

Common causes of shoes dermatitis

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ABSTRACT:

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The incidence of shoe contact allergy was studied in 71 patients with eczematous dermatitis of the feet correlated clinically with shoe's contact pattern. Only 51 patients showed positive patch test reaction to 1 or more allergens and were diagnosed as shoe allergic contact dermatitis (ACD), irritant contact dermatitis (ICD) (12 patients) and others (8 patients) including psoriasiform dermatitis, dyshidrosis, endogenous eczema. The majority of ACD cases were mercaptobenzothiazole (MBT), which was mainly rubber accelerator, followed by mercapto mix, thiuram mix, other rubber chemicals. Other relevant allergens were chromium, paraphenylenediamine, colophony, paratertiary butylphenolformaldehyde resin, while the others were nickel, balsam of Peru, fragrance mix, cobalt, neomycin, kathon CG, formaldehyde and parabens. The relationship between shoe dermatitis and relative factors such as atopic dermatitis, hyperhidrosis, occupation, clinical pattern on feet and style of shoes were not significant difference among ACD, ICD and the others group (ECZ).

Key word: allergic contact dermatitis, shoes

บทคัดย่อ:

ศิริลักษณ์ เลิศขุนพะเกียรติ พุกกลิ่น ตรีสุโกศล สาเหตุที่พบบ่อยของผื่นผิวหนังอักเสบจากรองเท้า
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สถาบันโรคผิวหนัง

ผื่นผิวหนังอักเสบที่เท้าเป็นปัญหาที่พบได้บ่อยในเวชปฏิบัติโรคผิวหนัง จากการศึกษาผู้ป่วยที่มีผื่นผิวหนังอักเสบที่เท้าโดยมีลักษณะของผื่นผิวหนังอักเสบที่สัมพันธ์กับลักษณะของรองเท้าจำนวน 71 ราย พบว่าผู้ป่วยจำนวน 51 รายให้ผลบวกกับการทำทดสอบทางผิวหนังที่เรียกว่า Patch test และได้รับการวินิจฉัยว่าเป็นผื่นผิวหนังอักเสบจากการสัมผัสกับรองเท้า, ผู้ป่วยจำนวน 12 รายได้รับการวินิจฉัยว่าเป็นผื่นผิวหนังอักเสบจากการระคายเคือง และอีก 8 รายเป็นผื่นผิวหนังอักเสบชนิดอื่นๆ สารก่อภูมิแพ้ที่เป็นสาเหตุของผื่นผิวหนังอักเสบจากการสัมผัสจากรองเท้าได้แก่ mercaptobenzothiazole ซึ่งเป็นสารที่ใช้เร่งปฏิกิริยาในขบวนการผลิตยาง สารก่อภูมิแพ้ที่เป็นสาเหตุอื่นๆ ได้แก่ mercapto mix, thiuram mix ความสัมพันธ์ของผื่นผิวหนังอักเสบที่เท้ากับประวัติภูมิแพ้ในครอบครัว ภาวะที่มีเหงื่อออกมาก อาชีพของผู้ป่วย ลักษณะของผื่นผิวหนังอักเสบที่เท้า และลักษณะของรองเท้าไม่ได้มีความแตกต่างกันในกลุ่มที่เป็นผื่นผิวหนังอักเสบจากการสัมผัสจากรองเท้า, กลุ่มที่เป็นผื่นผิวหนังอักเสบจากการระคายเคือง และกลุ่มที่เป็นผื่นผิวหนังอักเสบชนิดอื่นๆ

คำสำคัญ: ผื่นผิวหนังอักเสบ, รองเท้า

Shoe contact dermatitis is a common disease¹, but the fact that an etiological diagnosis is not always conduct. The available preventive measures are few which cause a serious problem to the patient. Characteristic feature is symmetrical eruption involved distal part of the dorsal surface of feet, ankles, sole (except instep and flexural creases of toes) corresponding with pattern of shoes. The clinical features also have been found in other foot dermatitis including irritant dermatitis, psoriasiform dermatitis, dyshidrosis. The hot and humid environment within a shoe, combined with

the presence of chemicals create an ideal situation for the development of allergic or irritant contact dermatitis².

Shoe dermatitis can be chronic in course and recalcitrant for treatment if the causes are not identified. Patch testing is very important and lead to avoid etiologic agents especially in the cases of allergic contact dermatitis (ACD). Constituents of rubber chemicals, adhesives, and leather are the most common causes of shoe allergic contact dermatitis^{1,3}. Substances in natural and synthetic fabrics as well as biocides or dyes added to the

finished or refinished shoe, are also suspect but seldom reported⁴. Most patients have hyperhidrosis together with personal or family atopic history that lead to the relationship of shoe contact dermatitis. The pattern of dermatitis on the feet of a person who is allergic to the shoe constituent mimics the

location of the offending chemical in the shoe. So the purpose of feet dermatitis on this study is to identify common causative allergen in the cases of shoe contact dermatitis^{5,6} and relative factors as atopic dermatitis, hyperhidrosis, occupation, pattern of distribution and style of shoes.

Table 1 Inclusion criteria & exclusion criteria

Inclusion criterias:	<ul style="list-style-type: none">- History of shoe using related to symptom for more than 2 weeks- Localization of eruption involved distal part of the dorsal surface of feet, sole except instep corresponding in pattern of shoes.- Clinical features are eczema, depend on stage of the eruption as well as treatment prior to the hospitalization.- Patch test is performed.
Exclusion criterias:	<ul style="list-style-type: none">- Patient who detects fungal infection on feet & response to antifungal drugs.- Pregnancy & lactation patient.- Patient with history of occupation hand & feet dermatitis.- Patient who don't want to associated this project.

Methods

A total of 96 patients fulfill with the criterias of shoe contact dermatitis were included in the study during February, 2002 to January, 2003 (Table 1). Only 71 of 96 patients finished in this study and had patch tested. All of them had investigated for fungal infection. The informations were recorded in patient record form: site, onset of dermatitis and its duration, history of previous treatment and

response to treatments, relationship to any particular shoes, presence of hyperhidrosis, atopic background and occupation. All selected patients were patch tested with standard patch test series, rubber chemicals and patient's own shoes (Table 2). Patch test result was interpreted followed by the International Contact Dermatitis Research Group.

Table 2 Allergen in Patch Test Series

No.	Substance	No.	Substance
1	Potassium dichromate 0.5%	18	Ethylenediamine 1%
2	Neomycin sulphate 20%	19	Quaternium 15 1%
3	Thiuram mix 1%	20	Nickel sulphate 5%
4	Paraphenylenediamine 1%	21	Cobalt chloride 1%
5	Kathon CG 0.01%	22	N-Cyclohexyl-N-phenyl 4 phenylenediamine 1%
6	Benzocaine 5%	23	N,N-Diphenyl-4-phenylenediamine 1%
7	Formaldehyde 1%	24	Dibenzothiazyl disulfide 1%
8	Colophony 20%	25	N,N-Diphenylguanidine 1.0%
9	Balsam of Peru 25%	26	Zinc diethyldithiocarbamate 1.0%
10	Mercaptobenzothiazole 2%	27	N,N-Diphenylthiourea 1.0%
11	Black Rubber Mix 0.6%	28	Zinc dimethyldithiocabamate 1.0%
12	Wool Alcohol 30%	29	Patient's shoe as is
13	Mercapto mix 2%		
14	Epoxy resin 1%		
15	Paraben mix 16%		
16	PTBP (BPF-Resin) 1%		
17	Fragrance mix 8%		

Results

Seventy one patients with a suspected of ACD of the feet were patch tested. Diagnosis of shoe ACD was detected in 51 patients (71.8%), irritant contact dermatitis (ICD) in 12 patients (16.9%) and other group including endogenous eczema, psoriasiform dermatitis, no specific diagnosis (ECZ) in 8 patients (11.3%) as shown in Table 3. The sex incidence of patients with ACD group was common in female (84.3%) more than male

(15.7%) and similar in ICD group and ECZ group. Regarding to age, each group was in varies from 10-80 yrs (mean 30-40 yrs). The duration of history (of feet dermatitis) was varied from 2 wks to 30 yrs in ACD group and 2 wks to 40 yrs in ECZ group. But ICD group had shorter duration (2 wks – 2 yrs). ACD group were commonly found in constructor (21.6%) and housekeeper (17.6%) respectively. History of atopy and hyperhidrosis were found in all groups and showed no significant

difference. The most common site of involvement in each groups was dorsum of feet. Skin lesions and sensation (itching, burning) showed no significant difference in each group.

Table 3 Patient's profile

	ACD	ICD	ECZ
1. No.	51(71.8%)	12(16.9%)	8(11.3%)
2. Sex	43 F(84.3%) 8 M (15.7%)	9(75%) 3(25%)	8(100%) 0
3. Age range(yr)	11-89(mean 38)	8-63(mean 31.58%)	11-54(mean 36.88%)
4. Duration (length of history)	2 wk-30 yrs (mean 3.5 yrs)	2wk-2yrs (mean 9 mon)	3wk – 40 yrs (mean 9 yrs)
5. Occupation			
Constructor	11(21.6%)	2(16.67%)	2(25%)
Housekeeper	9 (17.6%)	2(16.67%)	2(25%)
Government service	7 (13.7%)	1(8.33%)	1(12.5%)
Student	7 (13.7%)	3(25%)	2(25%)
Unemployed	5 (9.8 %)	2(16.67%)	0
Farmer	2 (3.92%)	0	0
Other	9 (17.6%)	2(16.67%)	1(12.5%)
6. Atopy history	16(31.4%)	7(58.33%)	1(12.5%)
7. Hyperhidrosis	7(13.7%)	3(25%)	2(25%)
8. Sites affected			
Dorsum of feet	47(92.16%)	7(58.33%)	5(62.51%)
Dorsum of toes	23(45.09%)	4(33.33%)	4(50%)
Sole (wt. bearing)	4(7.84%)	2(16.67%)	2(25%)
Ankles	2 (3.92%)	1(8.33%)	0
Hands	8(15.69%)	0	0

	ACD	ICD	ECZ
9. Skin lesion			
Erythema	51(100%)	12(100%)	8(100%)
Vesicles	22(3.14%)	3(25%)	3(37.5%)
Pustules	2(3.92%)	0	1(12.5%)
Hyperkeratosis	44(86.27%)	12(100%)	6(75%)
Fissuring	9(17.65%)	4(33.33%)	5(62.5%)
Sharp demarcation	50(98.04%)	9(75%)	8(100%)
10. Sensation			
Itching	51(100%)	12(100%)	8(100%)
Pain, burning	23(45.1%)	7(58.33%)	4(50%)

Table 4 Positive Rubber Chemicals

Rubber chemicals	No. of patient
Mercaptobenzothiazole	36(70.59%)
Mercapto mix	29(56.86%)
Thiuram mix	15(29.41%)
Black rubber mix	3(5.88%)
N-Cyclohexyl-N-phenyl-4-phenylenediamine	2(3.92%)
N,N-Diphenyl-4-phenylenediamine	0
Dibenzothiazyl disulfide	16(31.37%)
N,N-Diphenylguanidine	8(15.69%)
Zinc diethyldithiocarbamate	3(5.88%)
N,N-Diphenylthiourea	1(1.96%)
Zinc dimethyldithiocarbamate	7(13.73%)

Table 5 Common allergens in shoe allergic CD (51 Patients)

Allergens	No. of patients
Rubber chemicals	41(80.39%)
Leather (chromate 8, PTBP 1)	8(15.69%)
Glues in shoes (colophony)	4(7.84%)
PPD	4(7.84%)
Shoe samples	19(37.25%)

Table 6 Positive Patch Test results to other agents

Allergens	No. of patients
Nickel sulphate (5%)	12(23.53%)
Balsam of Peru (25%)	6(11.76%)
Fragrance mix (8%)	6(11.76%)
Cobalt chloride (1%)	4(7.84%)
Neomycin (20%)	3(5.88%)
Kathon CG (0.01%)	1(1.96%)
Formaldehyde (1%)	1(1.96%)
Paraben mix (15%)	1(1.96%)

Table 7 Correlation between distribution and allergic substance

Substance Distribution	Rubber				Leather	Glues	Shoes
	MBT	Mercapto mix	Thiuram	Others	Potassium dichromate	PTBP (Colophony)	samples
Dorsum of feet	31	25	12	14	7	1	18
Dorsum of toes	18	16	7	7	4	-	7
Soles (spare instep, web)	2	2	2	1	1	-	1
Ankles	1	1	1	1	-	-	1
Hands	2	2	4	1	-	-	1

Table 8 Style of shoe (71 pts)

ชนิดรองเท้า	No. of patients
Rubber Sandal	66(92.96%)
Leather Sandal	22(30.99%)
Leather Heeled Shoe	10(14.08%)
Leather Boot Shoe	2(2.82%)
Rubber Boot Shoe	2(2.82%)

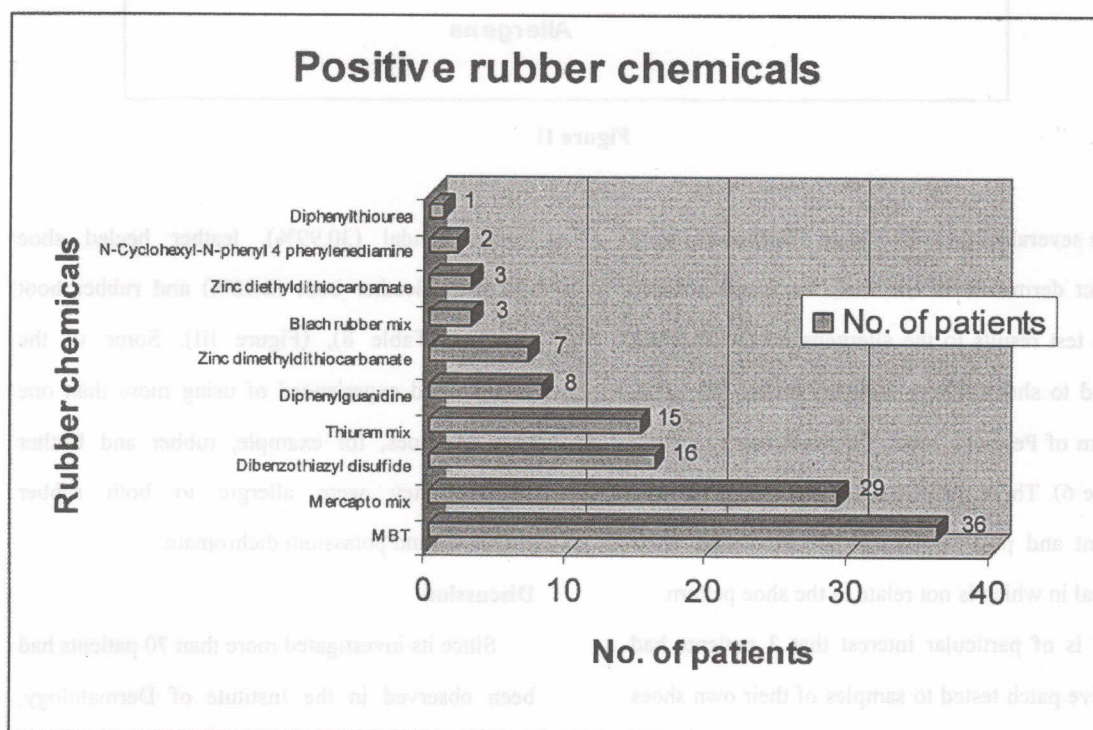


Figure I

In ACD group, the most common allergens were rubber chemicals (mercaptobenzothiazole (70.59%), mercapto mix (56.86%), thiuram mix (29.41%)) as shown in Table 4 and Figure 1. Other chemicals which showed positive reaction to patch

tests were leather (esp. potassium dichromate, present in 15.69%); colophony (use for heel and toe stiffeners, present in 7.84%); PPD (dye, present in 7.84%) and patient's shoe samples (present in 37.25%) (Table 5) (Figure II).

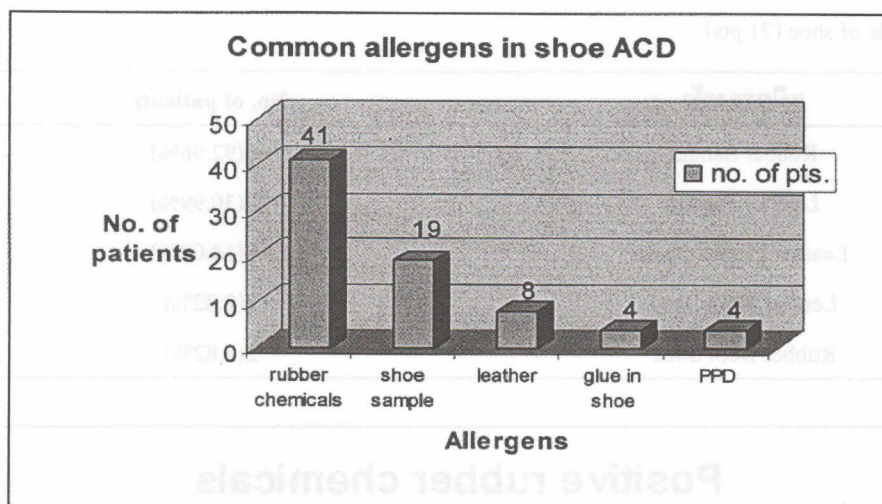


Figure II

In several subjects who were diagnosed as shoe contact dermatitis of the feet, we found positive patch test results to the allergens which were not related to shoes. These included nickel (23.53%), balsam of Peru (11.76%), fragrance mix (11.76%) (Table 6). These positive patch test results showed present and past relevant in all cases with their clinical in which is not relate to the shoe pattern.

It is of particular interest that 3 patients had positive patch tested to samples of their own shoes (two rubber and one leather) but were negative to all the above allergens.

In this series, the dorsal aspects of feet were the most common affected sites (Table 7). It showed no significant difference in distribution of clinical patterns and causative allergic substances. The styles of shoes in this study showed that the most common was rubber sandal (92.96%), followed by

leather sandal (30.99%), leather heeled shoe (14.08%), leather boot (2.82%) and rubber boot (2.82%) (Table 8), (Figure III). Some of the patients had experienced of using more than one type of shoes, for example, rubber and leather sandal. They were allergic to both rubber chemicals and potassium dichromate.

Discussion

Since its investigated more than 70 patients had been observed in the Institute of Dermatology, Bangkok. With a large number of these patients diagnoses were given as ACD (71.8%), ICD (16.9%) and ECZ (11.3%) respectively. Mean age, sex, distribution, occupation are no significant difference in each groups. The duration in ICD group was shorter than other groups but no difference in hyperhidrosis, history of atopy, distribution, skin lesion and sensation.

From the results of this study, shoe contact dermatitis appears to be a fairly common entity as is evident from 51 proven case of shoe allergy seen over a period of just one year. The highest incidence of positive allergen (70.59%) was obtained with mercaptobenzothiazole, the rubber accelerator and followed by mercapto mix (56.86%). There were 36 patients who had positive patch tests result to MBT (2.0% pet.), 29 patients to mercapto mix (2.0% pet.) and 15 patients to thiuram mix (1.0% pet.). The most common allergen in rubber is MBT. This results are similar to the previous study by Susan from Australia⁷ whereas leather is reported to be the common sensitizer in Italy¹ and India⁶.

Chromate, used as tanning agent in leather is obtained as potential shoe allergen (15.69%) for leather shoes. Paratertiary butylphenolformaldehyde resin (PTBFR) in neoprene shoe adhesives produced positive reaction in only 1 patient. The result in this study showed that all 8-positive leather patients were positive to potassium dichromate (0.5% pet.), so the most common leather allergen is chromate.

Paraphenylenediamine (PPD) produced positive reaction in 4 patients (7.84%) in this study.

And there was only one patient had positive patch test result to PPD with negative result to rubber chemicals. It may cross-react with certain

rubber additives or the patients were sensitive to dye¹

Of 51 patients, who were patch tested with their shoe samples, 19 patients (37.25%) were reacted. The negative cases may be explained by very small amount of allergen which were extracted from shoe samples, failure to test with the offending shoe or offending layer of the shoe, or by faulty occlusion of the patch. There were three cases with positive patch tests to samples of their own shoes and negative patch tests to shoe allergen series, this was suggested that there were unknown allergens in both rubber shoes (2 patients) and leather shoe (1 patient). This should be augmented patch test with samples of patient's shoes together with standard allergens & special set of rubber chemicals to obtain the causative allergen in the case suspected of shoe ACD.

Several cases with shoe ACD showed positive patch test results to other non-shoe related agents. It is possible to the allergens react with contact at sites other than feet. Nickel sulfate was the most common allergen (23.53%) of those. Others were balsam of Peru (11.76%), fragrance mix (11.76%), cobalt chloride (7.84%), neomycin (5.88%), formaldehyde (1.96%) and paraben mix (1.96%). All were interpreted as past relevant or coincidence allergens unrelated to shoe sensitivity.

The sites of lesion were analyzed and the results showed that all parts of feet were affected

except instep and interdigital webs. The most common site was dorsum of feet. In a large number of cases, the pattern of dermatitis corresponded with the straps of sandal shoes worn by the patients. In this series, hands involvement were more common in rubber than leather shoe. It is most likely due to daily contact of the hands to rubber products, for example, rubber band, rubber gloves for household worker or rubber sponges rather than autosensitization.

In conclusion, shoe contact dermatitis can be allergic, irritant in nature or other skin diseases. Patient's history and clinical manifestations are corresponded with the shoe's pattern in all three groups. Majority of cases are diagnosed as ACD. Rubber chemicals are the most common allergens especially MBT because of the widely use of rubber sandals. Some of them are allergic to more than one type of shoe. Shoe ACD is a rather common condition, associated with the use of several potentially allergic substances in the manufacture of footwear and with the operation of certain local factors particularly favorable to the

development of allergy such as friction, sweating, pressure and occlusion. Diagnosis of shoe contact dermatitis can be made by history and clinical features. Patch testing is necessary to address the causative allergens and also help in proper treatment by the shoes type selection.

References

1. Angelini G, Vena GA, Meneghini CL. Shoe contact dermatitis. *Contact Dermatitis*. 1980; 6: 279-83.
2. Fisher AA. *Contact dermatitis*. 3rd ed. Philadelphia: Lea & Febiger. 1986. p.316.
3. Varelzides A, Katsambas A, Geogala S, Capetanakis J. Shoe dermatitis in Greece. *Dermatologica*. 1974; 149: 236-9.
4. Rietschel RL, Fowler JF, Jr., editors. *Fisher's contact dermatitis*. 4th ed. Baltimore: Williams & Wilkins, 1995. p. 392-408.
5. Freeman S. Shoe dermatitis. *Aust J Dermatol* 1983; 24: 63-8.
6. Bajaj AK, Gupta SC, Chatterjee AK, Singh KG. Shoe dermatitis in India. *Contact Dermatitis*. 1988; 19: 372-5.
7. Freeman S. Shoe dermatitis. *Contact Dermatitis*. 1997; 36: 247-51.
8. van Cevorden AM, Coenraads PJ, Pas HH, van der Valk PGM. Contact Allergens in Shoe leather among patients with foot eczema. *Contact Dermatitis*. 2002; 46: 145-8.
9. Shackelford KE, Belsito DV. The etiology of allergic appearing foot dermatitis: A 5-year retrospective study. *J Am Acad Dermatol*. 2002; 47: 715-21.