is being sought).

Request for renewal must be made at least a month ahead of the expiry of validity along with a copy of the progress report.

  
Dr S Bhuvaneshwari  
Member - Secretary  
Institutional Human Ethics Committee



# PLAGIARISM TOOL

Turnitin Document Viewer - Google Chrome

[https://turnitin.com/dv?o=449216652&u=1030975926&s=&student\\_user=1&lang=en\\_us](https://turnitin.com/dv?o=449216652&u=1030975926&s=&student_user=1&lang=en_us)

The Tamil Nadu Dr.M.G.R.Medical ... TNMGRMU EXAMINATIONS - DUE 15-...

Originality GradeMark PeerMark

Common allergens in foot dermatitis attributable to footwear

BY 201230352.MD DERMATOLOGY VENEREO SWARNALAKSHMI S

turnitin 15% SIMILAR -- OUT OF 0

### INTRODUCTION

Contact dermatitis is classified into two groups: irritant contact dermatitis and allergic contact dermatitis. Irritant contact dermatitis is more frequent and common in severe exposure to an irritant for a sufficient duration. Allergic contact dermatitis is a T cell mediated reaction which occurs when the skin is previously sensitized to an allergen. It is caused by several factors acting singly or in combination. It can also be characterized into endogenous and exogenous causes such as contact dermatitis (both irritant and allergic).

No Service Currently Active

Submission Info

SUBMISSION ID	449216652
SUBMISSION DATE	06-Sep-2014 04:56PM
SUBMISSION COUNT	1
FILE NAME	Introduction.doc
FILE SIZE	1.96M
CHARACTER COUNT	95843
WORD COUNT	17080
PAGE COUNT	116
ORIGINALITY	
OVERALL	15%
INTERNET	5%
PUBLICATIONS	13%
STUDENT PAPERS	1%

PAGE: 1 OF 116



## **ACKNOWLEDGEMENT**

I would like to take this opportunity to express my gratitude to certain people who have helped me during my post graduate years.

I wish to thank, first and foremost, my guide, Dr. Chembolli Lakshmi without whom my thesis would not be completed. Her guidance throughout this study helped me expand my knowledge. I value her constant academic input and meticulous detail to perfection at every step of this dissertation.

Secondly, I would like to thank Dr. CR Srinivas who always encouraged us to think beyond the textbook. He has also taught me the importance of patient communication which is a valuable tip that I will carry into my practice.

It is with immense gratitude that I acknowledge Dr. Reena Rai. Her constant encouragement and interest for teaching has left me with a foundation to build my career on.

I would also like to thank Dr. P. Surendran for his continuous support and words of encouragement. He has taught me practical tips that will forever be useful in my future practice.

I want to take this opportunity to thank my colleagues Dr. Revathi, Dr. S. Priya for their motivating words throughout my post graduate course. I appreciate the guidance my seniors gave me especially Dr. Maria and

Dr. Gayathri. I am also grateful to my immediate juniors and my new juniors for their help and encouragement.

I want to thank Mr. Thirumoorthy who patiently assisted me time and time again throughout my study. I also need to thank Mrs. Shanthi who helped me finish the final copy of this dissertation.

I thank the Associate professors, assistant Professors and Senior Residents in the department of dermatology for sharing their experience.

I am greatly indebted to my parents, brother and in laws. I will not find words to express my gratitude to them. They have always believed in me. They are my support system.

Finally, I thank the almighty who has given me my son Rudhran who has brought meaning to my life and my husband Dr. J. Senthilvidhyasagar who supports me in every aspect of my life without whom, I would not have made it so far.

I thank all the patients, friends & well wishers for their constant support.

## **TABLE OF CONTENTS**

1.	INTRODUCTION	1
2.	AIMS AND OBJECTIVE	4
3.	REVIEW OF LITERATURE	6
4.	MATERIALS AND METHODS	63
5.	RESULTS	71
6.	DISCUSSION	83
7.	CONCLUSION	90
8.	HANDOUTS	93
9.	BIBLIOGRAPHY	
10.	ANNEXURE	

Clinical Photographs

Consent Form

Proforma

Master Chart

List of abbreviations

## LIST OF TABLES

S.NO	TABLES	PAGES
1	Classification of Dermatitis	8
2	Evaluation of Patch Test Reading	53
3	Allergens in ISS	67
4	Allergens in FWS	68
5	ICDRG Patch Test	70
6	Age and Sex	72
7	Site of Initial Lesions	73
8	Duration of Disease	74
9	Seasonal Variations	75
10	Signs and Symptoms	76
11	Clinical Presentations	77
12	History of Atopy	78
13	Type of Footwear	79
14	Patch Test Reports	80
15	Patch test results in patients with antibiotic sensitivity	81
16	Number of positive allergens in each materials	82

## LIST OF FIGURES

S. NO	TITLE	Page
1	Shoe Materials	20
2	Parts of Shoe with Allergens	21
3	Patch Test Allergens	Annexure
4	Patch Test Procedure	Annexure
5	Patch Test Reading On Day 2	Annexure
6	Foot Dermatitis- Scaling	Annexure
7	Foot Dermatitis- Toe Eczema	Annexure
8	Foot Dermatitis – Secondary Infections	Annexure
9	Foot Dermatitis – Dorsum Of Feet	Annexure
10	V Shaped Dermatitis – Rubber Chappals	Annexure
11	V Shaped Dermatitis – Plastic Dermatitis	Annexure
12	Foot Dermatitis – Depigmentation and positive reactions	Annexure
13	Positive Reactions	Annexure

# INTRODUCTION

## INTRODUCTION

Contact dermatitis is classified into two groups: irritant contact dermatitis and allergic contact dermatitis. Irritant contact dermatitis is more frequent and occurs in anyone exposed to an irritant for a sufficient duration and concentration. In contrast allergic contact dermatitis is a T cell mediated immunological reaction, occurs only when the skin in previously sensitized person is reexposed to that allergen.<sup>1</sup>

The etiology can be related to several factors acting singly or in combination. Contact eczema may also be characterized into endogenous conditions like atopic or exogenous causes such as contact dermatitis. (both allergic and irritant contact dermatitis).

Foot dermatitis is one of the common problems seen by the dermatologist. It causes discomfort and embarrassment to the patients.

Although the majority of the Indian population used to walk barefoot, the trend has changed with more adopting some protective footwear. As a result increasing numbers of dermatitis attributable to footwear present to the dermatologist. There are 4 major factors which influence footwear dermatitis, namely allergy, atopy, friction, and occlusion.<sup>2</sup>



The clinical presentation of foot wear dermatitis has varied presentation from region to region and with time .The prevalence in South India is 11.7% as compared to 3-6% from abroad<sup>3,4,5</sup> Leather, rubber & adhesives have been reported to be the most common allergen. Most of the incriminating allergens can be identified by patch testing. Irritant reactions have to be differentiated and usually fade by the second reading. The diagnosis of contact allergens by patch testing gives the clinician a distinct advantage in the subsequent management of the patient & improves the prognosis by avoidance of the possible sources of the allergen.<sup>6</sup>

In the market a variety of footwear is available from different manufacturers who do not furnish a list of the constituents. Incorporating the list of constituents of footwear would help sensitized patients to select those without the culprit allergens.

## **AIMS & OBJECTIVES**

## **AIMS & OBJECTIVES**

1. To identify the common allergens in foot dermatitis attributable to footwear.
2. To prepare handouts with information on the possible household and occupational sources of the incriminating allergens other than those in the Indian Standard Series (ISS).

# REVIEW OF LITERATURE

## **REVIEW OF LITERATURE**

Dermatitis or eczema is a reaction pattern of skin characterized by erythema vesiculation and pruritus in the acute phase and by dryness, hyperkeratotic fissuring and lichenification in its chronic phase<sup>7</sup>. Pathologically it is an inflammatory pattern of skin response.

. The term foot eczema implies dermatitis confined to foot with only minor involvement of other areas.

## **CLASSIFICATION**

Its not easy to classify dermatitis, because some have distinctive clinical features and there is considerable overlap in the etiopathogenesis. It is classified in to 2 broad group, exogenous and endogenous based on the causative factors. (Table.1)

External factors are comparatively well defined as compared to internal ones.

**TABLE - 1**  
**CLASSIFICATION OF DERMATITIS**

Exogenous – external	Endogenous - internal
Irritant contact dermatitis, Allergic contact dermatitis, Photo dermatitis, Infective dermatitis.	Atopic dermatitis, Seborrhic dermatitis Nummular eczema, Asteatotic eczema, Stasis dermatitis, Pompholyx Juvenile, plantar dermatitis, Eczema associated with systemic disease. Eczematous drug eruptions.

### **OVERVIEW OF FOOTWEAR CONTACT DERMATITIS.**

Several studies have been conducted to analyse the prevalence of Foot Eczema. Various large scale studies from abroad are reported.

Romaguera carols et al, patch tested 12,351 patients over 14 years period and detected allergic contact dermatitis in 7304, of which 225 patients showed sensitivity to footwear allergens.<sup>8</sup> .Warshaw E et al detected 109 patients with sensitivity to footwear allergens out of 10.601 patients over a 4 year period common allergens included rubber 40%, adhesives PTBFR 25%, chromate 17.5%, and carbamate 12%. 19 tested positive to other allergens (other than 65 NACDG standard allergens).<sup>9</sup> Epstein et al detected 40 out of 74 patients with footwear allergens.<sup>10</sup> Freeman studied 55 hyperhidrotic patients

with footwear dermatitis of which 43% were atopic. He followed 48 of 55 subsequently for 3 years .Common sensitizers were rubber (43.1%), chromate (23.6%), P-tetra-butylphenol formaldehyde resin (PTBFR), 20.0%, resin (9.0) & PPDA (3.6%). Positive reactions to patients own shoe materials with negative reaction to patch test allergens occurred in 14.5%. 3 years follow up showed good clearance in 87.5% and same status in 10% and worsening in 1%.<sup>11</sup> In an Israeli report 58 out of 140 patients tested positive for shoe allergy. Chromate 27%and PTBFR 9% were the common allergens.<sup>12</sup> In a Pakistani study involving 109 patients, 87 tested positive. Adhesives 34% were the commonest followed by PTBFR27% chromate 16%, rubber allergens 8%and dyes 8%.<sup>13</sup> A British study involving 230 patients with foot dermatitis over a 10 years period detected relevant results in 44 patients, the commonest being chromate (9 patients), neomycin(7), MBT(8), and thiuram(6).<sup>14</sup>

Dahl collected 59 patients suspecting shoe allergy but confirmed specific relevant allergens in only 33 patients, although shoes were positive in 42 patients.<sup>15</sup>

## **INDIAN STUDIES INCLUDE**

Shrutakirthi et al studied 195 patients with clinically suspected footwear dermatitis. Patch tested with 22 allergens of shoe series along with neomycin, gentamycin, soframycin, parabens, cresol and lanolin. The overall positivity



was 62%. The most common sensitizers were potassium dichromate, MBT, and nickel sulphate.<sup>16</sup>

Handa et al from Chandigarh studied the pattern of different kinds of footwear( 'V' chappals, sandals & closed shoe) in the elicitation of ACD to footwear. Patch testing on 30 patients with 16 Antigens (part of footwear series) detected sensitivity in 29. Common allergens were rubber ( 26 patients) ,dyes ( 10), leather ( 6), glues & neoprene in 4.<sup>17</sup>

In the series of 105 patients by Bajaj et al, 47 tested positive. The commonest was chromate (37) followed by MBT (14), TMT (10), rubber chemicals (5) –cyclohexyl benzothiazyl sulfonamide (2) and 1-3 diphenylguanidine (3)<sup>18</sup>

Cockayne et al studied allergic contact dermatitis to footwear among children in order to define clinical pattern & causative allergens out of 29 children. 15 were confirming contact allergens. 7 out of 9 reacted to rubber component and 2 reacted to other components of shoe namely chromate and colophony and 6 reacted to constituents of topical medicaments.<sup>19</sup> Thappa et al published the pattern of lower leg and foot eczema in south India. They found the dorsum of feet (49.5%) to be the commonest site, followed by lateral aspect of lower limb(31%), medial aspect of lower leg(17.5%) and ankle (12%).<sup>20</sup> Priya et al determined the causative agent in foot eczema with standard series. 24% showed positive to MBT.<sup>21</sup> Ghosh et al did patchtesting in 155 patients with footwear dermatitis. The study showed positive to 45.8%

potassium dichromate, 38.06% cobalt chloride, 32.25% PPD, 20% epoxy resins, 20% black rubber, 14.83% nickel sulphate, 12.9% MBT, 11.6% colophony, 10.32% thiuram mix, 9.67% formaldehyde resin and 4.5% formaldehyde.<sup>22</sup>

Saha et al showed the prevalence of footwear dermatitis among contact dermatitis cases to be 11.7% as compared to 3-6% from abroad.<sup>3,4,5</sup> They found potassium dichromate and colophony to be the commonest sensitizers.

## **ETIOLOGY**

Foot eczema is caused by diverse etiological factors and may be a part of several dermatoses. It is classified into exogenous & endogenous, the exogenous being related to clearly defined external trigger factors in which inherited tendencies play a minor role. Endogenous eczemas are thought to be mediated by processes originating within the body.

Classification of hand and foot eczema

### **Exogenous**

- Irritant contact dermatitis,
- Allergic contact dermatitis,
- Photo dermatitis,
- Infective dermatitis
- Post traumatic eczema
- Dermatophytide

## **Endogenous**

Atopic dermatitis

Seborrhic dermatitis

Nummular eczema

Asteatotic eczema

Stasis dermatitis,

Pompholyx

Juvenile, planar dermatitis

## **Eczema associates with systemic disease.**

Eczematous drug eruptions

Palmoplantar pustulosis

## **ALLERGIC CONTACT DERMATITIS (ACD)**

ACD is a T.cell driven process that begins when haptens come into contact with Langerhans cells in the epidermis. Stimulated Langerhan cells migrate to regional lymph nodes. Here antigen is processed by T Lymphocytes, which becomes specifically reactive to the presented allergen.

The T cells that respond when the individual is reexposed to the allergens are known as CD8 + T cells and are under the control of subset of CD4 + Tcells.

## **MECHANISM OF ALLERGIC CONTACT DERMATITIS**

Contact allergens almost invariably are small molecular substances of less than 500 daltons (Da) that reach the skin upon contact with the environment. Because of their small size, they penetrate the skin barriers which is relatively impermeable under normal circumstances to large molecules.

In order to induce contact allergy, these substances must be presented by Antigen presenting cells, principally epidermal Langerhan cells (LC) to T lymphocytes in an immunologically effective processed form.

As Antigen is presented to T lymphocytes, a glycoprotein, interleukin-1 (IL-1) is produced and released by LC. IL-1 is believed to activate Tcells and release IL-2. IL-2 stimulate Tcells to proliferate and secrete INF- $\gamma$ .<sup>23</sup>

Under ordinary condition, exposure to contact allergens sets in motion two competing mechanisms, the one mediated by effector T Lymphocytes and leading to a state of hypersensitivity which becomes clinically manifests as an Eczmatous skin reaction; the other mediated by suppressor cells and leading to relative or complete tolerance of the allergens. The state of reactivity of the skin at any particulars time and site is principally the result of the existing balance between the effector and the suppressor cells present.

## **PREDISPOSING FACTORS**

The five important precipitating factors for the development of ACD to shoes include heat, friction, occlusion, hyperhidrosis, and atopy. Allergens leach out of the footwear through the socks to the skin and cause sensitization. So the profession is important. Military personnel and sportsman who are constantly using occlusive footwear with socks have the higher chance of developing ACD to footwear.

Other factors:

## **CONSTITUTIONAL FACTORS**

Sensitization predispose an individual susceptibility. Some individuals are resistant to sensitization acquired by repeated exposure to sub-sensitizing dose of allergen.<sup>24</sup>

### **Age of onset**

Age has little influence on capacity of sensitization. In facts and elderly are less prone because of their simple environment compared to patients of other age group. But there is one condition called Juvenile Plantar dermatosis (JPD), which occurs between the age group of 3-14 years. Documented allergic reaction are seen mostly in older pediatric patients and are secondary to topical medications, plants, nickel, fragrances, or shoe related allergens.<sup>25</sup>

## **Sex incidence**

Most studies report no difference in susceptible with regard to gender but localization of dermatitis may vary with sex. Nickel sensitivity predominates in women related to closer contact with jewelry, ornamental footwear and perfumes<sup>26</sup>. Chromate allergy predominates in men due to more frequent exposure both occupational (cement) and personal (belts, footwear).

## **Hormones**

Contact dermatitis may flare up during the premenstrual period. Use of estrogen and pregnancy has been shown to either improve or aggravate contact dermatitis.<sup>27</sup>

## **Racial**

Racial difference has been documented. Experiments proved that blacks were found to be less susceptible to acquired delayed hypersensitivity than caucasians. Blacks were found to be more resistant to irritants also.<sup>28</sup>

## **Atopic Dermatitis**

The incidence of ACD in atopic dermatitis is controversial. Atopic dermatitis makes the skin vulnerable to non specific irritants(heat, dust, detergents, wool, perspirations, humidity) and predisposes to the development of ACD due to breach in the skin barrier.<sup>29</sup>

## **Pattern of Exposure**

Allergen exposure and hence the likelihood of sensitization, varies not only with age, but also with social customs, environmental facts, occupation etc.<sup>25</sup>

Principal allergens in sensitization to footwear include rubber accelerators present in rubber based liners and / or glues, isocyanates, P-tert-butyl phenol formaldehyde resins or potassium dichromate (tanned leather) present in shoes. Dyes in either shoes or socks are rare causes of ACD of feet. A study on construction workers revealed chromate to be the commonest allergen.<sup>30</sup>

## **Seasonal variations**

Varying results have been reported from different studies. Some studies report improvement in warmer months, while others have recorded deterioration in summer, attributable to increased friction.<sup>31</sup> In some patients, the influence of seasons was found to be minimal.

## **Local factors**

Sensitivity is easily acquired if an allergen is applied over damaged skin. Occlusion greatly promotes percutaneous absorption and contributes to occurrence of dermatitis from shoes and rubber gloves. The longer the duration of eczema the greater is the chance of sensitizations.<sup>32</sup>



## **Concomitant Disease**

Patient with acute or debilitating disease such as cancer, Hodgkins disease. Mycosis fungoides, sarcoidosis, lepromatous leprosy have impaired capacity for contact sensitization.<sup>33</sup>

## **Medications**

Antihistamines and disodium cromoglycate appear to have little effect but prednisolone and potent topical steroids suppress allergic contact reactions.<sup>34</sup> Aspirin depresses skin reactivity.<sup>35</sup> Sunshine light (UVB, PUVA) and x-rays may also temporarily reduce contact allergic reactions.

## **Role of friction in foot wear dermatitis**

Ill fitting shoes and anatomic foot deformities may cause excessive friction and wearing away of protective linings and may thus allow more intimate contact of shoe allergens with skin. Footwear soaked with perspiration may dry up and become brittle. Ridges in the shoe lining may irritate the skin of the feet.

## **Role of hyperhidrosis in footwear dermatitis**

Children whose feet sweat excessively and who use synthetic socks, sneakers, rubbers or rubber soled shoes for prolonged periods, may suffer from sweating socks dermatitis, an eruption of toes and interweb areas due to maceration by unabsorbed sweat.<sup>36</sup> These areas are prone for eczema and infection.

Footwear that creates a warm moist environment when combined with the presence of numerous chemicals creates an ideal situation for the development of ACD or irritant contact dermatitis(ICD). Sandals on the other hand are less prone to cause footwear dermatitis because of the open design which allows feet to “breathe.” In addition there are less shoe materials to cause sensitization or irritation..

### **Clinical picture of footwear dermatitis**

The dermatitis most often starts over the dorsal surface of the great toes and spreads to the dorsa of the feet and other toes. The interdigital spaces are normally not involved. The heels may be affected. On the heel, the patches of dermatitis may correspond to the tongue of the shoe.<sup>37</sup>

When the instep only is involved with small vesicles or pustules, footwear dermatitis is unlikely. The anterior part of the sole may be involved exclusively. The dermatitis may be patchy and it has often been reported as beginning or it can ever remain unilateral.<sup>38</sup>

Indian sandal dermatitis has a characteristics pattern of dermatitis often severely affecting first toe web space mainly and adjacent toes and dorsum of the foot. When the sole is involved, it normally affect the weight bearing area, sparing the instep. Leukoderma may be seen as a late sequel of phenols used in rubber.<sup>39,40</sup>

Boots produce a pattern similar to shoe dermatitis but may have additional eruptions at the upper margins or on the back of the calves. When black rubber boots are used petechial and purpuric eruptions may be seen.<sup>41</sup>

Patients with shoe dermatitis may have eczema of other sites, particularly the hands. This is called as id reaction or auto sensitization.<sup>42</sup>

The dorsal surface of the feet and toes, the back of the knees and inner aspects of the upper thigh are the areas most commonly affected when ACD is caused by nylon stocking dyes.<sup>43</sup>

### **Sources of allergens in ACD of foot**

1. Foot wear
2. Nylon stockings
3. Plant & wood
4. Topical medicaments.

### **Footwear**

Different chemicals in conjugation with a hot and humid climate within the footwear, provide an ideal situation for the development of allergic or irritant dermatitis. Among patients with contact dermatitis the prevalence of shoe dermatitis ranges from 3-11.7%.<sup>3,4,5</sup> Involvement is neither gender nor age specific. Females, males and children are equally affected.

Rapid globalization has led to variable trends in footwear, but types of shoes differ in different regions of the world, depending on the climatic conditions, socio economic factors and their traditions. Allergic shoe dermatitis is commonly caused by constituents in shoes like rubber, leather adhesives and rarely by linings and dyes. The spectrum of these allergens varies from country to country based on local traditions of footwear and the different substances and chemicals used during the manufacture of shoes. It is useful for a dermatologist to know about shoe construction and composition, but this knowledge is not easy to acquire because of constantly changing design and composition and manufacturers reluctance to divulge all the ingredients present.

Figure 1: Shoe Materials

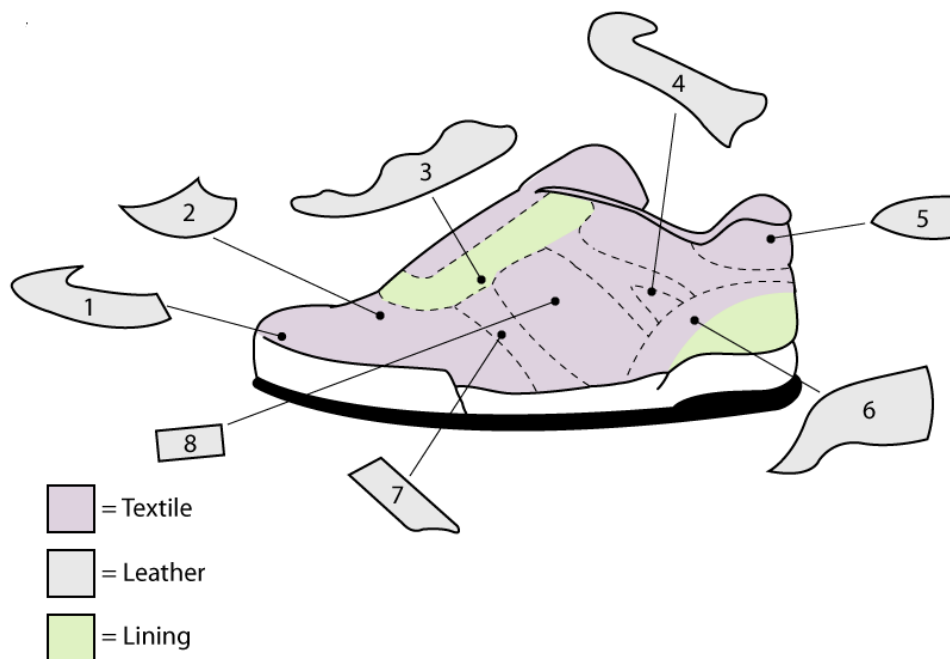
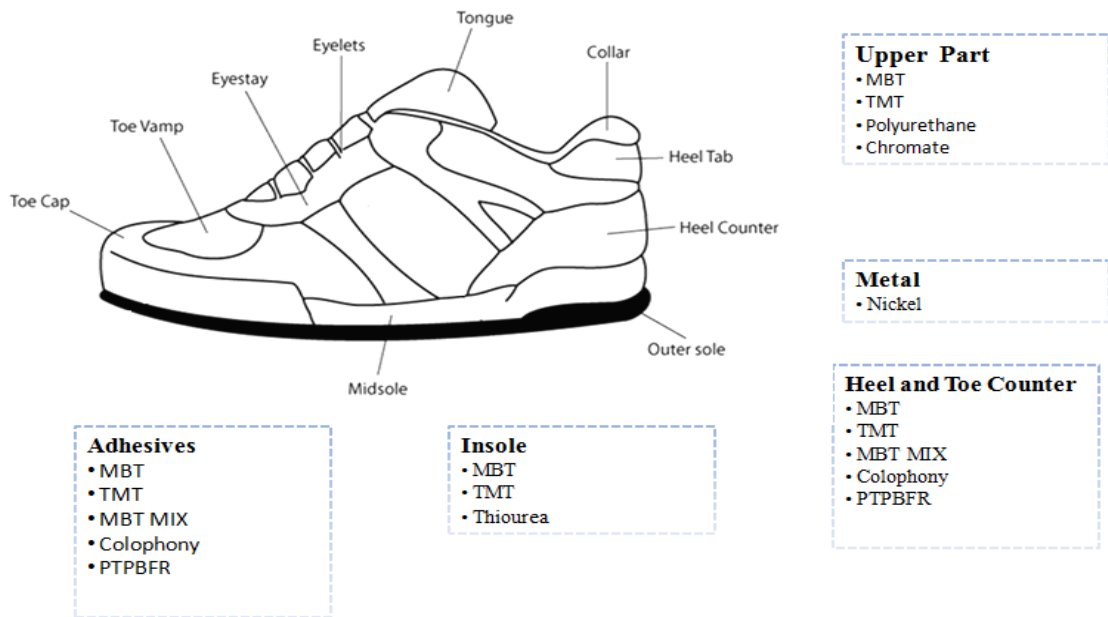


Figure 2: Parts of the shoe with Allergens in each part.



Allergic contact dermatitis of the footwear develops over time, as the skin of foot is repeatedly exposed to an allergen, causing sensitization.

In India sandals are most commonly used.

Socks and lining of shoes were known to be a causative agent for dermatitis since 1877, but it was not until 1930 when the patch test became more widely used that full potential of foot dermatitis became known.

## **COMMON ALLERGENS CAUSING FOOT DERMATITIS**

### **Rubber components**

- a. Mercapto accelerators (MBT-mercapto benzothiazole)
- b. Thiuram accelerators (TMT-Tetramethythyuram disulphide)
- c. Caba antioxidants (DPG-Diphenylguanidine and hydroquinone, monobenzyl ether, fixes, smoothers.)

### **Leather**

Potassium dichromate

Formaldehyde

Glutaraldehyde

Vegetable extracts used in tanning.

### **Dyes**

Paraphenylene diamine

Bismark brown

Chrysodine brown

Amido azobenzol

Amido azotolune

Some types of disperse dyes

Nigrosine.

## **Nickle**

In shoe dermatitis, such as metal buttons, buckles and zips etc.

## **Glues and adhesives**

Phenolformaldehyde resin

Rubber adhesive (Thiuram, MBT)

Colophony cellulose nitrate and cellulose acetate cements

Vinyl and polyurethane Resin<sup>44</sup>

## **Plastic and Synthetic Leather**

Polyvinyl chloride (PVC), Polyurethane resins, Dodecylmercaptane added to plastics to stop polymerization.<sup>45</sup>

## **RUBBER**

Rubber is derived from latex, the milky white fluid exuding out of the cuts on the trunk of the rubber tree *Hevea brasiliensis*. Unprocessed rubber is not a sensitizer whereas additive antioxidants such as Mono Benzyl ether of Hydroquinone (MBH) and accelerators such as MBT and TMT are potent sensitizers.<sup>46</sup>

MBT and TMT are the most common sensitizer in shoe dermatitis. MBT is also found in adhesives, black tyres, shoes, clothes, cutting oils, detergents, fungicides etc.



Rubber may be used on the outer sole of the shoes. In tennis shoe it may be wrapped over the outer toe of the shoe. It may also used as the midsole component. Sweating and moisture may cause migration of these allergens to the distant parts of the shoes and cause sensitization. Marcussen showed that MBT could diffuse out of rubber.<sup>47</sup>

There are two types of rubber

1. Natural
2. Synthetic rubber

In addition to rubber polymers itself, a rubber article may also have many additives. The most important for the dermatologist are vulcanizing agents and anti aging compounds (antioxidants, antiozonants, UV protectors).

### **Compounding and vulcanization**

Raw rubber in dry state has few commercial applications, because of its lack of strength, durability and elasticity.

Vulcanization is an irreversible process and was employed originally to denote heating rubber with sulphur but it has been extended to include all processes of combination of materials, that produce this effect.

## **Rubber Accelerators**

Speed up the slow process of vulcanization by acting as catalyst and undergoing chemical changes. The major accelerators are thiurams and carbamates, which act quickly, diphenylguanidine and mercaptobenzothiazole which act at moderate speed and thioureas which work more slowly. Carbamates are usually complexed with heavy metals such as zinc, cadmium, lead and others. The metal content of rubber is not allergic enough to cause ACD.

## **Anti Degradation Agents**

Anti oxidants and antiozonants prevent rubber from drying or cracking by preventing oxidation by atmospheric oxygen or by decreasing the effect due to ozone.<sup>48</sup>

The paraphenylenediamine type antioxidants are usually most effective in rubber.

## **Neoprene Rubber allergens**

Thioureas are used as accelerators and antioxidants in rubber and neoprene. Ethylbutylthiourea (EBTU) contact allergy has produced severe plantar foot dermatitis in 10 patients who wore Nike athletic shoes used the insole made up of EBTU prepared by Spenco medical corporation.<sup>49</sup>

## **Hydroquinones**

Leukoderma of the dorsum of the feet caused by the action of phenolic compound sometimes used in the manufacturers of footwear can be caused by two different substances. Monobenzyl ether of hydroquinone (MBH) used in rubber as antioxidants and paratetrabutyl phenol formaldehyde (PTBF) resin used in neoprene glues which are also used in rubber and synthetic leather. Bajaj and colleagues described 19 cases of depigmentation of the feet which are due to hydroquinones or phenols.<sup>39</sup>

## **N Isopropyl N Phenyl paraphenylenediamine**

It is also called isopropylphenyl para phenylenediamine or 4 isopropylaminodiphenylamine or IPPD and has caused ACD in rubber boot wearers.<sup>50</sup>

One epidemic of 109 patients in prague was reported by Cronin.<sup>51</sup> It produced an interesting purpuric eczema which could be reproduced on patch testing.<sup>50</sup> Allergy to IPPD has also be found in Maleki shoes in Iran. The sole of these shoes are made from recycled rubber tyres.<sup>52</sup>

## **Leather**

Leather is derived from the hide of animals. It is used for making sandals, chappals, boots, hand bags, purses, belts etc. It has to be processed before it can be used. Tanning is done with chrome, formaldehyde,

glutaraldehyde or with vegetable tannins. Further leather has to be dyed with different type of dyes.

Tanning agents and dyes are most likely to explain shoe allergy caused by leather.

### **Chrome tanning**

Chrome tanning was invented in 1858. It is superior to vegetable tanning leather in being more pliable and water resistant, and can be more easily impregnated with color.

Chrome tanning is used particularly for light, flexible leathers. Sweat is necessary to leach the chromates from the leather and produce dermatitis in chrome sensitive individuals. In cooler climates chrome gets fixed to the leather and decrease the incident of dermatitis.

Potassium dichromate 0.5% in petrolatum is the standard patch test for chromate allergy. Trivalent chrome salts such as chromic acid, chromic sulphate and chrome trichloride used in tanning but are less allergenic than hexavalent hence are not used in patch testing. Hypoallergenic leather using the trivalent chromate for tanning is available but very expensive.

Once shoe induced chromate dermatitis develops it can become chronic, although like other shoe allergies it may decrease with time.

## **Vegetable tanned leather**

Vegetable tanning has been done for thousands of years. It is very time consuming procedure. Chrome tanning requires 6 – 14 hrs where as vegetable tanning needs upto 6 months. Vegetable tanned leathers are more expensive and easily scuffed. Usually only black and brown leathers are available in vegetable tanning.

There have been reports of dermatitis following use of Indian leather sandals in the USA.<sup>53</sup> On detailed investigation the culprit was found to be oil added to the leather as the softening agent (sumac sap) and not the leather itself.<sup>54</sup>

Some of the vegetable tannins that may be used in leather are mimosa chestnut oak, hemlock, Turkish oak, red oak, mangrove, gambrier etc. In India trees such as “Mimosa” were used for leather tannage.

## **Formaldehyde and glutaraldehyde**

It is used principally in the production of white leathers or leather designed to have a high degree of water resistance. It is used in leather tannage and also in leather finishing after dyeing. (eg Chamois leather)

Glutaraldehyde is used widely to tan upper shoe leather.<sup>55</sup> It is mainly used as component to form chrome tanned leather which has good water resistance and reduces shrinkage. In spite of testing positive patients seldom

manifest shoe dermatitis. Glutaraldehyde is not considered to be a major sensitizer.

## **Dyes**

Dyes used to color leather are unusual causes of leather dermatitis. Fischer and Cronin did not report dermatitis to the initial dyed shoes.<sup>51,56</sup> However, redyed shoes may cause dermatitis. Leather dyes usually fix "azoaniline" group of dyes. Redyed shoes do not fix these dyes firmly.

The most commonly used dyes in footwear are

1. Bismark brown
2. Aminoazobenzol
3. Amidoazotoluene hydrochloride
4. Chrysodine brown pure powder
5. Acid yellow 36

Allergic reactions attributable to dyes used to color leather in clothing has been reported.

Shoe polishes are also rarely or never the cause of allergic contact dermatitis.

## **Plastic allergens in shoes**

Synthetic materials are beginning to replace leather and rubber in shoe manufacture. These allergens are used widely as adhesives, same also found use in solid shoe materials, e.g. polyurethanes. Robert and Hanifin reported

allergy to ethylbutyl thiourea used as an accelerator in polychloroprene (neoprene) adhesive used in running shoes.<sup>37</sup>

Polyurethanes are poly addition products resulting from the reactions between diisocyanates and polyhydroxyl compounds with free alcohol groups.<sup>57</sup> There is report of allergic reactions to dodecylmercaptan, which is used to arrest polymerization in some neoprenes.<sup>44</sup>

In the past an occlusive plastic shoe made in Japan caused an irritant dermatitis that came to be known as the “Japanese hot foot”.<sup>58</sup>

In 1971, Fregert presented a list of chemicals which could be used in both rubber and plastics such as polythene, polyvinylchloride (PVC), polyformaldehyde, polyurethane etc which may play a role in shoe dermatitis.<sup>56</sup> Synthetic materials such as PVC and polyurethanes used in making slippers are the common causes of contact dermatitis in plastic footwear's.

## **Adhesives**

There are 3 types of adhesives

1. Rubber adhesives
2. Neoprene adhesives
3. Urethane adhesives

They have been in use since 1910 and were rubber based. Since 1950 and 1960s neoprene and urethane based adhesives became popular.

## **Rubber adhesions and rosins**

Fischer observed that patients who reacted to rubber parts of shoe adhesives also show allergy to rubber tapes (plaster).<sup>56</sup>

Cronin suggested that thiurams and MBT in latex glues used for shoe linings could be responsible.<sup>51</sup>

Modern rubber cements are used for sole attaching or for sticking layers below the insole. They help to decrease the squeak of leather shoes. They are not as permanent as neoprene or urethane glues, and need not be, especially if the sole is sewn. They are largely replaced by rosin esters that act as tackifiers.

### **1. Neoprene adhesives and parateritary butyl phenol formaladehyde resin(PTBFR)**

Neoprene glues are usually used for sole attachments.<sup>59</sup> Thiurams and dodecylmercaptans are sometimes added to neoprene glues to control polymerization.<sup>52</sup> Dodecyl mercaptan has been reported to cause allergy (e.g. neoprene ACM by dupont). Ethylbutyl thiourea, used as an accelerators in neoprene adhesives can also causes allergic reactions.<sup>49</sup>

PTBFR in neoprene shoes may account 10-20% of patients with footwear allergy.<sup>56</sup> PTBFR adhesives are used widely in clothing items such as belts, watchstraps, and hats and in automobile upholstery . There are reports of allergic contact dermatitis by PTBFR in amputation prosthesis.<sup>60</sup>



## **2. Urethane adhesives**

Since urethane derivatives are light and durable which requires less curing are used extensively as adhesives. They are less common agents in causing sensitization to footwear. All leather shoes are polished regularly. The boot polishes containing waxes, solvents, turpentine may also be responsible for contact dermatitis.

### **Nylon stocking dermatitis.**

Nylon Hosiery was introduced into America in 1939 & was first made in Britain in 1947.<sup>61</sup> In 1947 Dobkevitch and Baer studied 13 patients who had nylon stocking dermatitis due to Azodyes used in stockings. Men's nylon socks have been described as source of ACD in France and in America many years ago.<sup>43</sup>

The sites of involvement include the dorsal surface of the feet and toes, the back of the knees and inner aspects of the upper thigh are the area most commonly affected when ACD is caused by nylon stocking dyes.<sup>56</sup>

### **Plant and wood dermatitis**

A large proportion of Indians especially in South India walk bare foot. Where they come in contact with plants such as parthenium hysterophorus, eucalyptus etc., which causes foot dermatitis.<sup>62</sup>

The incidence of plant dermatitis varies from country to country and it depends on the local flora. Farmers, Foresters, gardeners, florist and furniture makers are the occupational victims of plant and wood dermatitis due to the presence of chemical resins.

### **Clinical Pattern**

Plant and wood dermatitis often present as airborne contact dermatitis where in exposed parts of the face, necks and limbs are affected, gradually the process becomes generalized. Fissuring and hyperkeratosis is common in plant dermatitis.

### **Topical Medicament**

The most common cause of allergic contact dermatitis of the legs is the application of sensitizing medications to stasis eczema or ulcers. These include neomycin,<sup>63</sup> nitrofurazone<sup>64</sup>, streptomycin, local Anaesthetics, antimycotic agents, preservatives, steroids etc.,

### **Irritant contact dermatitis**

**Definition:** Irritant contact dermatitis include several inflammatory responses that follow damage to the skin. These may result from acute toxic results to the skin as well as accidental exposure to Acids, alcohols etc or they may arise from repeated and cumulative damage from more marginal irritations both physical and chemical. It has a role in precipitation and aggravation of ACD.

## **Mechanism of Action**

Most irritants induce damage by generally exhausting the horny layers, denaturing the keratin, removing stratum corneum lipids and altering the water holding capacity of the skin. This eventually leads to damage of living cells of the epidermis.<sup>65</sup>

## **Predisposing factors**

Genetics<sup>66</sup>, Dry skin, Fair skin, Aged skin, Hyperhidrosis, Atopic eczema.

Common irritant that cause foot dermatitis are water, detergents, soaps, industrial cleansing agents, alkalis including cement cutting oil, organic solvents, animal enzymes. There are no significant differences in pattern of inflammation with these irritants.

Other exogenous types of eczema include

## **Infective Dermatitis**

Infective eczema is caused by microorganism or their products and which clear when the organism are eradicated.

## **Dermaotophytids**

Eczematous reactions can occur as an allergic reaction to dermatophyte infections elsewhere on the skin.

## **Endogenous factors of foot eczema**

1. Atopic dermatitis
2. Juveniles plantar dermatitis
3. Acute irritant contact dermatitis
4. Cumulative irritant contact dermatitis
5. Asteatotic Eczema
6. Discoid eczema
7. Gravitational eczema
8. Pompholyxs
9. Hyperkeratotic palmar eczema
10. Eczema associated with systemic disease
11. Eczematous drug eruptions.

## **Atopic Dermatitis**

Moller et al, atopic dermatitis is often regarded as being a generalized condition but it can be localized to one area and localization being the fore foot.<sup>67</sup>

Atopic dermatitis aggravates the ACD due to the breach in the skin barrier.

## **Juvenile Plantar Dermatoses (JPD)**

Juvenile plantar dermatosis is characterized by dry fissured dermatitis of the plantar surface of the fore foot. It is more common in males between the age group of 3-14 years.

As of 1982, 42% of the 269 patients who had a personal or family history of atopy had JPD.<sup>68</sup> Absence of vesicles or signs of more acute dermatitis distinguished this condition from shoe dermatitis.

## **Acute irritant contact dermatitis**

It is produced by strong irritants, eg. Concentrated acids alkalis or solvents caustic burns from lime or cement may cause increased tissue damage.<sup>69</sup>

## **Cumulative irritant contact dermatitis**

It develops as a result of series of repeated and damaging insults to the skin which includes friction microtrauma, low humidity.<sup>70</sup>

## **Asteatotic Eczema**

Asteatotic Eczema occurs due to decrease in the skin surface lipids. It occurs particularly on legs, arms and hands. It is more marked in winter and in elderly people. The skin is dry and slightly scaly.

## **Discoid Eczema**

It is characterized by coin shaped plaque of closely set, thin walled vesicles, on an erythematous base, distributed symmetrically on the dorsal aspects of hands and feet.

ACD common in persistent discoid Eczema. The most common allergens are rubber, chemicals, nickel,<sup>71</sup> formaldehyde etc.,

## **Gravitational Eczema**

The primary cause of stasis dermatitis is venous insufficiency. It is secondary to venous hypertension, usually in the lower leg and often occur as a late result of previous deep vein thrombosis.

## **Pompholyx**

It is a form of eczema of palms and soles in which edema accumulates to form visible vesicles and bullae.

## **Hyperkeratotic Palmar Eczema**

It occurs more in adults and presents as hyperkeratotic scaly sometimes fissured thick infiltrated areas on palms and soles.

## **Eczema associated with systemic disease**

Intestinal malabsorption can be the cause or the result of widespread eczema.<sup>72</sup> A desquamating rash was noted in 20 of 100 cases of idiopathic steatorrhoea<sup>44</sup> and in some cases dermatitis preceded the symptoms of this disease.<sup>73</sup>

## **Eczematous drug eruptions**

Eczematous drug eruptions occur possibly more commonly after gold or neomycin, penicillin, beta blockers, methyl dopa and Clonidine.

## **Nylon stocking dermatitis**

Dermatitis from nylon stockings is caused by azodyes and anthroquinone dyes used in them. The 3 dyes namely disperse yellow, red and blue have continued to be the most frequently sensitizing nylon stocking dyes<sup>59</sup>.

## **Metals**

Some shoes made for children and ladies had decorative pieces and buckles made of metals which can cause dermatitis in nickel chrome and cobalt sensitive individuals.<sup>74</sup> Some female wear silver anklets and toe rings which may not only cause contact dermatitis, but also streaky black pigmentation due to impregnation of the metals into the skin.

## **Plant dermatitis**

Most plants are harmless but few causes allergic irritant and phototoxic dermatitis. In India parthenium hysterophorus is the most common cause of occupational exposure. The most intimate contact occurs in farmers, gardeners, grass cutters etc who come in direct contact with the plants. They also come in contact with insecticides, weedicides, pesticides, fungicides as well as fertilizers.<sup>75</sup>

## **Cement burns**

Greatest hazard from cement occur on building and construction sites and this includes bricklayers, labourers, plasterers, floor layers, carpenters etc.

Severe alkali burns of the lower limbs and feet from calcium hydroxide in wet cement have been reported. The skin is red scaly and thickened with the appearance of a subacute or chronic eczema. Hands and feet are involved.<sup>76</sup>

Allergic dermatitis can occur from the ubiquitous presence of hexavalent chromates in cement. Trivalent chromate is hypoallergenic and addition of ferrous sulphate converts allergenic hexavalent chromate into hypoallergenic trivalent form.<sup>77</sup>

The presence of hexavalent chromium in the cement or leather can be determined with the help of DPG (Diphenyl carbazide) test. The main sensitizer in cement are chromium, and metals such as nickel and cobalt.



## **Topical medications**

Broad spectrum antibiotics like neomycin, framycetin, nitrofurazone, gentamicin, can cause allergic contact dermatitis. Other antibacterial agents producing hypersensitivity includes oxytetracycline, bacitracin, and streptomycin<sup>78</sup> Preservatives added in antibiotics and steroid ointments can also cause ACD.

## **Soaps and detergents**

The alkaline and fatty acids of soaps are rare sensitizers, as are synthetic detergents with out additives. The additives in soap that may be cause of allergic dermatitis are lanolin, perfumes, resins (colophony), enzymes, deodorants, dyes, emulsifiers, antiseptics, antiperspirants etc.

Common among them are perfumes, colophony, and enzymes.

**Perfumes:** Benzyl salicylate is a common detergent ingredient which causes dermatitis in perfume sensitive patients. Contact sensitization to fragrance mix and balsam of peru<sup>79</sup> have been reported.

**Colophony:** Yellow laundry bars owe their properties to the presence of colophony, which is a chemical mixture derived from the various species of pine. It contains the mixture of complex abietic acids and esters. Transparent toilet soaps contains high amount of colophony.

**Enzymes:** Enzymes derived from *Bacillus subtilis* is used in detergents. About 70 – 75% detergents contain enzymes. Although they mainly produce irritant dermatitis, sensitization to enzyme detergents has been proved by demonstrating positive scratch test reactions.<sup>80</sup>

**Antiseptics:** Antibacterial agents in soaps like chloracetamide and chloroxylenol can produce contact dermatitis.

### **Cosmetics**

Nail polishes contain polyvinylchloride or an acrylate dissolved in chloroform apart from the coloring agents, perfumes, and other additives.

Nail polish remover contains mixture of acetone which may be rare sensitizer.<sup>81</sup> Toluene sulfonamide formaldehyde is the commonest sensitizer

### **Histopathology**

Biopsies are of little diagnostic help in contact dermatitis. Most types of eczema show identical pathological changes and allergic and primary irritant contact dermatitis cannot be distinguished with certainty.<sup>82</sup> The role of basophils and mast cells remain controversial. Electron microscopic studies suggest that Langerhans cells play an important role..

Recent histopathological immunocytochemistry and electron microscopy of the early cellular events in patients with induced allergic and irritant responses failed to show significant differences in the pattern of inflammation.

## **DIFFERENTIAL DIAGNOSIS**

1. Allergic, Mechanical And Irritant Dermatitis
2. Atopic dermatitis – irritation can precipitate an attack of dermatitis
3. Juvenile plantar dermatitis occurs on the toe and distal feet with instep sparing. Absence of vesicles or signs of more acute dermatitis is a distinguishing feature from shoe dermatitis.
4. Fungal infection predominant involvement of sole with hyperkeratotic lesions, pompholyx should lead to the suspicion of fungal infection, which can be confirmed with KOH smear.
5. Psoriasis may mimic hyperkeratotic eczema. Pustular lesions of localized pustular psoriasis mimics pompholyx. Scalp lesions, nail changes, history can help in diagnosing psoriasis.
6. Bullous pemphigoid can present as keratotic eczema over palms and soles.
7. Palmoplantar kaeratoderma
8. Pityriasis rubra pilaris

## **INVESTIGATIONS**

1. ACD is confirmed by patch testing
2. KOH to rule out coexistent fungal infections in patients with scaly lesions
3. Serum IgE in case of atopsics(personal and family history)
4. Pus culture sensitivity to rule out a concomitant bacterial infection

## **PATCH TESTING**

### **Introduction**

Patch test has place in almost all eczemas.

Apart from confirming suspected allergic contact dermatitis, patch testing can be carried out before using skincare products like sunscreens, moisturizers and cosmetic products. This is termed “predictive testing”

Expert in patch testing is based on generating a data base which is reinforced by patch testing and following the scent of trail until the source. The approach is not unlike Sherlock Holmes. Patch testing entails exposing the person to multiple allergens to pinpoint the culprit allergen and subsequently determining the relevance to the presenting ailment. A properly conducted and interpreted patch test is “scientific proof” of allergic sensitization and identifies the culprit which means not treating by mere “trial and error”.

The Indian Standard Series (ISS) is the basic series and comprises 25 allergens manufactured by Chemotechnique Diagnostics, Sweden and distributed by Systopic labs. Two readings are recommended, one after the removal of patches (Day 2) and the second reading on Day 3 and Day 4. Interpretation of the patch tested site is according to the International Contact Dermatitis Research Group (ICDRG).

Patch testing with the basic series and specific footwear series would identify the culprit allergen with ease.

Patch testing is an integral portion of a dermatologist's diagnostic work up of patients who experience chronic skin eruption; patch testing is used to determine whether or not a patient has a contact dermatitis or in other words an allergic reaction to something that contacts the skin. Not meant for everybody patch testing comes to the forefront of our mind when patient presents with chronic history of Eczematous process, that hasn't responded to therapy as expected, or may have an unusual distribution. Sometimes it is difficult to distinguish true eczema, contact dermatitis even psoriasis in certain situations. Some patients may even have an allergic reactions super imposed upon a true skin disease So it is helpful to have a diagnostic tool such as patch testing to confirm or disprove our suspicious.

## **History**

As early as 1840, Fuchs clearly understand that external agents were responsible for "Dermatitis Venenata" although he thought that the disorder was the result of idiosyncrasy and not allergy.

In 1847, Stadeler described a method to reproduce on human skin the lesions provoked by *Anacardium occidentale*. In 1889, Collins an ophthalmologist applied patches of atropine to his patients who were getting reactions to instillations of atropine. It was Jadassohn the father of Patch testing who unequivocally established the role of patch testing in 1896.<sup>83</sup> It was further developed and refined by Bonnevie in Europe and by Sulzberger

and Wise in USA. Standardization was further delineated by International Contact Dermatitis Research Group (ICDRG).<sup>84</sup>

Patch testing at present is the only scientific method to detect the cause of contact dermatitis. An ideal patch test produces no false positive reactions. The ideal allergen should fulfill the following characteristics

- The allergen should be pure and in the right concentration,
- The risk of active sensitization should be low,
- There should be minimum irritant reactions
- It should be easy to apply,
- It should be stable,
- Easy to read
- Suitable to all group of patient.

### **Indications for patch testing**

1. All cases of dermatitis, which do not resolve in a short time.
2. Whenever there has been chronic medicament usage on such sites as the hands, face, lower legs, feet, ears, eyes and anogenital region.
3. In Persistent or atypical eczema.
4. “Predictive testing” of alternative products such as gloves, skincare products and medicaments.

Patch testing should be performed when the dermatitis has subsided. The procedure should at least be delayed until the test site has been clear for atleast a fortnight.

### **Contraindications**

The test is to be postponed if the patient is having acute dermatitis, because at that stage, the skin is likely to be in an irritable state and may give rise to false positive reactions. Introduction of the antigen during patch test may also aggravate the existing dermatitis. The patch test may be done even before the dermatitis has subsided in situations where a drug is the suspect and it is essential to find out at the earliest drugs in which the patient does not react so as to select the drug for treatment of the disease.

The patch test may also be postponed if the patient is being treated with immunosuppressive drugs such as systemic corticosteroids, Cyclophosphamide, methotrexate etc., because these drugs are likely to suppress the cell mediated hypersensitivity of the patient, mask the reaction to the antigen and give rise to a false negative results.<sup>85</sup>

### **Selection of Patch Test Site**

In an allergic patient, the whole skin is capable of reacting with antigen, but the patch tests are generally done on the back.<sup>86</sup> Because it provides a large skin area for testing. The region used for testing is important with regard to the result of the investigation as both allergic and irritant reactions are most



easily provoked on the upper back. Moreover pressure on the back during lying down helps a better contact of the antigen with the skin. If the back is not available for some reason the patch tests can be done on the upper arm or the flexural surface of the forearm, though at these sites there is a greater risk of false negative results. If hairs are present it should be shaved off 24 hrs prior to the patch testing.

## **Method**

Patch tests elicits an immune response by challenging an already sensitized person to defined amounts of allergen and assessing the degree of the response.

Various types of chamber or discs are used to ensure occluded contact. The fixing tape should be non occlusive, non allergic and non irritant.

If the adhesive tapes peel off, the test must be repeated. The ideal regimen is a 48 hrs application time, with reading taken 30 minutes after removal and again 48 hrs later i.e. at 2 days and 4 days.<sup>87</sup>

The first patch tests used were pieces of cotton fabrics which was soaked with allergen solution. This test was made easy by cutting 4 cm square pieces of adhesive tape and fixing in the center of each patch a 2.5 cm square piece of clean cotton gauze or foam. The cotton gauze should have at least four layers and preferably eight layers thick. The antigen is to be placed on or soaked into this central piece of cotton/filter paper.

Presently Finn chamber is most commonly used patch test unit which consists of stiff aluminum and has a diameter of 8mm and a depth of 0.5mm<sup>88</sup>

Advantage of this type includes

- Tight opposition in the skin thus localizing the reactions,
- Use of porous tape,
- Reaction to the test site alone and
- Small area required for patch testing.

These chambers are supplied in strips of five or ten (two rows of five) and consist of small aluminum discs, to give skin occlusion, mounted on acrylic based adhesive, non occlusive tape, which has been chosen for its excellent adhesive properties and hypoallergenicity.

## **Vehicles**

Few substances can be applied to the skin as they are. But in order to avoid an irritant effect, they must be mixed or dissolved in a vehicle to achieve a suitable concentration. The test substance should, if possible be soluble in the vehicle. If a dispersion of allergen in petrolatum is used, contact with the skin depends on the size of the particles and on their solubility or dispersion in petrolatum. Uniform dispersion and particle size are important.

Aqueous solutions and solvents such as ethanol, acetone, methyl ketone and ethyl ether have been tried and are still recommended for special allergen.

At present the standard vehicle is white petrolatum due to the refined nature and almost negligible sensitizing potential.<sup>89</sup> Petrolatum is generally more reliable and also has the added advantage of being occlusive, which helps to prevent oxidation and prolongs shelf-life. Allergic reactions to petrolatum itself are very rare. Petrolatum is highly lipophilic and most allergens are hydrophilic. The bioavailability of such allergens from petrolatum seems to be low.

### **TRUE TEST (Thin layer Rapid Use Epicutaneous Test)**

This is a new pre-packaged, ready to use patch test system. TRUE TEST based on a dispersion of allergen in a hydrophilic polymer but this is only available as a standard series of 24 allergens. It was developed by Fischer and Marbach. It meets almost all prerequisites of the most suitable test method due to the least possible time consumed in application of the patches, uniform distribution and release of antigen, less amount of antigen required, minimum irritant reactions, easy storage and stability.<sup>90</sup>

Reactions to the adhesive tape may occur, but they are irritant not allergic. To reduce the incidence of such reactions, the strips must be applied without tension, with the patient in a relaxed posture.

## Concentrations

Choice of a suitable concentrations is of fundamental importance. Too high concentrations result in false positive reactions, because of their irritant effect, and may even sensitize patients, too low concentrations produce false negative results.

To find a non irritant concentrations, most chemicals can be tested with three concentration 10%, 1% and 0.1% in aqueous solution or in petrolatum. But a positive reaction should not be accepted as allergic unless atleast 20 controls are negative.

The allergens must be stored properly so that they are protected from environmental influences. Polypropylene syringes kept in a cool dark place protect the allergens from heat, light, UV ray, air, humidity and microbial contaminants. Some standard allergen such as fragrance mix and chromate may be marginally irritant.<sup>91</sup>

## **Principles of Patch testing**

1. Test only with known substances in “Standard concentrations”. If in doubt, do open or “use” tests with controls.
2. Test should not be done if there is acute dermatitis. The test site must be completely free of dermatitis.
3. Patches are normally applied for 48 hrs on the upper back. The patient is instructed to avoid exercise, sweating, wetting the areas rubbing and scratching. Certain types of heavy work are contraindicated as well, especially if the patient sweats considerably.
4. Patient should be instructed to remove that patch without disturbing others if there is burning sensation or itching.
5. The patient should not expose the area to sunlight or sun lamps and steroids.<sup>92</sup>
6. The test area should be marked with colored or fluorescent ink.
7. Though there are reports of positive reactions after less than one hour application of nickel salts, neomycin, P-phenylenediamine often shows maximum reactions on days 4 and 7 after application and this may occur with other allergens as well.
8. Irritant and allergic reactions may be difficult to distinguish. As a rule, allergic reactions itch more than irritant reactions. Certain patch test substances commonly produce weak irritant reaction. Especially on highly sensitive skin or on subjects who have several strong allergic reactions simultaneously.

**TABLE - 2**  
**EVALUATION OF PATCH TEST READING**

<b>Grading</b>	<b>Evaluation</b>	<b>Clinical Findings</b>
± or ?	Doubtful reaction	Faint erythema only
+	Weak (non vesicular) Positive reaction	Erythema, infiltrations and possibly discrete papules
++	Strong (vesicular) Positive reaction	Erythema infiltration. Papules and vesicles.
+++	Extreme (Bullous) Positive reaction	Intense erythema infiltration and coalescing vesicles
2	Negative reactions	
Ir	Irritant reactions	
Nt	Not tested	

### **Causes of false positive reactions<sup>93</sup>**

- Too high concentration
- Irritant vehicle
- Adhesive tape reactions
- Uneven dispersion
- Excess allergen applied
- Impure substance
- Current dermatitis at Patch test site
- Current dermatitis at distant sites
- Pressure effect of hard materials
- “Angry back: reaction.
- Artifact

## **Cause of False – negative reactions**

- Too low concentration
- Poor adhesions of patches
- Insufficient amount applied
- Inappropriate vehicles
- Patches applied at wrong site
- Readings performed too early
- Substance degraded
- Pretreatment of patch test with topical corticosteroids
- Systemic treatment with corticosteroids.

## **Complications**

1. Patch test sensitization
2. Irritant reactions from the nonstandard allergens or products brought by the patients
3. Flare of previous existing dermatitis due to percutaneous absorption of the allergen
4. Subjective complaints
5. Depigmentation eg phenols
6. Pigmentation sometimes after sunlight exposure of test sites
7. Anaphylactoid reactions or shock from eg neomycin, bacitracin
8. Scars and keloids
9. Granuloma from beryllium, zirconium
10. Infections (bacteria, virus)

### **Other test for allergic contact dermatitis open tests**

This is an artificial procedure and it has been suggested that clinical exposure might be more closely stimulated by simple application of the sensitizer to uninvolved skin.

The technique is simple. The liquid test substance is dropped on an area of the skin measuring about 1 cm in diameter and the solution is allowed to dry. The time for reading and the characteristics of the reaction are the same with closed patch testing. The reaction is often weaker and consist of isolated papules only. Open test are used as preliminary screening procedure with less well known substances to reduce to risk of severe reactions.

### **Semi open test**

The product (solution or suspension) is applied with a cotton swab as is in a small amount (15microlitre) to an area of 2\*2 cm. after complete drying it is covered with acrylate tape for 2 days. The site is checked for contact urticaria at day2 and 4 for signs of contact dermatitis.

### **Usage Tests**

This test is useful in suspected cosmetic and clothing dermatitis. In cases of doubt, when either a closed patch test or open test is negative and yet the history suggest contact dermatitis, the pattern should be asked to use the preparation again. It produces all the other factors associated with the original dermatitis for example sweating, friction and application of allergen on



damaged or presensitized skin it is sometimes positive when a conventional patch test is negative.

The substances are applied twice daily on at least a 5 cm<sup>2</sup> area on the upper arm for 7 days or until positive eczematous reaction develops. This test may be used to help determine the relevance of doubtful positive patch test reactions to preparations in which allergen is present in a low concentration.

### **Repeated Open Application Test**

The ROAT in a standardized form was introduced by Hannuksela and Salo. Test substances are applied twice daily for 7 days to the outer aspect of the upper arm, antecubital fossa, or back skin. A positive response – eczematous dermatitis – usually appears on days 2-4 but the recommended to extend the applications upto 3 weeks in order not to miss late appearing reactions.

### **Non Invasive Techniques**

To reduce interindividual variation when scoring patch test reactions, various bioengineering techniques has used. Erythema and skin color can be assessed by laser Doppler flowmetry (LDF), reflectance, and colorimeters, and edema with calipers, ultrasound, and electrical impedance.

## **Intradermal Tests**

It is not commonly used but only for investigative purpose due to numerous technical pitfalls, non availability of sterile solutions, active sensitization and ethical considerations.

The technique has proved reliable for nickel<sup>94</sup> and corticosteroids.

## **Photo Patch Testing**

Antigens are applied in duplicate parallel to each other and covered with opaque material. The patches are removed on day 2 and read as usual. One set is then irradiated with UVA. When the allergic reaction occurs on irradiated side it is considered as positive photo allergic patch test. The commonest photosensitivity related drugs are thiazide, diuretics, Antinflammatory and chlorpromazine.

While performing photopatch test distinguishing between phototoxic and photoallergic reactions is utmost important. A phototoxic reaction is characterised by well defined erythema, infiltration with burning sensation. It also has the tendency to subside quickly (peak intensity is reached within 24 hrs), and this observation is called decrescendo pattern.

A typical photoallergic pattern has a greater degree of pruritis, with papules or vesicles, and can extend beyond the area of contact with the allergen. There is also tendency to increase in intensity with a peak reactions in 48 or 72 hrs post irradiation. This feature is called crescendo pattern. It occurs in previously sensitized individual. Very small quantity of allergen is required to provoke such reaction.

Histopathological differences exists between the two reactions. Spongiotic dermatitis with no sunburn cells on histology suggestive of photoallergy.

Multiple reaction combinations can occur such as negative or irritant reactions on sides, photoaugmentation and photoinhibition. A photoaugmented reaction is said to be suggestive of both photoallergy and allergic contact dermatitis. Whereas photoinhibition is probably due to UV induced immunosuppression or false technique whereby different areas of the back receive varying amount of irradiation.

### **In vitro Test**

These includes inhibition migration test, lymphocyte transformation tests leukocyte procoagulant activity.

## **Spot Tests**

These include Dimethylglyoxime test for nickel, Lutidine test for formaldehyde and Diphenylcarbazide test for chromate.

## **General Measures Of Shoe Dermatitis**

After the culprit allergens have been identified the patient has to be counselled to avoid potential sources of exposure in the workplace and household settings. Handouts containing the informations prepared for the purpose of this study will be distributed to the patients.

1. Avoidance of allergens by distribution of pamphlets and by excluding the culprit allergens in footwear. Some companies may manufacture the footwear without the culprit allergens but at prohibited costs
2. Advise to use socks which have been washed prior to use, preferably white or fawn in color, to prevent additional sensitization to dyes. The socks on the other hand may prevent direct contact of allergens with skin. Socks should be washed more frequently with mild detergents so as to reduce allergenic load.
3. Minimizing friction using lubricants, emollients, and occasionally topical corticosteroids at night.

4. Suggest to keep multiple pairs of footwear and use them on the rotational basis.
5. Treatment of hyperhidrosis

People who have hyperhidrosis are more prone to the development of shoe dermatitis. So when hyperhidrosis controlled people can wear the incriminated shoes for the short period of time.

Zeasord powder dusted into shoes may lesser perspiration. Drysol is 20% aluminum chloride in ethyl alcohol can be used. The drionic device is an iontophoretic device that passes a electric current through the skin in minimal quantity. Repeated treatment inactivate eccrine sweat glands. Botulinum toxin intradermal injection control hyperhidrosis for up to 6 months.

Tea foot baths are another way. They assist in calming an acute dermatitis but has the adverse effect of staining feet and nails.

#### **Instructions for Tea foot bath.**

- 6-8 Tea bags in 1 quarter of water is boiled for 10 mts.
- Place in basin and cool to leukewarm temperature.
- Soak feet for 30 mts once or twice daily.
- After 1-2 weeks frequency can be reduced.

6. It is preferable to avoid dark color synthetic socks, since most dyes are used in their manufacture. Woolen socks have to be avoided in atopy. Cotton, linen and silk are the preferred materials.
7. Patient may have unique allergy to dyes, fungicides, vegetable tanning or adhesive ingredients which is present in only one pair of shoe. Once the dermatitis cleared with medicine, and the patient has worn one pair of all leather, all wood or all plastic shoes, the suspect shoes can be slowly reintroduced. This has to be done one pair at a time and not more than weekly.

## **Specific Advises For Certain Allergens**

### **1. Rubber Allergy**

Leather shoes (sewn leather moccasins) with outsoles or outer sole, 100% plastic shoes without insoles (injection molded) can be used. Rubber free tennis shoes made of polyolefine, urethanes and ethylvinyl acetate can also be used. After checking the shoe labels for the materials incorporated, if needed insole can be replaced with cork, felts or gel insoles. Wooden shoes are also best substitute.

## **2. Leather Allergy**

Wooden, plastic, all fabric shoes rubber footwear are the other alternatives. Vinyl shoes and boots can also be recommended. Insole made of leather is removed because they are chrome tanned. Vegetable tanned are best alternative. Leather footwear shocked in citrus fluid lost their allergic nature.

## **3. For PTBFR adhesive allergy.**

To find about the adhesive used in shoe, its necessary to contact the manufacturers. 100% leather, plastic (if not neoprene) or wooden shoes should be tolerated by the individuals. It is better for go for urethane glued shoes. Liners must be removed and replaced with gel cork or felt insoles glued in place with acrylic adhesive or elmer's type glue.

## **MATERIALS AND METHODS**



## **MATERIALS AND METHODS**

This study was conducted over the period of 16 months from April 2013 to August 2014 in the department of Dermatology PSGIMSR Coimbatore Tamilnadu..

During this period total number of 40 patients with foot dermatitis attending the outpatient departments were included in this study. An informed consent was taken from all the patients.

Patients details were recorded in the proforma (age, occupation, duration of illness, site of initial lesion, extent of involvement, type of footwear, seasonal variations, association with atopy).

In patients showing extensive scaling/suspecting fungal infections KOH Skin scraping was carried out in addition to patch testing. In patients with family history or personal history of atopy serum IgE was done.

In case of purulent discharge from the lesions pus culture sensitivity was sent to rule out concomitant bacterial infections. Past treatment history (topical/systemic) was also recorded.

The Clinical signs and symptoms like itching with oozing, scaling, pustules, erythema, vesicles, purpura, hyperpigmentation, depigmentation, lichenification were recorded.

Area of involvement was recorded as symmetrical/ asymmetrical lesions, dorsum of the foot, dorsum of the toe, plantar surface, heel and sparing of instep/flexures.

### **Inclusion criteria**

Investigation of patients with eczematous eruptions mainly over the foot.

### **Exclusion criteria**

- pregnant and lactating mother
- patient with exfoliative dermatitis
- patients on systemic immunosuppressants and high dose oral steroids

Photographs of each patient were taken using DSLR Nikon D500 camera.

Photographs of the patch test site were also taken at each reading to document positive reactions.

The patients after screening were subjected to patch testing using Indian Standard Series(ISS) of allergens and footwear series Manufactured by Chemotechnique Diagnostics and approved by Contact And Occupational

Forum Of India (CODFI). There was overlap of few allergens which was not repeated twice.

We did patch test with the patients own shoe materials in 2 patients who strongly had a suspicion of the particular footwear as the cause of their dermatitis. Piece of the footwear material was collected from the part which was in direct contact with the skin and it was crushed, soaked in distilled water for few minutes and then patch tested over the arm along with control. The patch was removed after 5 days and the readings were taken which showed strong positive in one individual and other had severe itching over the patch tested site and hence the patch was removed in 2 days which also showed positivity.

The list of allergens in ISS and FWS

**TABLE - 3**  
**ALLERGENS IN ISS**

<b>S.NO</b>	<b>ANTIGEN</b>	<b>CONCENERATION</b>
01	Control	100
02	Potassium dichromate	0.5
03	Neomycin sulfate	20.0
04	Cobalt chloride	1.0
05	Benzocaine	5.0
06	Formaldehyde	1.0
07	PPD	1.0
08	Parabens	15.0
09	Nickel sulfate	5.0
10	Colophony	20.0
11	Gentamicin	20.0
12	Mercapto mix	2.0
13	Epoxy resin	1.0
14	Fragrance mix	8.0
15	Mercaptobenzothiazole	2.0
16	Nitrofurazone	1.0
17	PEG 400	100
18	Chlorocresol	1.0
19	Wool alcohols	30.0
20	Balsam Peru	25.0
21	Thiruam mix	1.0
22	Chinoform	3.0
23	Black Rubber Mix	0.6
24	P-T B P F Resin	1.0

**FWS**

**TABLE - 4**  
**ALLERGENS IN FWS**

<b>S.NO</b>	<b>ANTIGEN</b>	<b>PERCENTAGE %</b>
01	Control	
02	N-isopropyl-N-phenyl-4-phenylenediamine	0.1
03	Glutaraldehyde	0.2
04	Disperse Orange3	1
05	Acid yellow36	1
06	Hydroquinone monobenzylether	1
07	Thiuram mix	1
08	Potassium dichromate	0.5
09	4-tert-Butylphenol formaldehyde resin	1
10	4-Phenylenediamine base	1
11	Nickel Sulfate	5
12	Colophony	20
13	Formaldehyde	1
14	Diphenyl thiourea	1
15	2-Mercaptobenzothiazole	2
16	Diethylthiourea	1
17	N,N-Diphenylguanidine	1
18	Dibutylthiourea	1
19	Epoxy resin	1
20	Dodeacylmercaptan	0.1
21	Cl+Me-isothiazolinone (Kathon CG, 200ppm)	0.02
22	4-Aminoazobenzene	0.25
23	2-n-Octyl-4-isothiazolin-3-one	0.1
24	Dithiodimorpholine	1

## **PROCEDURE**

Patients were explained about the procedure and an informed consent was taken. The back of the patient was wiped with tissue paper to absorb sweat and excessive hair if any was shaved before applying patch test units. The antigens were placed in aluminium chambers in the prescribed sequence and applied on the upper back of the patient. The patient was instructed not to wet the back. They were asked to restrict from physical exercises and other activity which could result in profuse sweating. They were also instructed not to wear tight clothing, to avoid friction, rubbing or scratching and to sleep on their sides.

The subjects were asked to avoid sunlight and UV exposures, topical and systemic medications which interfere with the results of patch testing.

After 48 hrs micropor tape which was used to hold the patch test units were carefully removed and the areas marked using a marker pen. Readings were recorded after a gap of half an hour, according to ICDRG (International Contact Dermatitis And Research Group) criteria.

**TABLE - 5**  
**READINGS OF PATCH TESTING (ICDRG)**

1	Faint erythema	Doutful reactions	+/-
2	Erythema, papules and infiltration	Weak positive	+
3	Erythema, papules vesicles, infiltration	Strong positive	++
4	Erythema, edema, vesicle ulceration	Extreme positive	+++
5	No change	Negative	-

The second reading was taking at 72 hrs and recorded as above.

# RESULT

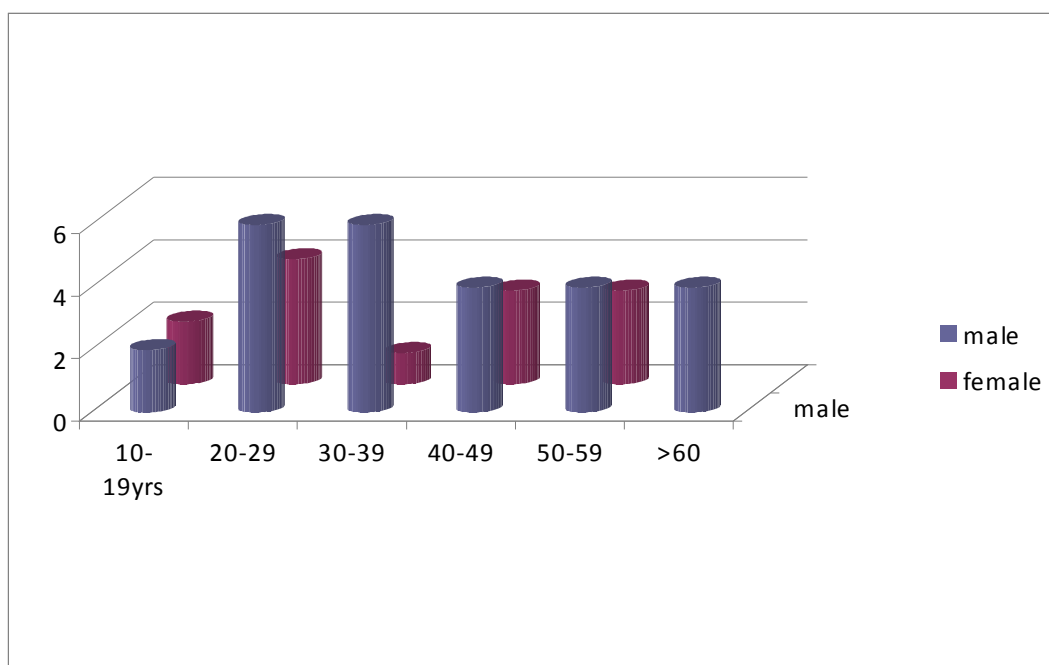


## Results

**TABLE - 6**  
**AGE AND SEX**

AGE IN YRS	FEMALE	MALE	TOTAL	%
10 – 19	2	2	4	10
20 -29	4	6	10	25
30 – 39	1	6	7	17.5
40 – 49	3	4	7	17.5
50 – 59	3	4	7	17.5
>=60	1	4	5	12.5
	14	26	40	100
	35%	65%		

A total of 40 patients completed the study of which 14(35%) were female and 26(65%) were males. The male to female ratio was 1.9:1. The peak age of onset was found to be between 20 – 29 years. Table 6

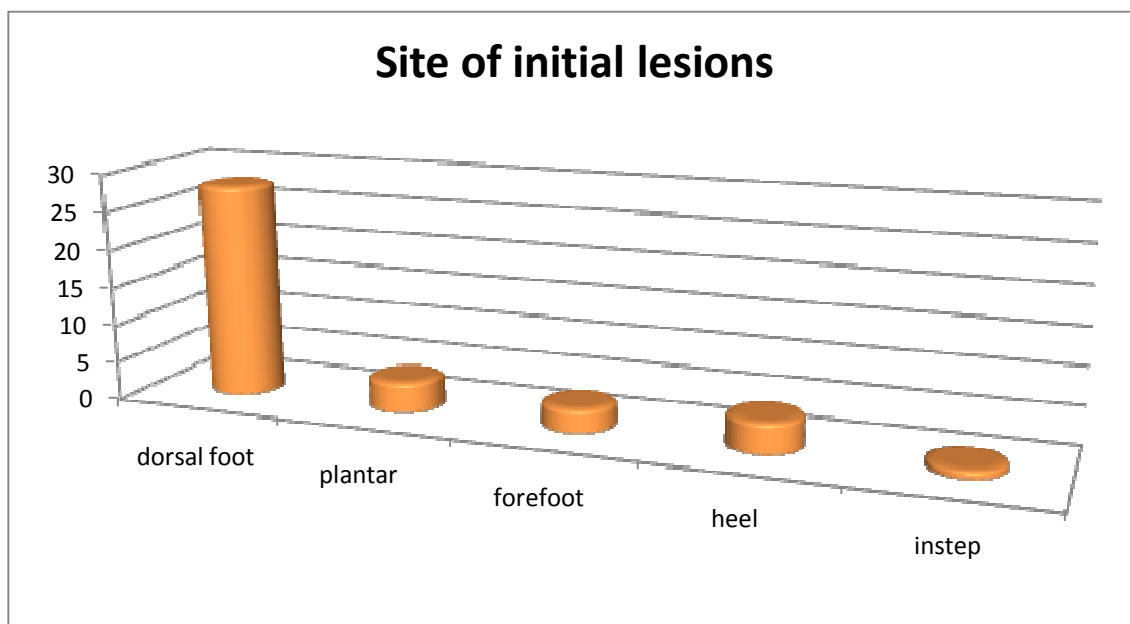


## SITE OF INITIAL LESION

Dorsal aspect of the foot was the commonest site of involvement (70%) Table 7

**TABLE -7**  
**SITE OF THE INITIAL LESION**

SITE	FREQUENCY	PERCENTAGE%
DORSAL ASPECT OF FOOT	28	70
PLANTAR ASPECT OF FOOT	4	10
FORE FOOT	3	7.5
HEEL	4	10
INSTEP	1	2.5
	40	100

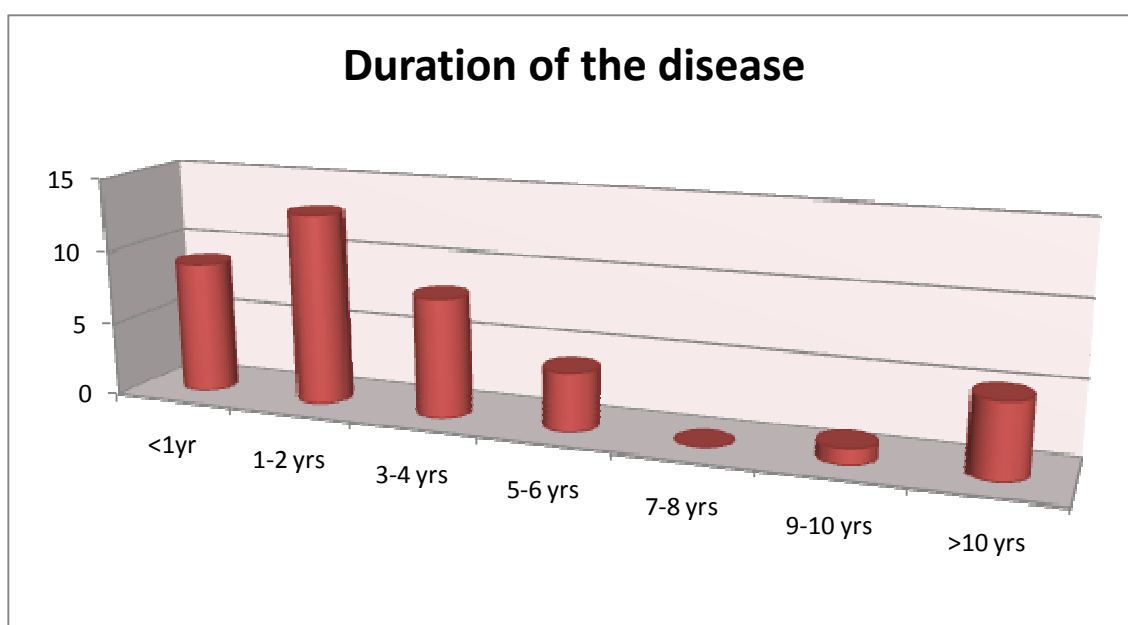


### DURATION OF THE DISEASE

In 13 patients, the duration of the disease was between 1-2 yrs followed by less than 12 months in 9 patients. Five patients have disease duration more than 10 yrs. (table 8)

**TABLE - 8**  
**DURATION OF THE DISEASE**

DURATION	NO OF PATIENTS	PERCENTAGE
< 1 YR	9	22.5
1 – 2	13	32.5
3 – 4	8	20
5 – 6	4	10
7 – 8	0	0
9 – 10	1	2.5
>10	5	12.5
	40	100

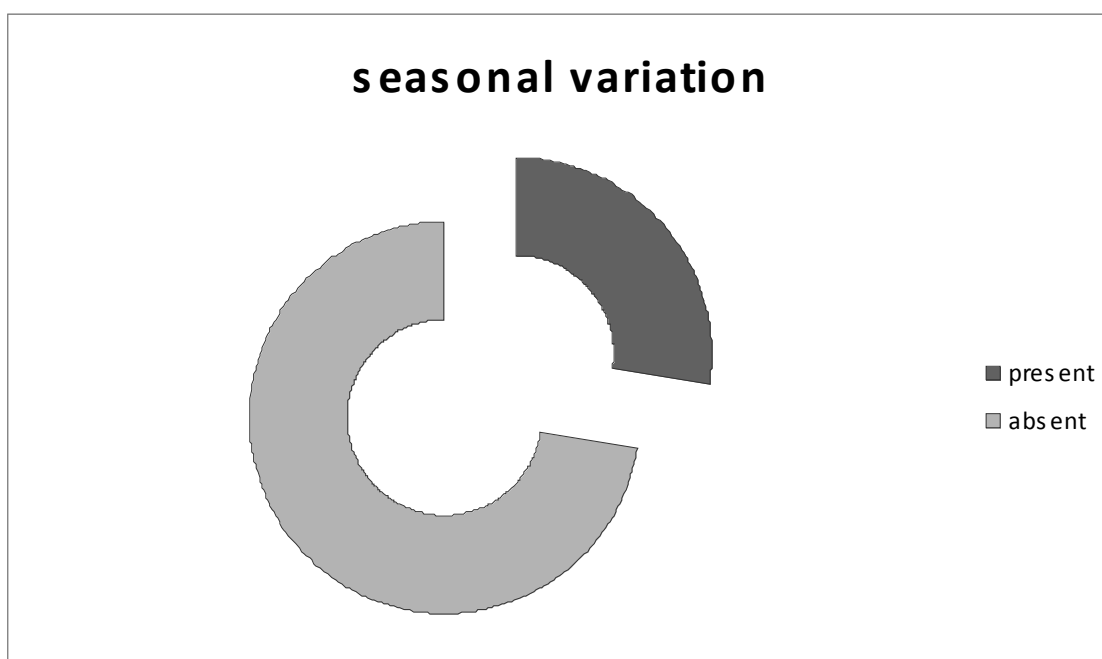


## SEASONAL VARIATION

Seasonal variations was observed in 11 patients of which 5 showed summer aggravations and 6 showed winter aggravations. Table 9

**TABLE - 9**  
**SEASONAL VARIATION**

NO OF PATIENTS	PRESENT	ABSENT
	11	29
	27.5%	72.5%



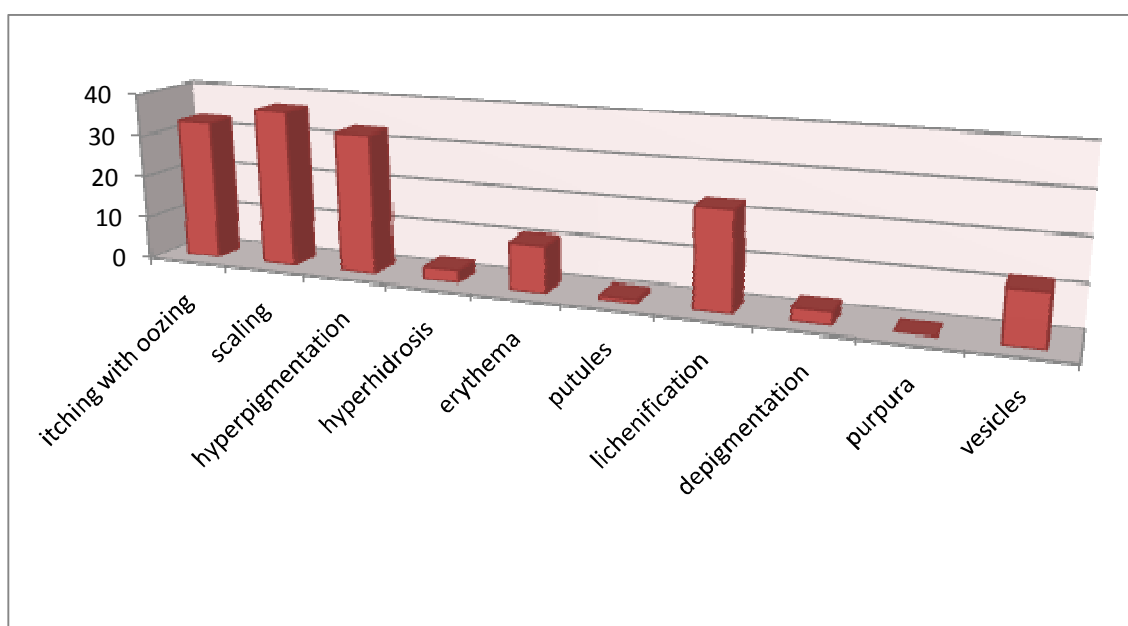
## SIGNS AND SYMPTOMS

Scaling was the commonest symptom, followed by itching with oozing and hyperpigmentation (82.5%) and lichenification 57.5% of the patients .

TABLE 10

**TABLE - 10**  
**SIGNS AND SYMPTOMS**

SIGNS AND SYMPTOMS	NO OF PATIENTS	PERCENTAGE
ITCHING WITH OOZING	33	82.5
SCALING	37	92.5
VESICLES	12	30
HYPERPIGMENTATION	33	82.5
HYPERHIDROSIS	3	7.5
ERYTHEMA	11	27.5
PUSTULES	1	2.5
LICHENIFICATION	23	57.5
DEPIGMENTATION	3	7.5
PURPURA	0	0

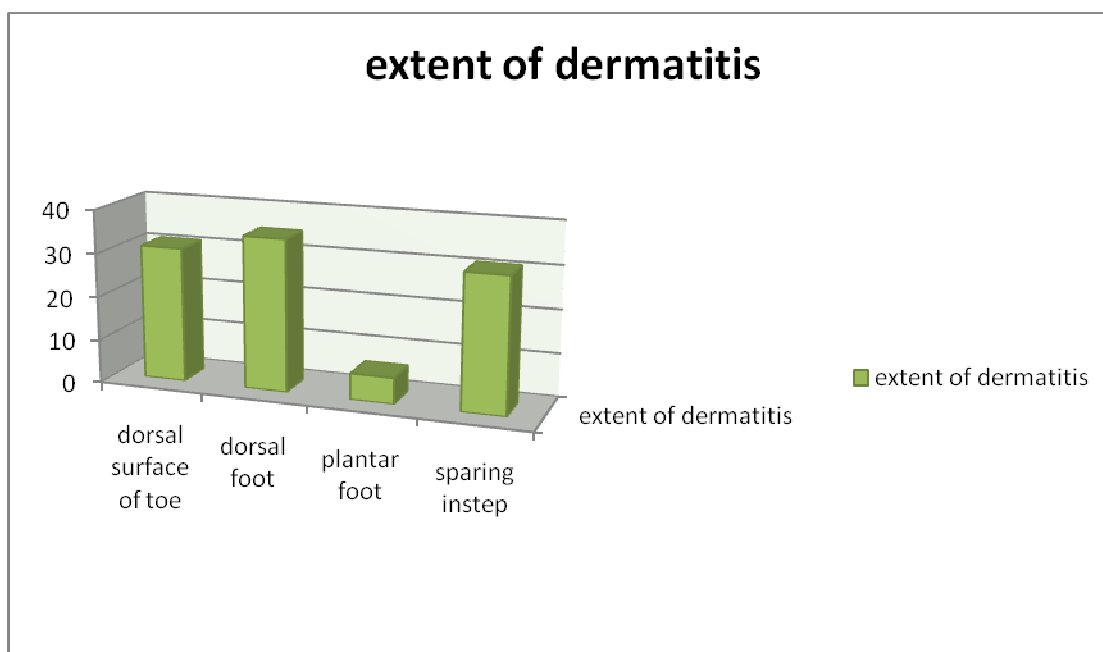


## CLINICAL PRESENTATION OF DERMATITIS

Majority showed involvement of dorsal surface of the foot and toe with plantar surface less frequently involved. Lesions were bilaterally symmetrical in 36/40 patients and the instep area showed sparing in 31/40 patients. TABLE 11

**TABLE - 11**  
**CLINICAL PRESENTATION OF DERMATITIS**

EXTENT	NO OF PATIENTS	PERCENTAGE
DORSAL SURFACE OF TOE	31	77.5
DORSAL FOOT	35	87.5
PLANTAR SURFACE OF FOOT	6	15
SPARING INSTEP/FLEXURAL CREASES	31	77.5
SYMMETRY	36	90%
ASYMMETRY	4	10%



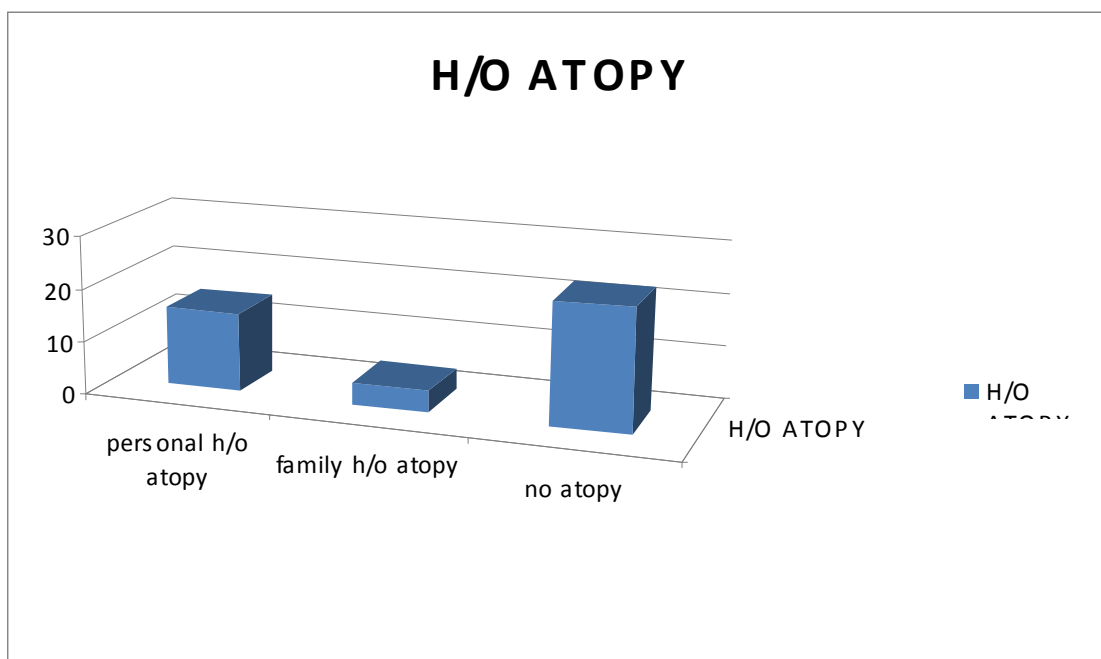
## HISTORY OF ATOPY

History of atopy(personal/family) was present in 17 and was absent in

23. Out of 17 atopic patients ,13 showed raised IgE levels. TABLE 12

**TABLE - 12**  
**HISTORY OF ATOPY**

History of atopy	Present	absent
	17	23

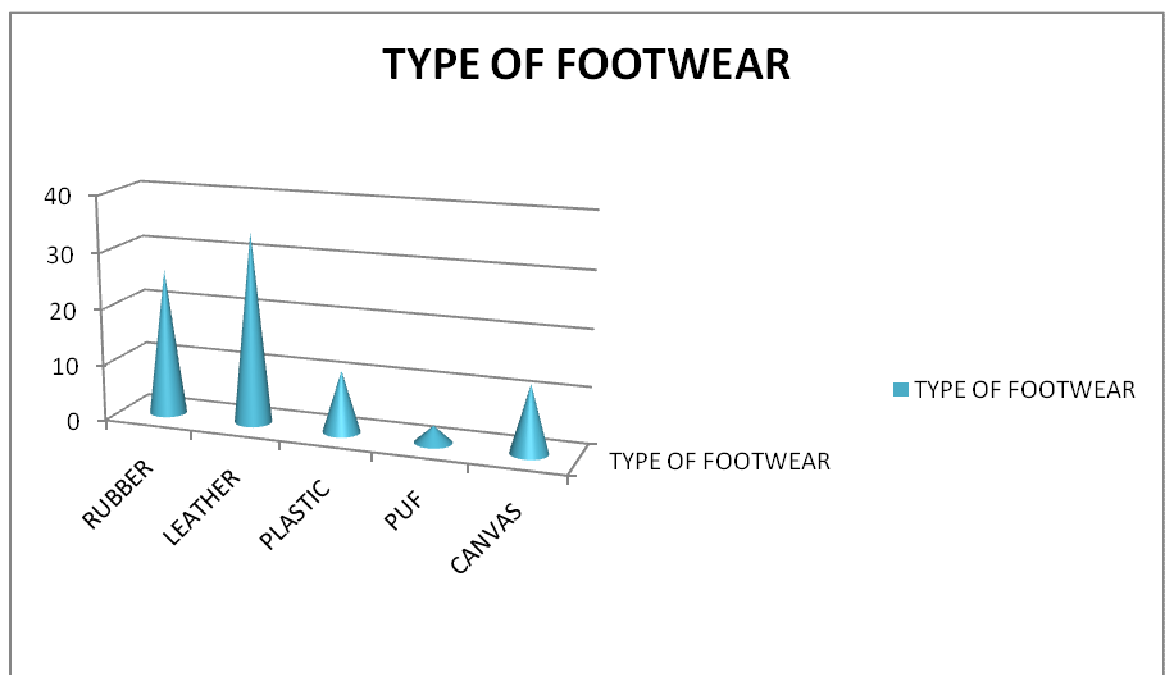


## TYPES OF FOOTWEAR

The subjects did not use one type of footwear. Leather footwear was recorded to be the commonest (85%) worn by the patients followed by rubber (65%). The other footwear materials were plastic (27.5%), PUF (7.5%), and Canvas(30%). TABLE 13.

**TABLE - 13**  
**TYPES OF FOOTWEAR**

Type of footwear	No of patients	Percentage
Rubber	26	65
Leather	34	85
Plastic	11	27.5
PUF	3	7.5
Canvas	12	30





## PATCH TEST REPORT

**TABLE - 14**  
**PATCH TEST REPORT**

Antigen	No of patients	Nil (+/-)	+	++	+++
potassium dichromate	14		11	2	1
Neomycin sulphate	6		2	3	1
Cobalt chloride	1			1	
Benzocaine	1			1	
Formaldehyde	4		4		
PPD	5		4	1	
Parabens	2		2		
Nickel sulphate	17		10	7	
Colophony	6		5	1	
Gentamicin	2		1	1	
Epoxy resin	1		1		
Fragrance mix	3		3		
Mercaptobenzothiazole	2		1	1	
Nitrofurazone	1				1
Chlorocresol	2		2		
Wool alcohol	2		2		
Balsam of peru	2		2		
Thiuram mix	2		1	1	
Black rubber mix	1		1		
PT BPF RESIN	1		1		
N isopropyl n phenyl 4 PD	2		2		
Disperse orange	3		3		
Hydroquinonemonobenzyl ether	1		1		
Diphenyl thiourea	1			1	
Diethyl thiourea	1		1		
N N diphenyl guanidine	13		11	2	
Dibutyl thiourea	2		2		
Dodecyl mercaptan	2		2		
Cl – Me- isothiazolinone	2		2		
4 amino azobenzene	6		5	1	
2N Octyl 4 isothiazoline 3 one	2		2		
Dithiodimorpholine	1		1		

**TABLE - 15****PATIENTS PATCH TEST RESULT IN PATIENTS WITH  
POSITIVE ANTIBIOTICS POSITIVITY**

Patients Patch Test Result in patients with positive antibiotics positivity					
Serial Nr	Patient ID Number	Neomycin (+/-)	Gentamicin (+/-)	Nitrofurantoin (+/-)	ISS/FWS
1	3	+	+	-	Chromate,Nickel,NND PG
2	4	+	+	-	Formaladehyde,Chloro cresol, Balsum Of Peru
3	5	+	-	-	Formaladehyde, Balsum Of Peru, Thiuram, NNDPG, Dibutyl Thiourea
4	10	+	-	+	Formaladehyde, Paraben, Aminoazobenzene
5	14	+	-	-	Cromate, Nickle
6	23	+	-	-	Nickel

**TABLE - 16****NUMBER OF POSITIVE ALLERGENS IN EACH MATERIAL**

Number of positive Allergens in each materials			
Material Name	Allergen Name	Number of Positivity	Total
Rubber	Black rubber	1	22
	carbonate	0	
	MBT	2	
	Thiourea	4	
	Thiuram	2	
	NNDPG	13	
Adhesives	PTBFR	1	8
	Colophony	6	
	Epoxy	1	
Tanning	Chromate	14	18
	Glutaraldehyde	0	
	Formaldehyde	4	
Dyes	PPD	5	8
	Disperse Orange	3	
Metals	Nickel	17	18
	Cobalt	1	

**DISTRIBUTION OF POSITIVE AND NEGATIVE PATCH TEST RESULTS**

Out of 40 patients there were negative patchtesting in 10 patients

Among 40 patients only one showed multiple positivities. Nearly 75% of the patients showed positive patch tests.

## **DISCUSSION**

## **DISCUSSION**

Out of 40 patients there were negative patch testing in 10 patients

Among 40 patients only one showed multiple positivities. Nearly 75% of the patients showed positive patch tests.

**Various factors having impact on footwear dermatitis are discussed**

### **Age**

All age group including children and both sexes can be affected. In our study subjects between 17 to 74 years showed involvement with maximum number seen in age group 20-29 years. This could be related to increase chance of exposure to allergens at younger age as compared to earlier due to technological and economic advancement.

### **Sex**

Our study showed male (26/40) preponderance with female accounting for (14/40) cases of ACD. This is consistence with various other reports .Few female use occlusive footwear with or without socks compared to men in and around Coimbatore. This could also be a contributory factor for higher prevalence in males.

Barring the very low socioeconomic groups who wear chappals. Men from all other socioeconomic groups use occlusive footwear whereas women from all socioeconomic groups .in this part of country prefer nonocclusive footwear.(eg fashionable sandals and chappals)

### **Duration of Disease**

In our study majority of the patient presented to us with the duration of 1-2 years. This group includes 32.5%. Mean duration of disease showed by other studies was 2.5 years.

### **Clinical pattern of footwear**

Most often patient present with history of change of footwear.

In the acute stage patient presented with eczema, oozing, vesicles, crusting and scaling whereas in chronic lesions presented with hyperpigmentationand lichenification. Concomitant bacterial and fungal infections were identified and treated.

The most common site of initial lesion in our study was on the dorsal aspect of foot which seen in 28(70%) patients followed by heel 4(10%), plantar aspect of foot 4(10%), forefoot 3(7.3%) and instep 1 (2.5%). This study was comparable with earlier studies by Handa S et.al Priya K.S. et.al who showed similar lesions on the dorsum of the feet corresponding to the shape of the footwear (V shape chappals, slippers). This type of footwear is usually worn

without socks and is preferred by the people living in warm and humid topical climates as in our place. Similar observations have been made in other studies.

The location of allergens in dorsal foot could be shoe upper shoe tongue. (figure 2) Plantar dermatitis sparing insteps and flexures could be related to allergens in insoles, shoe linings or adhesives. Instep involvement seen in 1 subject could be related to endogenous eczema (atopy). Insidiously this subject also did not show any positive reactions to patch testing.

In chronic cases the presentation may change with involvement of other areas. Shoe allergens can migrate to other parts of shoe and even the socks mimicking dermatitis due to socks and confusing the picture. Ideally patch testing with dyes, and allergens in socks should be the part of the armamentarium in the investigation of footwear dermatitis.

Allergy to topical medications may also add to the confusion. Common topical medications should also be included in patch testing (topical steroids and antibiotics). In our study topical corticosteroids, antibiotics, and antifungals were used 36, 25, and 7 subjects respectively of which 9/40 showed the positive patch test to topical antibiotics (neomycin, gentamicin and nitrofurazone). These patients showed multiple patch testing to allergens in ISS and FWS. **Table 15.**

Few patients who developed negative reactions for ISS and FWS were additionally tested with their own footwear.

Of the 3/40 patients who showed depigmentation 1 had vitiligo elsewhere, 2<sup>nd</sup> gave a long term use of potent topical corticosteroids, 3<sup>rd</sup> reason not known. Leucoderm associated with foot dermatitis has been reported from India. Monobenzylether of hydroquinone and PTBFR resins are thought to be cause of depigmentation.

### **Endogenous precipitating factors:**

Of the factors implicated in aggravating foot eczema the background of atopic disease has been stated to be important in many studies. In the series done by Epstein E, Out of 43 patients six patients has coexistence of atopic eczema and another 6 patients had past history of atopic eczema. In the present study 17/40 of the patients had history of atopy(personal/family) of which 13/40 showed raised IgE levels.

Heat, humidity, friction which are exogenous factors thought to aggravate footwar dermatitis. Coimbatore is dry for most of the year, patient did not report any seasonal aggravation. Dryness plays an important role in patient wearing openfootwears made of various materials. Since 34/40 of the subjects did not use occlusive footwear which cause heat, humidity and friction. Dryness predispose to the development of ACD to footwear by impairment of barrier function of skin.



## **Footwear**

Different kind of were used by each of the subject excepting one who used only khadi leather chappals. He did not show positive patch test to any of the allergens in ISS and FWS. Khadi leather is manufactured using vegetable tanning which was hypoallergenic. He was not atopic. Excess dryness and friction have precipitated the dermatitis which resolved with emollients and mild topical steroids.

## **Treatment History**

Lyden and kligman concluded that use of topical antibiotics like neomycin associated with sensitization. They concluded that intermittent use of same antibiotic is not associated with an excessive rate of sensitization.

Steroids , vehicles used in steroids are some of the allergens in –patients who used to mishandle treatment on their own.

From our study we found that 36(90%) of the patients gave history of topical application of steroids, 25(72.5%) were given topical antibiotics. Systemic steroids, antibiotics were used in 3(7.5%), and 7(17.5%) respectively. Other drugs likie moisturizers and antihistaminics were used by the patients.

## Patch Test Results

Positive patch test reactions are the best objective evidence for shoe allergy. In our study 75% of the patients gave positive patch test results of which Nickel sulphate was the commonest sensitizer with 17(42.5%) patients testing positive out of which 7 has strong positive reactions. Potassium dichromate was found to be second sensitizer comprising 14(35%) patients where again 2 had strong positive reactions.. It is used as tanning agent in leather shoes and is also present in soaps and detergents.

Next to potassium dichromate N N diphenylguanidine showed increased positivity with 13(33.5%). It is used as antioxidants in rubber industry.

.Neomycin sulphate, colophony, 4 aminoazobenzene, showed positive in 6(15%) of the patients separately.

PPD 5(12.5%), formaldehyde 4(10%), disperse orange 3(7.5%), respectively showed their positive reactions.

5% positivity was found in parabens thiuram mix, n isopropyl n phenyl 4 phenylene diamine, gentamicin, mercaptothiazole chlorocresol, wool alcohol, balsam of peru, dibutyl thiourea, dodecyl mrcaptan, cl- me- isothiazolinone, 2n octyl 4 isothiazoline 3 One.

2.5% positivity in cobalt chloride, benzocaine, epoxy resin, nitrofurazone, black rubber mix, PT BPF resin, hydroquinone, diphenyl thiourea, diethyl thiourea, and dithiodimorpholine.

## **CONCLUSION**

## CONCLUSIONS

Foot eczema is one among the many common dermatological disorders that is seen in dermatology outpatient departments. The most common morphological pattern was dry scaly plaque. Patch testing has played an important role in identifying patients with footwear dermatitis as all patch positive (30 out of 40) patients showed sensitivity to one or more of the allergens in the footwear series. Instep involvement, an uncommon presentation in footwear dermatitis, was seen in a single patch test negative patient who was an atopic with raised IgE. The 3 common allergens include nickel, chromate and NN DPG. Although nickel and chromate have remained the commonest allergens in the past, the rubber allergen NN DPG has emerged as a common sensitizer. Earlier reports have detected MBT to be the common allergen in rubber. This could be related to the increasing use of NN Diphenylguanidine in the processing of rubber.

Sometimes patch testing with foot wear series may yield negative results; in this situation it would be advisable to include pieces of patients own footwear for testing. Sometimes the specific needs to be released from the footwear prior to testing by sophisticated processes like ultrasonication. HPLC(high pressure liquid chromatography) may isolate the individual components of the particular footwear and patch testing with these may sometimes yield a positive result.

This study has enabled the compilation of data related to household and occupational exposure of the allergens in the footwear series in the form of pamphlets for distribution to the patients both in English and Tamil. This would help to educate patients on allergen avoidance for freedom from disease.

# **THE HANDOUTS ISSUED TO THE PATIENTS**

## **THE HANDOUTS ISSUED TO THE PATIENTS**

### **1. Potassium Dichromate**

It's the 4<sup>th</sup> most common metal in earth crust. Metabolic chromate is not a sensitizer. Hexavalent chromium is a strong sensitizers. It causes ACD with insidious onset. Rarely there is acute oozing eczema. It causes chrome ulcers by primary irritant and corrosive effects. On systemic ingestion pompholyx occurs.

This compound is focused in cement / bricks / drywall, leather in gloves & shoes bleaching agents, detergents, brushless shaving cream, match stick heads, glue, flooring adhesives, chromic catgut, crayons, yellow, orange and green paints.

It's an inorganic chemical reagents. Most commonly used as an oxidizing agents in various laboratory and industrial application. It is used for cleaning glassware and in etching of glass materials.

It is used as a component in cement in which it slows the setting of the mixture and improve its density and texture. The hexavalent chromium salt present in this mixture causes contact dermatitis in construction workers. Its also used to tan leathers in the foot wear industry which causes foot dermatitis. It has a important uses in photography and in photographic screen printing. It is a common cause of contact dermatitis in developing countries.

The presence of chromium can be detected with the help of diphenyl carbazide test.

## **Introduction**

4<sup>th</sup> common metal in earth crust.

Metallic chromate is not a sensitizer.

Hexavalent chromate is a strong sensitizer

## **Clinical Features**

Insidious onset CAD

Rarely acute oozing eczema

Primary irritant and corrosive effect chrome ulcer

Systemic ingestion pompholyx

## **Sources Of Exposure**

### **General population**

Cement/ brick/ drywall

Leather in gloves and shoes

Bleaching agents and detergents

Brushless shaving creams

Matchstick heads

Glue, flooring adhesives

Chromic gatgut

Crayons

Paints yellow orange and green



## **Industrial exposure construction industry**

Leather shoe and belts

Automotive industry primer paints and dips to prevent corrosion

Welding with chrome alloys

Foundries

Ink makers

Match factory workers

Furniture polishers

Dyeing, printing photography

Television manufacturer

## **2. PPD**

Paraphenylenediamine or PPD is an agent used in hair dyes. It is an organic compound which is derived from aniline. It is mainly used in the manufacture of polymers and composites. PPD easily oxidizes and hence is used as antioxidants in the rubber industry. The substituent groups such as naphthyl, isopropyl etc., affect the antioxidant properties as well as potency to cause skin irritation. It is also used in the film development process as a developing agent reacting with the silver grains present in the films and forming colored images.

PPD causes ACD, contact leukoderma, allergic contact urticaria, EM, ABCD (air borne contact dermatitis )

## **PPD (4 phenylenediamine )**

It is a colorless compound that acts as a primary intermediate in hair dyes and fur dyes.

### **Clinical Features**

1. ACD
2. EM
3. ABCD
4. Allergic contact utricaria
5. Contact leukoderma

### **Sources of exposure to PPD**

Permanent hair dyes, fur dyes

Photographic developers lithography

Photocopying

Oils, greases gasolins

Rubber and plastic industry

Blood reagent

Instructions to the patients

1. You allergic to PPD. This is a black dye. In general once the dye has set it is non allergic.
2. The allergy manifests with use of hair dyes, cloth dyes and even with some rubber goods.
3. Henna is safe alternative
4. You may react to sulpha drugs and sunscreens based on PABA

### **3. Nickel Sulfate**

Nickel is a most common allergen in all metals. Specific clinical manifestations include exudative and hand eczema, lichenified lesions and nummular eczema. Occupational contact dermatitis can occur in those involved in the hair dressing, Textile manufacturing, sewing, catering and other industries.

Spread of dermatitis can occur from the primary site to flexures face and eyelids. The dimethylglyoxime test indicates the presence of Nickel. A few drops of 1% alcoholic solution of DMG and aqueous ammonium hydroxide are placed on a clean glass slide, a cotton bud is dipped in each and the metal object is rubbed on the surface presence of pink colouration indicates presence of nickel. The test can detect nickel in concentration upto 10 PPM.

#### **Clinical Features**

1. Primary dermatitis :eczematous or papular in areas OF CONTACT
2. Secondary dermatitis : involvement of selective symmetrical areas when dermatitis spreads
3. Non eczematous id eruptions: pompholyx, erythema multiforme, urticaria
4. Ingestion asthma, anaphylaxis, vasculitis

## **General population**

Hairpins , curlers, earrings, necklace clasps, safety pins  
Spectacles, belt buckles, zippers, jeans buttons, watchbands,  
Medallions, metal identifications tags  
Wire, needles, scissors, coins and pens  
Screws, bolts, plates  
Detergents

## **Industrial exposure**

Alkaline batteries  
Ceramics  
Electroplating  
Electric wiring  
Hardening of fats  
Insecticides mordant in dyeing and printing  
Nickel alloys plastics pigments in paint for glass and wall paper

## **Instructions to the patients**

1. You are allergic to nickel. This metal accounts for most costume jewelry reaction. Direct contact will cause rash at the site of contact eg use of metal pins and snaps in clothing will cause rash at the site of contact.
2. Sometimes rash persists even after avoiding all skin contacts with allergens. Nickel in food may be responsible for this. Avoid the list of foods for 3 weeks to find the critical food.
3. First litre of water taken from the tap in morning should not be used for food preparation as the metal may release from the tap or pipe at night.  
Foods to be avoided

Green leafy vegetables, legumes, nuts, grains, potatoes peas  
pineapple chocolates fish

#### **4. Colophony**

Colophony is a solid form of resin obtained from plant material mainly Pines and conifers. It is produced by heating fresh liquid resin to vapourize the volatile liquid terpene components. It mainly consists of different acids such as abietic acid.

It causes ACD stomatitis from dental exposure and lip lick cheilitis in children due to chewing gum.

It is used as ingredient in printing inks. Photocopying and laser printing papers, varnishes, adhesives (glue) soap, paper sizing. soda, soldering fluxes and scaling wax. It is also used as a glazing agents for medications and gums.

It may be used in fabric manufacturing to obtain a smooth finish and thereby cause contact dermatitis in susceptible individuals on contact.

#### **Source of exposure**

Adhesives tapes plasters glues and stamps

Topical medications

Floor polish and varnishes

Cloth finish

Chewing gums

Cosmetics mascara eye shadow nail varnish epctating wax

Rosin on musical instruments

Handles of golf club tennis racquet badminton racquet  
Clear transparent soap  
Dentistry impression pastes dental cement periodontal dressings

### **Occupational exposure**

Paper production  
Glossy paper/paper flim  
Floor polish/furniture polish/ car polish  
Wood workers exposed to saw dust  
Textile production  
Printers

## **5. Balsam of Peru**

Myroxylon or Balsam of peru is a genus of 2 species of central American and south American trees belonging to the fabaceae (Leguminosac). The tree is well known in the western world as the source of the fragrant peru balsam and tolu balsam. They are large trees growing to 40 m tall, with evergreen pinnate leaves 15cm long with 5-13 leaflets

. In the natural state, balsam of peru is a viscous fluid obtained by inflicting trauma to the bark of the trees. Its sweetish sent mimics fragrance of vanilla and green olives and hence it is used in the manufacture of perfumes as a source for balsam. It is used as flavouring and fragrance in many product such as topical medications, hair serum and cosmetics. It can cause allergic reactions in susceptible individuals.

Allergens present in it include cinnamic acid, cinnamic aldehyde, methyl cinnamate, eugenol vanillin and benzyl cinnamates. Remaining components include esters of cinnamic and benzoic acid. These agents are present in preserves, peels of fruits used to make confectionary essence and other perfumed products.

## **6. Cobalt Chloride**

Cobalt is an element that exists in a combined form in the earth's crust. The elemental form of this substance is a hard, lustrous silver gray metal. It is used in the manufacture of batteries, alloys, catalysts and pigments. A combined sensitivity to cobalt due to coexistence of nickel as an impurity is commonly encountered.

Cobalt can cause localized vesicular eruption and hand eczema to more severe disseminated dermatitis.

It is an inorganic compound of cobalt chloride.

Used as an indicator for water in desiccants.

In 2005- 2006 it is the 8<sup>th</sup> most prevalent allergen in patch test.

Invisible ink

Electroplating, catalyst preparation and painting

Blue pigment in porcelain, glass, pottery, ceramics, and enamels.

Water color paints and crayons

Metal plated objects : buckles, buttons, zippers, snaps, costume jewellery, utensils and tools

Vitamin B12 preparations and dental plates

Hair dyes light brown shades

Cement has cobalt oxide

Polyester resin manufacture

Pottery workers

## **7. Thiuram mix**

Rubber accelerators are chemicals used to increase the speed of manufacturing process of rubber (Vulcanisation). This process involves addition of sulphur to natural rubber latex to increase its tensile strength and make it suitable for use in the manufacture of many rubber products.

It is commonly found in elastic bands, crepe soles, condoms, ear phones, oxygen masks, rubber handles, swim gear & caps.

It is composed of the following antigens

Dipentamethylene thiuram sulfide 0.25%

Tetra methylthiuram disulfide 25%

Tetra ethyl thiuram disulfide 0.25%

Tetra methyl thiuram monosulfide 0.25.

Clinical features

### **ACD**

Systemic contact dermatitis ingestion of tetra ethyl thiuram sulphide

(disulphiram) as antabuse in previously sensitized individuals results in widespread eczematous reaction.



## **Sources of exposure**

Adhesives, fungicides, shampoos, antabuse, crepe sole rubber bands condoms tubes and hoses motor vehicle parts rubber sheet rubber bulb eye dropper elastic garments rubber pillows and cushions dyes insecticides germicides paints lubricating oils ear phones oxygen masks bank note counters rubber gloves tourniquet hot water bottles rubber handles artificial limbs swim gears and caps.

These are the substances which have thiuram. Avoiding them will prevent dermatitis in future

## **8. Black rubber mix**

This is a mix of three chemicals

N isopropyl-N-phenyl paraphenyldiamine.

N-cyclohexyl-N-phenyl paraphenyldiamine

N-diaphenyl paraphenylene diamine.

They are commonly used as antioxidants in the production of rubber.

They prevent rubber from drying or cracking.

The common source of occupational exposure are shoes and boots, black rubber gloves, tyres, underwear elastic etc. They cause ACD, lichenoid pigmented contact dermatitis & PPPS syndrome – purpura, petechia, pruritus causes by IPPD.

## **9. Fragrance mix**

Fragrance mix consists of mixture of a fragrance commonly used in waxes, polishes, room fresheners, perfumes and soaps, paints, cutting fluids and metal working fluids may contain fragrance antigen to mask offending odours.

## **10. Neomycin sulphate**

It belongs to the aminoglycoside group of antibiotics. It is obtained from streptomyces fradiae. It is found in numerous topical ointments, eyedrops, dentistry, deodorants, soaps and Animal foods. Neomycin has activity mainly against gram negative bacteria with partial effect against gram positive bacteria.

It is common to also be allergic to bacitracin, gentamycin and tobramycin if there is allergic to neomycin.

Betadine & mupirocin ointments are safe alternative.

## **11. Benzocaine**

Chemically, Benzocaine is an ester of P-aminobenzoic acid or (PABA). It is commonly used as a topical pain reliever. It is essentially a local Anaesthetic and is used in many over the counter formulations to relieve sore throat aphthous ulcer etc.,

## Benzocaine

Widely used local and topical anaesthetics

Preparations containing benzocaine are

1. Wound and burn preparations
2. Sunburn remedies
3. Haemorrhoidal preparations
4. Oral and gingival products
5. Sore throat spray/ lozengens
6. Collous and wart remedies
7. Toothache and denture irritation products

Disease

ACD

UTRICARIA

Anaphylaxis

It is a PABA(para amino benzoicacid) derivatives and cross reacts with other benzoic acid derivatives. It cross reacts with PPD, found in hair dyes, sulfonamides, sulfonylurea, PABA based sunscreens, thiazide related diuretics.

## 12. Formaldehyde

Formaldehyde is a simple organic compound which is used in the preparation of various industrial products such as urea, formaldehyde resin, polyoxymethylene, plastic, melanin etc., it is used as preservative for biological material and in disinfection.

It also finds application in the textile industry where it is added to fabric to give a crease free finish.

The various types of commonly encountered formaldehyde.

- Cashew nut shell oil
- Resorcin
- Urea
- Melamine
- Phenols

Smokes from fires or cigarettes contain formaldehyde. It may cause rash in sensitive areas exposed to air, like eyelids, clothing that is permanent press usually contains formaldehyde and may cause rashes.

### **Clinical features**

ACD

Allergic contact urticaria

EM

ABCD

### **Sources of exposure**

Shampoos detergents, liquid soap,

Dental plastics

Disinfectants

Deodorizers, antiperspirants

Glues paints and coatings

Cosmetics

Medicaments urinary antiseptics injectables/a/b vaccines

Fabrics

## **Occupational**

Textile production

Urea fertilizers

Polishes

Chipboard production

Dry cleaning materials

Mineral wool production

Paper industry

Metal working fluids

Photographic paper solutions

Insulations

Clothing that are permanently press usually contains formaldehyde and may cause rash

Smoke from cigarettes contains formaldehyde it may cause a rash in sensitive areas like eyelids

## **13. Parabens**

Parabens are compounds that belong to a class of chemicals widely used as preservatives by cosmetic and pharmaceutical industries. Moreover they have additional bactericidal and fungicidal properties.

They can be found in soaps, shampoos, commercial moisturizers, shaving gels, personal lubricants, topical medicaments, lotions, parenteral pharmaceuticals cosmetics and toothpaste. They are popular due to this low cost and high efficacy parabens can cause irritant reactions and contact dermatitis or rosacea in susceptible individuals.

## **Parabens**

Disease

ACD

Rosacea

Used as preservatives in pharmaceutical and cosmetics.

Bactericidal and fungicidal

Shampoos moisturizers shaving gels personal lubricants topical/  
parenteral pharmaceuticals spray tanning solutions make up and  
toothpaste

Food additives

## **14. Gentamycin**

Gentamycin is a type of aminoglycoside antibiotic administered intravenously, topically or intramuscularly to treat infections. It is obtained from *Micromonospora purpurea*, an actinomycete. It is used to treat gram negative bacterial infections.

## **15. Mercaptomix**

Mercaptomix is a combination of three chemicals used in the rubber manufacturing process. These chemicals are added to rubber as accelerator before vulcanization take place.

It is used in the manufacture of gloves, hoses electrical cards, mattresses etc.,

Non rubber products which has mercaptomix are cutting oil greases coolants, adhesives, tire paints etc.,

## **16. Epoxy Resin**

Epoxy resins or polyepoxides are polymers composed of functional epoxide groups. Epoxy resins are cross linked with themselves or other amines or acids through a process known as homopolymerisation to produce raw materials used in paints, adhesives coating and composites.

## **17. Mercaptobenzothiazole**

Rubber accelerators are chemicals agents used to increase the speed of rubber processing or vulcanization. This process increases the tensile strength of natural rubber rendering it suitable for use in the production of a variety of rubber products.

It is commonly found in shoe rubber, rubber gloves, industrial products containing rubber & rubber bands.

It is a component of mercaptomix an accelerator.

It is tested separately since many patients who react to 2% MBT may not react to the mix

Clinical features

ACD most commonly presenting as shoe dermatitis

This is present in rubber chemicals.

Adhesives

Tapes

Pesticides  
Animal repellents  
Animal medicines

### **18. Nitrofurazone**

This compound is also known as Nitrofurazone or furacilin. It is a bactericidal agent used in topical formulations. It is less frequently used now a days as products with better efficacy have become available.

### **19. PEG 400**

It is a clear, viscous and colorless liquid. It is a low molecular weight form or grade of polyethylene glycol. Because of its low toxic potential, PEG 400 has a broad base of usage in a number of pharamaceutical formulations.

### **20. Chlorocresol**

Chlorocresol is a phenol compound which is chlorinated and used as an antiseptic and preservative/ It is used as a disinfectant such as a hand wash and soap, where it is dissolved in alcohol or mixed in with other phenols..

### **21. Wool Alcohols**

Acetylated lanolin alcohol is also known as “sheep alcohol”, lanolin alcohol or wool alcohol. It is a organize compound produced from lanolin, which is combined with acetic acid. Synthetic derivatives are available and have a higher allergic potential. Acetylated lanolin alcohol is used as an emollient to soften skin.



## **22. Chinoform**

It is a halogenated hydroxyquinolone. It is available as topical formulation used for antifungal treatment. It is often combined with a topical steroid such as betamethasone.

## **23. P-T-BPF Resin**

It is para-teritary-butylphenol formaldehyde resin. It is a resin made by reacting the substituted phenol P-Tert-butylphenol with formaldehyde. It is used in manufacture of adhesives. It has good binding qualities especially leather and rubber surfaces. Due to this particular property, it is found in glued leather goods such as shoes, bells, handbags and watch straps.

Other sources of formaldehyde resin and Lacquer resins include leather antioxidants, printing inks, motor oil additives, fibre glass products, plywoods, insecticides, deodorants and commercial disinfectants.

## **24. Fragrance mix**

A complete perfume compound consist of from 10 to more than 300 basic components therefore use of screening allergens is essential in diagnosing fragrance allergy.

## **25. Hydroquinone monobenzylether**

It is an organic chemical belonging to phenol family.

Used widely in the past as the topical drug for depigmentation. On topical application it causes destruction of melanocytes and permanent depigmentation. Hence in case of universal vitiligo patients few areas of pigmentation is treated with this to match the color seen in most of the region

Derive dyes from fibre dyeing

Rubber industry

Disease

Leucoderma over the foot

## **26.4 Tetra Butyl Phenol Formaldehyde Resin**

It is a resin made by reacting the substituted phenol p- tert- butylphenol with formaldehyde.

### **Clinical features**

ACD

Depigmentation of the skin

### **Sources of exposure**

General population

Adhesives for shoes, bindhies and watchstraps

Gloves

Plywood insulators

Ink papers

Disinfections/detergents/insecticides

Deodorants

Occupational  
Dental personal  
Box makers  
Textile manufacturers  
Leather finishers  
Shoe makers  
Automobile workers  
Flim developers  
Printing inks

**27. Diphenyl thiourea**

**28. Diethyl thiourea**

**29. Dibutyl thiourea**

Off white crystalline powder  
Used In ore filtering, metal refinery and cleaning  
Additive in fertilizers  
Light sensitive photocopy papers  
Explosives  
Photography  
Animal hide glues  
Insecticides and fungicides  
Textile treating agents  
Rubber as vulcanization agents  
Dyes  
Dry cleaning compounds  
Thiazole drugs  
Radioactive compounds in medicine(renal function  
assessment,enzyme study, poisoning)

Rubber accelerators are

Thiazole

Sulphenamide

Thiurams

Guanidine

Thioureas

### **30. N N diphenyl guanidine**

White to pale pink powder .

It is a strong alkaline and water soluble compound.

This is formed by the oxidation of guanine in urine as the normal product of protein metabolism

#### **Sources of exposure**

Plastics

Resins

Rubber chemicals

Explosives

Photochemicals

Fungicides and disinfectants

Oxygen scavenger to prevent corrosion damage

Rocket propellants

### **31. Epoxy resins**

Resin based on epichlorhydrin and bisphenol. It varies in molecular weight from 340 to larger polymers.

#### **Clinical features**

ACD

ABCD

EM

Contact urticaria

#### **Sources of exposure**

Adhesives and laminates

Paints and inks

Product finishes

Vinyl gloves

Surface coatings

Electrical insulations

Used with fibre glass to make strong sheeting

Plasticizer

Polymer stabilizer

Cement additives

Sculpture makings

Root canal procedures

Art mixed with paints

Marines as varnishes band adhesives

### **32. Dodecyl mercaptan**

Used in polymerization of neoprenes

Local analgesics and anti inflammatory

Paints coating materials

Biocides

Plasticizers curing agents

Adhesives

Lubricants

Food additives

Surfactants

Photographic chemicals

### **33. Cl Me Isothiazolinone(Kathon Cg)**

It is a mixture of two chemicals (chloro 2 methyl 4 isothiazoline 3 one and 2 methyl 4 isothiazoline 3 one)

Used as preservative in cosmetics

Commercial household products

Industrial preservative for cutting fluids

Creams lotions

Shampoos

Clanser

Washing materials

Instruction to the patient

Check product label and use only ingredient labeled products that donot list this chemical or its synonyms

If the spouse uses products that are on the list skin to skin transfer may occur

4 amino azobenzene

Orange powder

They are azo dyes. Different shades are yellow, red, orange, brown and blue

Used as dye for lacquer, varnishes, wax products, oil stains, and styrene resins

Used as insecticides

In manufacture of dyes

### **34.2 N Octyl Isothiazoline**

Amber oily liquid

Preservatives in latex paints

Leather and fur in small %

Pulp industry

Wool impregnating industries

Paints

Adhesives cutting oils ,water system, cosmetics ,household goods  
wound protectants

Preservatives

Disinfectant

Fungicides

### **35.4 4 Dithio Dimorpholine**

It is a rubber vulcanizing agent.

It decomposes on heating resulting in toxic nitrogen oxides  
resulting in fire hazards

Polyurethane foams

Boiler water treatment system

Optical brightners

Plasticizers in toiletry and cosmetic products

Water resistant emulsifiers

Bactericides and disinfectants

Hair conditioners

Deodorant products as quaternary morpholium salts

Hair dyes and blue prints as colorants

Analgesics antibiotics antimycotics and local anesthetics



# **BIBLIOGRAPHY**

## BLIOGRAPHY

1. Lakshmi C, Srinivas CR. Hand eczema an update. Indian J Dermatol Venerol and Leprosy 2012;78:569-82.
2. Coevorden Van, Coenraads PJ, Pas HH. Contact allergen in shoe leather among patients with foot eczema. Contact dermatitis 2002;46:145-48
3. Saha MS, Srinivas CR, Shenoy SD. Footwear Dermatitis 1993;28:260-64
4. Angelina G, Vena GA. Shoe Contact Dermatitis Contact Dermatitis 1980;6:279-83
5. Epstein E. Shoe Contact Dermatitis JAMA 1960;209:1487-492
6. Rycroft RJG, Is patch testing necessary in recent advances in dermatology. Champion RH, Pye RJ, Churchill livingstone. London:1999
7. Bruton IL, Holden CA. Eczema Lichenification and Prurigo in Rooks / Wilkinson/ Ebling Textbook of Dermatology.
8. Romaguera C. Shoe Contact Dermatitis. Int Journal of dermatology 1987;26:533-35
9. Warshaw E, Schrams, Belsito D et al. Shoe allergens: review of literature and retrospective analysis of cross sectional data from NACDG. 2001-2004.
10. Epstein. Shoe Contact Dermatitis JAMA 1969;209:1487-92
11. Freeman S. Shoe Dermatitis Contact Dermatitis. 1997;36:247
12. Trattner A, Farchi. Y, David. Shoe Contact Dermatitis in Israel. Am journal contact dermatitis 2003;14:12
13. Rani Z Hussain I Haroon T. Common Allergens in shoe dermatitis: our experience in Lahore, Pakistan. Int journal dermatol 2003;42:605-07
14. Holden C, Gawkrödger D. 10 years experience of patch testing with a shoe series in 230 patients. Contact dermatitis 2005;53:37-39
15. Dahl MV. Allergic Contact Dermatitis from footwear. MINN. Medicine 1975;58:871.
16. Shruthakirthi
17. Handa S, Sharma SC, Sharma VK, Kaur K. Footwear Dermatitis – clinical pattern and contact allergens. Indian J of dermatology 1991;57:174-77
18. Bajaj AK , Gupta SC, Chatterjee AK, Singh KG. Shoe Dermatitis in India. Contact dermatitis 1988;19:371-75
19. Sarah E , Cockayne, Manushah, Andrew G, Messenger, David J. Foot Dermatitis in children; causative allergens and follow up. contact dermatitis;1998;38:203-06
20. Chougule A, Thappa DM. Pattern of lower leg and foot eczema in south India. Indian J dermatol Venerol leprol 2008;74(5):458-61.

21. Priya KS, Kamath G, Martis J. Foot Eczema the role of patch test in determining the causative agent using standard series. *Indian J dermatol Venerol leprol* : 2008;53:68-69
22. Chowdhuri S, Ghosh S. Epidemioallergological study in 155 cases of footwear dermatitis *Indian J dermatol Venerol leprol* : 2007;73:319-322.
23. Smitha KA, Larkman LB, Openheim JJ, Favata MF. The functional relationship of interleukins. *J of Exp Medicine* :1980;151:1551-56
24. Moss O, Friedman PS, Shuster S. Susceptibility and amplification of sensitivity in contact dermatitis. *Clinical Exp immunology* 1985;61:232-41
25. Kwangsukstith C, Maibach H. Effect of age and sex on the induction and elicitation of allergic contact dermatitis 1995;33:289.
26. Jordan WP, King SE. Delayed hypersensitivity in females. The development of allergic contact dermatitis in female during the comparison of 2 predictive patch test. *Contact dermatitis* 1997;3:19
27. Derman AM. Pregnancy and immunological disorders. *Br Med J* 1982;284:999-1000
28. Anderson KE, Maibach HI. Black and white human skin differences. *J Am Acad Dermatol* 1979;1:276-82
29. Fischer contact dermatitis – Robert L, Rietschel Joseph F. 6<sup>th</sup> edition chapter textiles and shoe.
30. Geier J, Schnuck A. A comparison of contact allergy among construction workers and non construction workers attending contact dermatitis clinic in Germany. *Am J contact dermatitis* 1995;6:86-94
31. Millard LG, Gould DJ. Correspondence, clinical and experimental dermatology 1977;786-87
32. Meneghini CL. Sensitization in traumatized skin. *Am J Int Medicine* 1985;8:319-21
33. Rea TH. Allergy In Leprosy. A Beneficial Phenomenon. *J Invest dermatol* 1979;72:206.
34. Feurerman E, Levy A. A study of effect of prednisolone and antihistamine on patch test reactions. *Br J dermatology* 1972;86:68-71
35. Sonnex TS, Ryan TJ. Investigation into the significance and much of production of positive patch test using trafuril and aspirin. *Br J dermatol* 1981;105:18-19
36. Gibson WB. Sweaty sock dermatitis. *Clini Pedia* 1963;2:175
37. Robert JL, Hanifin JM. Athletic Shoe Dermatitis. Allergy to ethyl butyl thiourea *JAMA* 1979; 24:275
38. Gaul LE, Underwood GM. Primary irritants and sensitizers used in fabrication of footwear. *Arch dermatol* 1949;60:649

39. Bajaj A Footwear depigmentation . contact dermatitis 1996;35:117.
40. Srinivas CR, Footwear dermatitis due to bisphenol A contact dermatitis 1989;20:150.
41. Calnan CD, Peachey RDG. Allergic Contact Purpura. Clinics Allergy 1971;1:287.
42. Adams RM, Shoe Dermatitis calif med 1972;117:12
43. Dobkevitch S, Baer RL. Eczematous cross hypersensitivity to azodtes in nylon stockings and to PPD. J Invest dermatol 1947;9:203
44. Grimalt F, Romaguera C. New resin allergen in shoe. Contact dermatitis 1975;1:169
45. Surmound O, Vespiyk miynessen GAW. Allergic Contact Dermatitis due to shoe and leather prosthesis dermatol 1967;134:371-78
46. Jordan WP. Clothing and shoe dermatitis post graduate medicine 1972;52:143
47. Marcursen PV. Rubber footwear as a foot eczema Acta Derma Venerol 1943;23:331
48. Nicholas PP, Luxeder AM, Brooks LP, Hammer PA. Antioxidants and antiozonants. In kirk othmer encyclopedia of chemical technology vol 3 3<sup>rd</sup> edition New York; wiley interscience 1978
49. Roberts JL, Hanifin JM. Athletic Shoe Dermatitis JAMA 1979;241:275
50. Calnass CD, Allergic Contact Purpura Clinic Allergy 1971;1:287
51. Cronin E. Studies in contact dermatitis: dyes and clothing. trans St Joseph Hospital dermat soc 1968;54:156
52. Leppard BJ. Parhizar B. Contact Dermatitis to PPD rubber in maleki shoes. Contact dermatitis 1977;3:91
53. Lynch BJ, Indian Sandal strap dermatitis JAMA 1969;209:1906
54. Minkin W, Cohen HJ, Frank S. Contact dermatitis to east Indian leather. Arch dermatol 1971;103:523
55. Jordan WP, Dahl MV, Albert HL. Contact dermatitis from glutaraldehyde. Arch dermatol 1972;105:523
56. Fischer A Some practical aspects of the diagnosis and management of shoe dermatitis arch dermatol 1959;79:276
57. Foussereau J, Benezra C, Maibach H. Occupational Contact Dermatitis. Clinical and chemical aspects. Ist ed. Philadelphia:WB Sanders, 1982:1
58. Shallow H. Dermatitis from Japanese rubber thong slippers. Fam phys 1961;1:44
59. Malten KE, Rath R, Pastors PHM. P tert butyl phenol formaldehyde and other causes of shoe dermatitis. Dermatosen beruf umwelt 1983;31:149

60. Corecher BL, Perez AG. Dermatitis from shoes and an amputation prosthesis due to mercaptobenzothiazole and para tert butyl formaldehyde resin. *Contact dermatitis* 1981;7:275
61. Felming AJ. The provocative test for assaying the dermatitis hazards of dyes and finishes used on nylon. *J invest dermatol* 1948;10:281.
62. Parischa JS. *Contact Dermatitis caused by wearing apparel and jewellery. Contact dermatitis in India. 2<sup>nd</sup> edition New Delhi; off setters:1988*
63. Angelini G, Rantuccio F, Meneghini CL. Contact Dermatitis in patients with leg ulcers. *Cont derm* 1975;1:81
64. Fischers A. A Contact urticaria due to polyethyl glycol. *Cutis* 1977;19:409
65. Fulmer WA Kramer GJ. Stratum corneum lipid abnormalities in surfactants induced by dry scaly skin. *J invest dermat* 1986;86:598-602
66. Host R, Moller H. one hundred twin pair patch tested with primary irritants. *Br J Dermatol* 1975;93:145-49
67. Julian Verbov. Atopic eczema localized to the forefoot. An unrecognized entity. *The practioner* 1978;220:465-67
68. Mackie RM. Juvenile plantar dermatitis *semin dermatol* 1982;1:67
69. Farakas J. Caustic ulcers from lime dust. *Contact Dermatitis* 1981;52:55-60
70. Rycort RJ, Smith WDL. Low humidity occupational dermatosis. *Contact dermatitis* 1980;6:488-93
71. Sheno SD, Seth M. Environmental Influence, Atopy Contact Sensitivity in nummular dermatitis. *Indian J Dermatol Venerol Leprol* 1999;65:245
72. Wilkinson JD, Hambly EM, Wilkinson DS. Comparison of patch test results in two adjacent area of England medicaments. *Acta derm venerol* 1980;60:245-49
73. Lyon CC, Tucker S Karlberg AT, Beck MH footwear dermatitis to colophony. *British Journal of dermatology* 1999;141:9
74. Kousa M Soini M contact allergy to stockings *contact derma* 1980;6:472
75. Emmet EA, Risbery TH, Jiang long. Allergic contact dermatitis to nickel. Bioavailability from consumer products and provocation threshold. *J Am Acad dermatol* 1988;19:314-22
76. Calnan CD. Cement dermatitis *journal of occupational medicine.* 1960;2:15
77. Fregert S Gruvberger B, Sandahi E. Reduction of chromate in cement by iron sulphate. *Contact dermatitis* 1979;5:39-42
78. Sidi E, Hincky M, Longueville R. Cross sensitization between neomycin and streptomycin. *J invest dermatol* 1958;30:225-32

79. Lassen WG. Perfume dermatitis. A study of 20 patients arch dermatol 1977;113:623-26
80. Duxksbusy CFL, Dave VK. Contact dermatitis in home help following the use of enzyme detergents. Br med J 1970;1:537-40
81. Tostia A, Gnerra L, Vincenzi. Contact sensitization caused by toluene sulfonamide formaldehyde resin in women who use nail cosmetics. Am J contact dermatitis 1993;4:750-53
82. Rantuccio F, Sinis D, Scardigno A. Histological aspects of patch test reactions in allergic contact dermatitis. contact dermatitis 1978;4:338-42
83. Jadassohn J. Zur Kehntnis. Derm medicamentosa dermatoses verhandlinger der deutschen dermatologischen congress; wein 1895;103-129
84. Wilkinson DS, Fregret S, Magnusson B. Terminology of contact dermatitis acta dermatol venerol 1970;50:287-92
85. Fischer, Maibach HT. Patch testing in allergic contact dermatitis, an update in occupational and industrial dermatology. Chicago year book medical 1987;190-210.
86. Magnussan B, Herslek. Patch test methods. Regional variations of patch test responses. Acta dermatol venerol 1965; 45:357-61
87. Shehade SA, Beckmh, Hiller VF. Epidemiological survey of standard series patch test results on day 2 and day 4 readings contact dermatitis 1991;24:119-22
88. Wilkinson JD, Shaw S. Contact dermatitis Rooks / Wilkinson / Ebling textbook of dermatology 8<sup>th</sup> edition oxford; black well science; 1998
89. Doods Goosens A, Degreeef H. Contact allergy to petrolatum. Sensitizing capacity of different brands of yellow and white petrolatum's. Contact dermatitis. 1983;9:99-107
90. Fischer T, Maibach HI, Easier patch testing TRUE test. J Am acad dermatol 1989;20:447-53
91. Burrows A Anderson KV. Trail of 0.5% versus 0.375% potassium dichromate contact dermatitis 1989;21:35
92. Sjoval P. Ultraviolet radiation and allergic contact dermatitis. An experimental and clinical study. Thesis. 1988, university of lund, Sweden
93. Forsch. Contact dermatitis 5<sup>th</sup> edition chapter 41
94. Christenson OB, Wall LM. Open, closed intradermal testing nickel allergy. Contact dermatitis 1987;16:21-6
95. Lyden JJ, Kligman AM. Contact dermatitis to neomycin sulphate JAMA 1979;242:1276.

**ANNEXURE**

**Figure - 3**  
**Patch Test Allergens**



**Figure - 4**  
**Patch Test Procedure**





**Figure - 5**  
**Patch Test Reading On Day 2(ISS & FWS)**



**Figure - 6**  
**Foot Dermatitis Showing Scaling Over The Dorsum Of Feet**



**Figure -7**

**Foot Dermatitis Predominantly Showing Toe Eczema**



**Figure - 8**

**Foot Dermatitis With Secondary Infection**





**Figure- 9**

**Dermatitis On The Dorsum Of Foot**



**Figure - 10**

**V Shaped Dermatitis Corresponding To The Contact Site Of Rubber Chappals**



**Figure – 11**

**V Shaped Dermatitis Corresponding To The Contact Site  
Of Plastic Chappals**



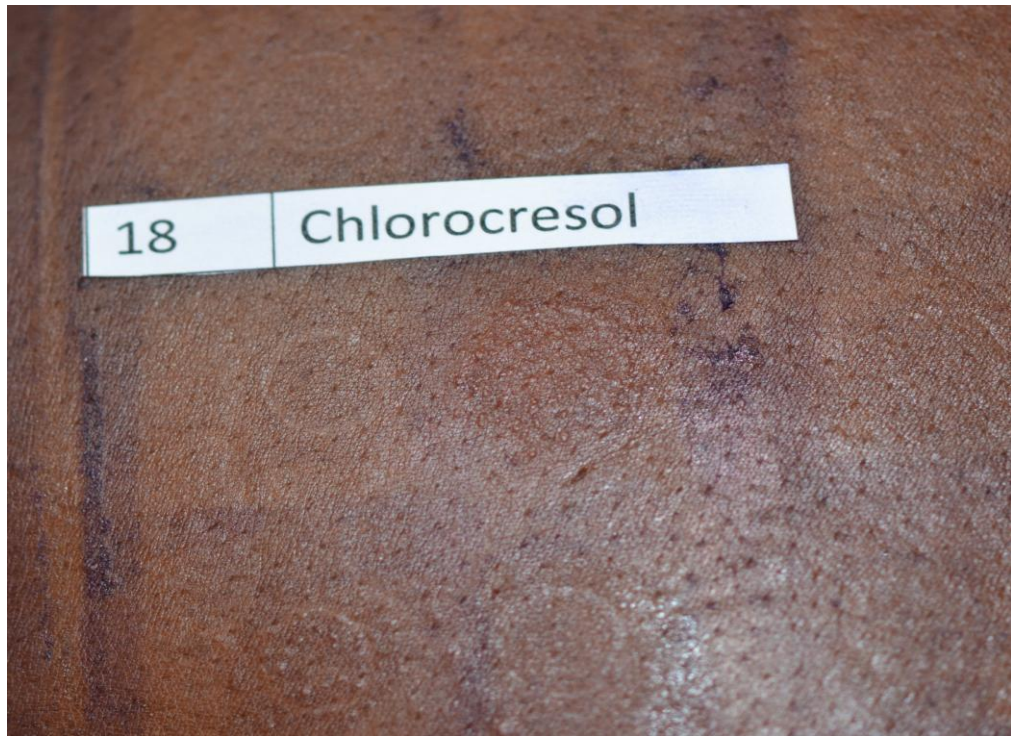


**Figure – 12**

**Footwear dermatitis showing depigmentation at contact site  
and patch testing showed positive reactions to nickel,  
mercaptobenzothiazole and PT BPF Resin**



**Figure – 13**  
**Positive reactions in patch tests**



*2+ positive (ICDRG)*





## ஓப்புதல் படிவம்

ஸ்வர்ணலக்ஷ்மி என்ற மருத்துவராகிய நான் மரு.செம்பொழிலக்ஷ்மி அவர்களின் வழிகாட்டுதலில் பாதங்களில் வரும் சரும நோய் (Dermatitis) உண்டாவதற்கு காரணமான ஒவ்வாமை பொருள்களை கண்டறியும் ஆய்வு பி.எஸ்.ஜி, மருத்துவமனையில் மேற்கொள்கிறேன். இதன் மூலம் அவ்வொவ்வாமை பொருட்களை தவிர்ப்பதால் வருங்களில் சருமநோயிலிருந்து பாதுகாத்துக் கொள்ளும் வாய்ப்புள்ளது. தங்களை முழுமையாக ஆய்வு செய்த பிறகு, முதுகில் ஒட்டிப் பார்க்கும் (Patch Test) என்ற பரிசோதனை செய்யப்படும். இப்பரிசோதனையின் பொழுது ஒரு சிலருக்கு அரிப்பு ஏற்பட வாய்ப்புள்ளது. அதுவும் மூன்று நாட்கள் மருந்து உட்கொள்ளுதல் மூலமாக குணமடையும்.

### ஓப்புதல்

மேற்கூறிய அனைத்து விவரங்களுதம் எனது தாய்மொழியில் எனக்கு மருத்துவரால் கூறப்பட்டது. அனைத்தையும் புரிந்து கொண்டபிறகு, இந்த ஆய்வின் பங்கு கொள்ள முழு சம்மதம் தெரிவிக்கிறேன். எனக்கு ஏதேனும் சந்தேகம் ஏற்பட்டால் மரு.ஸ்வர்ணலக்ஷ்மி (9443381999) அவர்களை தொடர்பு கொள்ளவும் அறிவுறுத்தப்பட்டது.

நோயாளியின் கையொப்பம்

ஆய்வுமேற்கொள்ளும்  
மருத்துவரின் கையொப்பம்

## ஒப்புதல் படிவம்

### 7-18 வயது குழந்தைகள் ஆராய்ச்சியில் ஈடுபடுத்தும் பொழுது அனுமதி கோரும் விண்ணப்பம்

1. ஏன் உங்களை சந்திக்கிறோம்?

ஆராய்ச்சி என்பது மனித நோய்களைப் பற்றிய ஆய்வு மரு. சுவர்ணலக்ஷ்மி ஆகிய நான் பாதங்களில் ஏற்படும் சரும நோயைப் பற்றிய ஆராய்ச்சியை மேற்கொள்கிறேன். நீங்கள் ஆய்வில் பங்குபெற சம்மதம் கோருகிறேன்.

2. ஏன் இந்தஆராய்ச்சி?

பாதங்களில் காலணிகள் அணிவதால் ஒரு சிலருக்கு அலர்ஜி ஏற்படுகிறது. அந்த காலணிகளிலுள்ள ஒவ்வாமை பொருட்களைக் கண்டறிந்து நீங்கள் எந்த பொருட்களுக்கு அலர்ஜி என்பது எடுத்துரைக்கப்படும். இதில் 5-8 குழந்தைகள் (7-18 வயது) பங்கு பெற வாய்ப்புள்ளது.

3. நீங்கள் ஆராய்ச்சியில் ஈடுபடுத்தும் பொழுது என்ன நடக்கும்?

உங்கள் அனுமதி பெற்ற பிறகு உங்கள் முதுகில் (Patch test) என்ற ஒரு பரிசோதனை ஒட்டப்படும். 3 நாட்களுக்கு பிறகு முடிவு பார்க்கப்படும். உங்களுக்கு அலர்ஜி, ஆஸ்துமா போன்ற நோயுள்ளதா? காலணிகளால் சருமநோய் உண்டாகிறதா? போன்ற கேள்விகள் கேட்கப்படும். பின்பு நீங்கள் ஆய்விற்கு தகுதியானவர் என்று முடிவு செய்யப்படும்.

4. இந்த ஆய்வு என்னை காயப்படுத்துமா?

இல்லை. முதுகில் ஒரு சிலருக்கு கொப்பளம் ஏற்படலாம். அதுவும் 3 நாட்களில் குணமடையும்.

5. இந்த ஆய்வினால் எனக்கு என்ன பயன்?

தங்களுடைய ஒவ்வாமை பொருட்களின் பட்டியலில் தரப்படும். இதன் மூலம் அப்பொருட்களை தவிர்ப்பதால் வரும் காலங்களில் நோயிலிருந்து பாதுகாத்துக் கொள்ளமுடியும்.

6. என்னைப் பற்றிய தகவல்கள் பாதுகாக்கப்படுமா?

தங்களைப் பற்றிய எந்த தகவல்களும் ஆய்வில் இல்லாத ஒருவருக்கும் வெளிப்படுத்தமாட்டோம்..

7. இது எனக்கு நன்மை தருமா?

கண்டிப்பாக நன்மை தரும்.

8. இதில் பங்கு பெறும் எனக்கு ஏதாவது பணஉதவி அல்லது பொருள் உதவி கிடைக்குமா?

இல்லை.

**9. எனக்கு ஆய்வின் முடிவு தெரியப்படுத்தப்படுமா?**

ஆய்வின் முடிவில் ஓவ்வாமை பொருட்களின் பட்டியலில் தரப்படும். ஆய்வின் முடிவு தேவைப்பட்டால் மருத்துவ நாளிதழில் வெளிப்படுத்தப்படும். தங்களை பற்றிய தனிப்பட்ட எந்த விவரமும் வெளிப்படாது.

**10. தங்களுக்கு ஏதேனும் சந்தேகம் உள்ளதா?**

தாங்கள் எந்த சந்தேகம் இருந்தாலும் என்னை எப்பொழுது வேண்டுமானாலும் கேட்கலாம். என் செல் எண் 9443381999.

**11. நான் இந்த ஆய்வில் கண்டிப்பாக பங்கு பெற வேண்டுமா?**

இல்லை. இது முழுக்க தங்களின் சம்மதம் பொருத்து. எந்த வற்புறுத்தலும் இல்லை. இதனால் தங்களுக்கு எந்த விதத்திலும் பாதிப்பு ஏற்படாது.

**12. யாரிடம் நான் பேசலாம்?**

ஆய்வு மேற்கொள்ளும் என்னிடம் பேசலாம். அல்லது தாங்கள் யாரிடம் கூற விரும்புகிறீர்களோ அவர்களை அழைத்து வரலாம். நீங்கள் இந்த ஆய்வில் பங்குபெற சம்மதமா. சம்மதம் இல்லையா என்பதை என்னிடம் கூறலாம்.

ஆய்வு மேற்கொள்பவரின் கையெழுத்து

இந்த ஆய்வைப் பற்றிய முழு விவரமும் ..... (குழந்தையின் பெயர்)யிடம் அவர் புரிந்து கொள்ளும் தாய் மொழியில் எடுத்துரைக்கப்பட்டது. பிறகு ஆய்வில் பங்கு பெற சம்மதம் தெரிவிக்கின்றனர்.

.....

.....  
ஆய்வு மேற்கொள்பவர் கையெழுத்து மற்றும் பெயர்  
தேதி

## பகுதி 2 ஒப்புதல் படிவம்

நான் இந்த படிவம் முழுவதும் படித்தபிறகு, என்னுடைய கேள்விகளுக்கு விளக்கம் அளித்தபிறகு, இதில் பங்கு பெற சம்மதிக்கிறேன். அல்லது

இந்த ஆய்வில் பங்கு பெற எனக்கு சம்மதமில்லை.

பெயர் (குழந்தை) : .....

கையெழுத்து: .....

தேதி: .....

### எழுத்தறிவில்லாதவர்

எனக்கு தெரிந்து இந்த குழந்தை ஆய்வாளரின் விளக்கத்தை தெரிந்து கொண்ட பிறகு, சந்தேகங்களை நிவர்த்தி செய்த பிறகும். மேற்கொண்டு சந்தேகங்கள் கேட்கும் வாய்ப்பு பற்றிய விரங்கள் அறிந்த பிறகு இந்த குழந்தை ஆய்வில் பங்கு பெற விருப்பம் தெரிவித்துள்ளது.

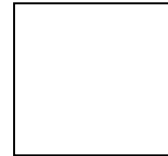
சாட்சியாளர் பெயர் .....

கையெழுத்து .....

தேதி : .....

ஆய்வாளர் கையெழுத்து

குழந்தையின்  
பெருவிரல் ரேகை



## பெற்றோர் ஒப்புதல் படிவம்

### ஆய்வின் தலைப்பு

“பாதங்களில் வரும் சரும நோயையை உண்டாக்கும் ஒவ்வாமை பொருட்களை கண்டறியும் ஆய்வு”

ஆய்வாளர் பெயர் : மரு. சுவர்ணலக்ஷ்மி

துறை : தோல் பால்வினை மற்றும் தொழுநோய்துறை

சுவர்ணலக்ஷ்மி என்கிற மருத்துவராகிய நான் PSG மருத்துவமனையில் ஆய்வு மேற்கொள்கிறேன். நான் தங்கள் குழந்தையை இந்த ஆய்வில் பங்குபெற சம்மதம் கேட்கிறேன். என்னுடைய ஆய்வில் 5-8 குழந்தைகள் பங்குபெற உள்ளனர். தாங்கள் அனுமதித்தால் தங்கள் குழந்தையும் இந்த ஆய்வில் சேர்த்துக் கொள்ளப்படுவர்.

தங்களைப் பற்றிய இரகசியம் பாதுகாக்கப்படும். இதற்கு சம்மதம் தெரிவிக்கவில்லையென்றால் தங்களுக்கும் பி.எஸ்.ஜி மருத்துவமனைக்கும் உள்ள தொடர்பு எந்த வகையிலும் பாதிக்கப்படாது. எந்த சந்தேகங்களும் என் செல் எண் 9443381999 அல்லது 0422-2570170 Extn.5818 என்ற எண்ணுக்கு தொடர்பு கொள்ளலாம்.

இந்த படிவத்தில் ஒரு நகல் தங்களுக்கு கொடுக்கப்படும். இவை அனைத்தும் அறிந்த பிறகு. தங்கள் குழந்தையை இந்த ஆய்வில் பங்குபெற நீங்கள் முழுமனதுடன் சம்மதம் தெரிவிக்கிறீர்கள்.

குழந்தையின் பெயர் :

பெற்றோர் / பாதுகாவலர் கையெழுத்து :

ஆய்வாளர் கையெழுத்து :

**PROFORMA**  
**PATCH TESTING WITH SHOE SERIES**

ASD NO. :

Hosp No. :

NAME :

AGE :

DATE :

OCCUPATION:

SEX :

ADDRESS :

TEL NO. :

**COMPLAINTS WITH DURATION**

Itching with oozing

--	--

Scaling

--	--

Vesicles

--	--

Hyperpigmentation

--	--

Hyperhydrosis

--	--

**SEASONAL VARIATION**

Aggravation in SUMMER

--	--

Winter

--	--

H/o Atopy

--	--

**TYPE OF FOOTWEAR WORN : SANDALS / SHOES / OTHERS**

**FOOTWEAR MATERIAL**

Rubber

Leather

Plastic

PUF

Canvas

SITES INVOLVED SYMMETRICAL  
ASYMMETRICAL


Dorsal surface of Great Toe


Dorsal foot

Planter surface of foot


Sparing of insteps & toe flexural creases

--	--

LESIONS:

Erythema


Vesicles

Oozing

Pustules

Scaling

Depigmentation

Purpura

Lichenification


INVESTIGATION DONE

CBC

Serum IgE

Skin Scraping for KOH

Pus for culture and sensitivity

TREATMENT HISTORY

Topicals : Steroids Antibiotics Antifungal Others

Systemic : Steroids Antibiotics Antifungal Others

DIAGNOSIS

SERIAL NUMBER	NAME	AGE	SEX	OCCUPATION	DURATION OF DISEASE	ITCHING WITH OOZING	SCALING	VESICLES	HYPERPIGMENTATION	HYPERHIDROSIS	ERYTHEMA	PUSTULES	LICHENIFICATION	DEPIGMENTATION	PURPURA	RUBBER	LEATHER	PLASTICS	PUF	CANVAS	SUMMER	WINTER	ATOPY(PH/FH)	SYMMETRY/ASYMMETRY	DORSAL SYRFACE OF TOE	DORSAL FOOT	PLANTAR SURFACE OF FOOT	SPARING INSTEP/TOE FLEXURAL	IgE	KOH	PUS C/S	TOPICAL SYSTEMIC	SITE OF INITIAL LESION
1	O1/13828	30	M	SERVICE	C	✓	✓		✓				✓			✓	✓							S	✓	✓		✓		-		SB	D
2	12/73746	48	F	HOUSE WIFE	B	✓	✓		✓				✓	✓		✓	✓							S	✓	✓		✓		-		SB H	D
3	12/80932	44	M	OFFICE	B	✓	✓	✓	✓		✓						✓			✓				S	✓	✓	✓	✓		-		SB H	P
4	12/80319	52	M	FARMER	C	✓	✓	✓	✓		✓	✓	✓			✓	✓							S	✓	✓		✓		-	SA	SB H	D
5	11/62593	63	M	RETIRED	B		✓		✓		✓		✓			✓								S	✓	✓		✓		-		SB	F
6	12/84108	32	M	OFFICE	B		✓		✓				✓			✓				✓			PH	S	✓	✓		✓	E	-		FB	D
7	13/02274	63	M	BUISSNESS	D		✓							✓		✓								S	✓	✓		✓		-		S	D
8	13/01817	22	M	DRIVER	B		✓		✓				✓					✓	✓					S	✓	✓		✓		-		S	D
9	13/08715	19	M	STUDENT	C		✓		✓				✓				✓			✓				S	✓	✓	✓	✓		-		SB B	P
10	13/O5415	23	F	OFFICE	A		✓		✓		✓					✓	✓			✓	✓		FH	S	✓	✓		✓	E	-		S B	D



SERIAL NUMBER	NAME	AGE	SEX	OCCUPATION	DURATION OF DISEASE	ITCHING WITH OOZING	SCALING	VESICLES	HYPERPIGMENTATION	HYPERHIDROSIS	ERYTHEMA	PUSTULES	LICHENIFICATION	DEPIGMENTATION	PURPURA	RUBBER	LEATHER	PLASTICS	PUF	CANVAS	SUMMER	WINTER	ATOPY(PH/FH)	SYMMETRY/ASYMMETRY	DORSAL SYRFACE OF TOE	DORSAL FOOT	PLANTAR SURFACE OF FOOT	SPARING INSTEP/TOE FLEXURAL	IgE	KOH	PUS C/S	TOPICAL SYSTEMIC	SITE OF INITIAL LESION
11	14/14898	42	M	TAILOR	A		✓		✓				✓				✓			✓				S	✓	✓		✓		-		S	D
12	13/15633	63	M	PILOT	A	✓	✓		✓		✓		✓			✓	✓			✓			PH	S	✓	✓		✓	N	-		SB	D
13	13/18628	65	M	BUISSNESS	A	✓	✓	✓	✓				✓			✓						✓	PH	S	✓	✓		✓	E	-		SFB	D
14	13/20680	24	F	HOUSEWIFE	D	✓	✓		✓								✓							S	✓	✓		✓		-		S	D
15	13/34119	24	F	HOUSEWIFE	G	✓	✓		✓				✓			✓	✓	✓				✓		S	✓	✓		✓		-		SBF SBF	D
16	13/26733	45	M	FARMER	D	✓	✓	✓	✓		✓		✓				✓							A	✓	✓		✓		-		SBF	D
17	13/89229	36	F	HOUSEWIFE	B	✓	✓						✓	✓			✓		✓			✓		S	✓	✓		✓		-		SB	D
18	14/10335	26	M	IT	B	✓	✓		✓				✓			✓	✓					✓		S	✓	✓		✓		-		SBF	D
19	14/11408	45	F	HOUSEWIFE	A	✓	✓		✓				✓			✓	✓			✓			PH	S	✓	✓		✓	E	-		SB	I
20	14/26978	71	F	HOUSEWIFE	C	✓	✓									✓	✓	✓		✓			PH	S	✓	✓	✓		N	-		S	F

SERIAL NUMBER	NAME	AGE	SEX	OCCUPATION	DURATION OF DISEASE	ITCHING WITH OOZING	SCALING	VESICLES	HYPERPIGMENTATION	HYPERHIDROSIS	ERYTHEMA	PUSTULES	LICHENIFICATION	DEPIGMENTATION	PURPURA	RUBBER	LEATHER	PLASTICS	PUF	CANVAS	SUMMER	WINTER	ATOPY(PH/FH)	SYMMETRY/ASYMMETRY	DORSAL SYRFACE OF TOE	DORSAL FOOT	PLANTAR SURFACE OF FOOT	SPARING INSTEP/TOE FLEXURAL	IgE	KOH	PUS C/S	TOPICAL SYSTEMIC	SITE OF INITIAL LESION
21	14/32509	31	M	ELECRICIAN	C	✓	✓		✓		✓					✓	✓	✓					PH	S	✓	✓		✓	E			SBF	D
22	99/82308	53	F	HOUSEWIFE	F	✓	✓		✓	✓						✓	✓	✓			✓		PH		✓	✓		✓	E			SB B	D
23	13/83746	49	M	BUISSNESS	A	✓	✓	✓	✓								✓							S	✓	✓		✓				SB	O
24	14/39711	26	M	BUISSNESS	B	✓	✓		✓							✓	✓	✓	✓	✓		✓	PH						E				O
25	14/43010	51	F	HOUSEWIFE	C	✓	✓									✓	✓							S	✓	✓		✓				SB	D
26	14/20528	40	F	HOUSEWIFE	B	✓	✓		✓		✓						✓						PH						E			SB	P
27	14/9136	53	F	HOUSEWIFE	A	✓	✓	✓	✓				✓			✓	✓	✓				✓	PH	S	✓	✓		✓	E			SB B	O
28	12/11863	22	M	BUISSNESS	B		✓		✓				✓				✓						PH	A	✓	✓		✓	N			S	D
29	12/19169	58	M	FARMER	A	✓			✓								✓			✓	✓		PH	A			✓		E			S	O
30	10/95996	52	M	LABOUR	G	✓		✓	✓				✓			✓	✓						PH	S		✓			E			SBF SBF	D

SERIAL NUMBER	NAME	AGE	SEX	OCCUPATION	DURATION OF DISEASE	ITCHING WITH OOZING	SCALING	VESICLES	HYPERPIGMENTATION	HYPERHIDROSIS	ERYTHEMA	PUSTULES	LICHENIFICATION	DEPIGMENTATION	PURPURA	RUBBER	LEATHER	PLASTICS	PUF	CANVAS	SUMMER	WINTER	ATOPY(PH/FH)	SYMMETRY/ASYMMETRY	DORSAL SYRFACE OF TOE	DORSAL FOOT	PLANTAR SURFACE OF FOOT	SPARING INSTEP/TOE FLEXURAL	IgE	KOH	PUS C/S	TOPICAL SYSTEMIC	SITE OF INITIAL LESION
31	11/1539	34	M	BUISSNESS	G	✓	✓	✓	✓				✓			✓	✓						PH	S		✓			N			SB H	D
32	07/13439	35	M	BUISSNESS	B	✓	✓	✓									✓	✓		✓				S			✓	✓				SB	F
33	10/61841	18	F	STUDENT	A	✓	✓		✓				✓			✓	✓							S	✓	✓		✓				S	D
34	10/11940	28	M	MECHANIC	B		✓		✓							✓	✓	✓						S	✓	✓		✓				S	D
35	10/37611	19	M	STUDENT	C	✓		✓		✓	✓					✓	✓							A		✓							D
36	10/61772	18	F	STUDENT	C	✓	✓	✓			✓						✓				✓		PH	S			✓		E			S	P
37	12/69588	34	M	OFFICE	B	✓	✓		✓							✓				✓	✓		PH	S	✓	✓		✓	E			SB	D
38	12/19986	23	M	LABOUR	G	✓	✓		✓	✓			✓					✓						S		✓						S	D
39	10/73619	29	F	HOUSEWIFE	G	✓	✓	✓	✓		✓		✓			✓	✓	✓						S	✓	✓		✓	N			SBF SBF	D
40	14/20234	56	M	RETIRED	D	✓	✓		✓				✓			✓	✓							S	✓	✓		✓				S	D

ISS AND FOOTWEAR SERIES

Sl.No.	Control	PotasSium Dichromate	Neomycin sulphate	Cobalt chloride	Benzocaine	Formaldehyde	PPD	Paraben	Nickle Sulphate	Colophony	Gentamicin	Mercaptomix	Epoxyresin	Fragrance Mix	Mercapto Benzo thiazole	Nitro Furazone	PEG 400	Chlorocresol	Wool Alcohol	Balsam of Peru	Thiruammix	Chinoform	Black Rubber Mix	PT BPF Resin	N Isopropyl N phenyl 4 PD	Glutaraldehyde	Disperse orange	Acidyellow 36	Hydroquinonemonobenzyl Ether	Diphenyl Thiourea	Diethyl Thiourea	NN Diphenyl Guanidine	Dibutyl thiourea	Dodecolmercaptane	Cl-Me-Isothiazolinone	4 Amino Azobenzene	2N Octyl -4 Isothiazoline 3 one	Dithiodimorpholine			
1		+							+																																
2						+			+	+																															
3		+	+								+																						+								
4			+			+					+							+		+																					
5			+			+														+	+													+	+						
6																																									
7		+					+		+																								+				+				
8																																	+								
9									+																																
10			+			+		+																													+				





[illegible]

## **LIST OF ABBREVIATIONS USED**

- |     |        |  |
|-----|--------|--|
| 1.  | ACD    | Allergic Contact Dermatitis                  |
| 2.  | DPG    | Diphenylguanidine                            |
| 3.  | EBTV   | Ethyl Butylthiourea                          |
| 4.  | HQ     | Hydroquinone                                 |
| 5.  | ICD    | Irritant Contact Dermatitis                  |
| 6.  | IPPD   | N Isopropyl N Phenyl Paraphenylene Diamine   |
| 7.  | JPD    | Juvenile Plantar Dermatoses                  |
| 8.  | LC     | Langerhans Cell                              |
| 9.  | MBT    | Mercaptobenzothiazole                        |
| 10. | MBH    | Monobenzyl Ether of Hydroquinone             |
| 11. | PVC    | Polyvinylchloride                            |
| 12. | PT BPF | Paratertiary Butyl Phenol Formaldehyde Resin |
| 13. | TMT    | Tetra Methyl Thiuram                         |
| 14. | PUF    | Polyurethane foam                            |