

A Study of As is Patch Test in Cosmetic Contact Dermatitis

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Background : Cosmetics are one of the common causes of contact dermatitis and many new cosmetic products are being introduced rapidly into our market.

Objective : Our purpose was to investigate the as is patch test result by several factors including age, cosmetic product and atopic diseases, and to compare as is patch result with those of standard and cosmetic patch tests.

Methods : The records of 240 patients were reviewed who had been patch tested with their own cosmetics and toiletries with a clinical impression of cosmetic contact dermatitis at the patch clinic of Kangnam St. Mary's Hospital in the period of 1991-1995.

Results : Of the 95 patients who were tested with European standard series 54 (56.8%) showed a positive reaction and nickel sulfate was the most common allergen. Eighteen (38.3%) of the 47 patients tested with a cosmetic series revealed a positive reaction and imidazolidinyl urea and dodecyl gallate were the most common allergens. In as is patch test, 99 (41.3%) of the 240 patients showed a positive reaction to 248 (7.3%) of the 3403 cosmetics. Common cosmetic products showing positive reactions were skin care products (26.2%), face make-ups (19.8%), and hair preparations (16.9%). There was no statistically significant difference in the positive reaction rate between atopy and non-atopy patients. The positive correlation rate of as is test with standard and cosmetic series was relatively low.

Conclusion : Commercial standard patch test series including cosmetic series are not enough to detect causative allergen in cosmetic contact dermatitis. As is patch test should be encouraged to detect new allergens, because many cosmetic ingredients are developed and introduced in market. (Ann Dermatol 11(4) 207~213, 1999).

Key Words : As is test, Cosmetic contact dermatitis, Cosmetic series, Standard series.

Virtually everyone today has contact with cosmetics in the form of hair products, skin moisturizers, or cleansers. Relative to their wide usage, serious adverse effects from cosmetics and toiletries are infrequent. However, mild reactions such as itching, burning or dry skin, may be experienced by many consumers. In a recent epidemiological survey, 12.2% of an unselected population of 1609 individuals aged between 33-64 years had experienced

adverse reactions to cosmetics and toiletries in the preceding 5 years¹. The most frequently reported side-effect of such products in patients seen in dermatological clinics is contact dermatitis²⁻⁵.

We have tried to investigate the as is patch test result by several factors including age, cosmetic product and atopic diseases, and to compare as is patch result with those of standard and cosmetic patch tests.

MATERIALS AND METHODS

1. Materials

The records of 240 patients were reviewed who had been tested with their own cosmetics and toiletries with clinical impressions of cosmetic con-

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tact dermatitis at the patch clinic of Kangnam St. Mary's Hospital in the period of 5 years (1991-1995).

2. Patch testing

Patch testing was performed with European standard series, a cosmetic series, and patients'

Table 1. Age and sex distribution of patients

Age group	Distribution of patients		
	Male	Female	Total
0 - 9	0	1	1
10 - 19	0	6	6
20 - 29	4	51	55
30 - 39	4	56	60
40 - 49	2	53	55
50 - 59	0	40	40
60 or over	4	19	23
Total	14	226	240

own cosmetics and toiletries. Standard series and the cosmetic series were supplied by Chemotechnique Diagnostics AB, Sweden. Most cosmetics and toiletries were tested undiluted. Shampoos and shaving soaps were diluted to 2% in water, hair colors to 5% in water. All patch tests were applied to the upper back under occlusion using Finn Chamber® and Scanpor® tape. The patch tests were read at 48 and 96 hours after application according to IC-DRG (International Contact Dermatitis Research Group) recommendations.

3. Statistics

The data for the comparison by atopic diseases was analyzed using Mann-Whitney U Test.

RESULTS

1. Age and sex distribution of patients

As is test performed on 240 patients, of whom 14 (5.8%) were male and 226 (94.2%) were female. The age varied from 7 to 82 years and the av-

Table 2. Results of the European standard series

Order	Allergen	Conc. % (W/W)	Positive	Patients
			No.	%
1	Potassium dichromate	0.5	13	13.7
2	4-Phenlenediamine dihydrochloride	0.5	4	4.2
3	Thiuram mix	1	2	2.1
4	Neomycin sulfate	20	15	15.8
5	Cobalt chloride	1	8	8.4
6	Mercury ammonium chloride	5	6	6.3
7	Nickel sulfate	5	17	17.9
8	Quinoline mix	6	3	3.2
9	Colophony	60	0	0
10	Parabens	15	1	1.1
11	Black rubber mix	0.6	0	0
12	Wool alcohols	30	1	1.1
13	Mercapto mix	2	0	0
14	Thimerosal	1	5	5.3
15	Balsam of peru	25	4	4.2
16	4-Tert-butylphenol formaldehyde resin	1	0	0
17	Carba mix	3	0	0
18	Formaldehyde	1	10	10.5
19	Fragrance mix	8	8	8.4
20	Imidazol urea	1	1	1.1
21	Quaternium 15	1	3	3.2
22	Captan	0.01	2	2.1

erage was 40.2 years old. The majority of them were in the age group 20 to 49 years (70.7%) (Table 1). Of the 240 patients, 95 were tested with a European standard series and 47 were done

with a cosmetic series.

2. Patch test result

1) European standard series

Table 3. Results of the cosmetic series

Order	Allergen	Conc. % (W/W)	Positive	Patients
			No.	%
1	Isopropyl myristate	20.0	3	5.9
2	Amerchol L 101	100	2	3.9
3	Triethanolamine	2.0	0	0
4	Polyoxyethylenes orbitan oleate	2.0	0	0
5	Sprbotan monooleate	2.0	0	0
6	2-Tert-butyl-4-methoxyphenol	2.0	0	0
7	2,6-Ditert-butyl-4-cresol	2.0	1	2.0
8	Octyl gallate	0.25	1	2.0
9	Triclosan	2.0	0	0
10	Sorbic acid	2.0	0	0
11	4-Chloro-3-cresol	1.0	0	0
12	4-Chloro-3-xenol	0.5	0	0
13	Thimerosal	0.1	1	2.0
14	Imidazolidinylurea	2.0	4	7.8
15	Hexamethylenetetramine	2.0	0	0
16	Chlorhexidine digluconate	0.5	1	2.0
17	Parabens	15.0	1	2.0
18	Phenylmercuric acetate	0.01	1	2.0
19	Chloroacetamide	0.2	0	0
20	Hexahydro-1,3,5-tristriazine	1.0	1	2.0
21	Clequinol	1.0	0	0
22	Ethylenediamine dihydrochloride	1.0	0	0
23	Abitol	10.0	0	0
24	Phenyl salicylate	1.0	0	0
25	2-Hydroxy-4-methoxybenzophenone	2.0	0	0
26	Sorbitan sesquioleate	2.0	0	0
27	Propyleneglycol	5.0	3	3.9
28	Stearyl alcohol	30.0	0	0
29	Cetyl alcohol	5.0	0	0
30	Benzyl salicylate	2.0	0	0
31	2-Bromo-2-nitropropane-1,3-diol	0.25	0	0
32	Sodium-2-pyridinethiol-1-oxide	0.1	2	2.0
33	Cocamidopropyl betaine	1.0	2	3.9
34	Benzyl alcohol	1.0	0	0
35	Kathon CG	0.02	0	0
36	Tert-butylhydroquinone	1.0	1	2.0
37	2-Benzotriazol	1.0	0	0
38	Propyl gallate	1.0	0	0
39	Dodecyl gallate	0.25	4	7.8
40	Quaternium 15	1.0	0	0

Table 4. Results of as is test

Cosmetic category		No. of cosmetics tested	Positive cosmetics		No. of pt. tested	Positive pt.	
			No.	%		No	%
1	Skin care products	1195	65	5.4	213	40	18.8
2	Cleanliness products	359	24	6.7	156	17	10.9
3	Face make-ups	604	49	8.1	183	35	19.1
4	Lip cosmetics	359	26	6.9	135	19	14.1
5	Eye cosmetics	328	26	7.9	119	17	14.3
6	Nail cosmetics	17	0	0	12	0	0
7	Hair preparations	278	42	15.1	121	32	26.4
8	Baby products	57	2	3.5	39	2	5.1
9	Masks	44	0	0	31	0	0
10	Sunscreens	42	2	4.8	34	2	5.9
11	Fragrance products	23	1	4.3	18	1	5.6
12	Oral hygiene products	16	6	37.5	13	5	38.5
13	Shaving preparations	5	2	40	3	1	33.3
14	Others	59	3	5.1	41	3	7.3
Total		3403	248		1118	174	

Table 5. Cosmetic categories held responsible for cutaneous reactions

Cosmetic category		No.	% (N=248)
1	Skin care products	65	26.2
2	Face make-ups	49	19.8
3	Hair preparations	42	16.9
4	Lip cosmetics	26	10.5
5	Eye cosmetics	26	10.5
6	Cleanliness products	24	9.7
7	Oral hygiene products	6	2.4
8	Baby products	2	0.8
9	Sunscreens	2	0.8
10	Shaving preparations	2	0.8
11	Fragrance products	1	0.4
12	Nail cosmetics	0	0
13	Masks	0	0
14	Others	3	1.2

Of the 95 patients, 54 (56.8%) had at least 1 positive reaction to 17 of the 22 allergens (Table 2). Nickel was the most common allergen (17.9%).

2) A cosmetic series

Eighteen of the 47 patients (38.3%) had at least 1

positive reaction to 15 of the 40 allergens (Table 3). Imidazolidinyl urea and dodecyl gallate were the two most common allergens (7.8%, each).

3) As is test

Patch tests were performed on 240 patients with 3403 cosmetics and toiletries which patients had carried. Of the 3403, 1195 products belonged to the category of skin care products followed by 604 face makeups (Table 4). Next were lip cosmetics (376), cleanliness products (359), and eye cosmetics (328). The numbers of subjects tested with each cosmetic category were in similar order (Table 4). Ninety-nine subjects (41.3%) showed positive reactions to 248 products (7.3%). Of the positive reactions, 26.2% were associated with skin care products. Facial make-ups and hair preparations, including hair dyes, followed. Next were eye and lip cosmetics (Table 5).

(1) Comparison of positive reactions by 14 cosmetic categories

There were positive reactions to all 14 categories except two. Cosmetics showing relatively higher positive reaction rates were: shaving preparations (40%), oral hygiene products (37.5%), hair preparations (15.1%), facial makeups (8.1%). But in concern of the positive rate to tested patient, oral hygiene products showed the highest

Table 6. As is test results by age group

Age group	No. of cosmetics tested	Positive cosmetics		No. pt. tested	Positive pt.	
		No.	%		No	%
-9	4	0	0	1	0	0
10-19	54	6	1.1	6	2	33.3
20-29	960	45	4.7	55	20	36.4
30-39	758	53	7.0	60	23	38.3
40-49	790	60	7.6	55	21	38.2
50-59	563	51	9.1	40	17	42.5
60-	274	33	12.0	23	15	65.2

Table 7. Correlation between as is test result and standard series or cosmetic series results

Cosmetic product	No. of positive pt. in as is test	Common allergen	No. of positive pt. in s & c series
Skin care products	40	Preservatives	8
		Emulsifiers	3
		Lanolin	0
Facial make-ups	23	PABA derivatives	NT
		Fragrances	0
		Emulsifiers	2
		Preservatives	4
		Propylene glycol	1
		Lanolin derivatives	1
		Isopropyl myristate	1
Lip cosmetics	13	D & C red 21, 31, 19, 17	NT
		D & C yellow 11	NT
		Castor oil	NT
		Propyl gallate	0
		Monotert-butylhydroquinone	1
		Benzophenone 3	0
		Amyldimethyl aminobenzoic acid	NT
		Phenyl salicylate	0
		Lanolin	0
		Fragrances	1
Eye cosmetics	17	Preservatives	1
		Nickel	0
		Cobalt	0
		Chromate	0
		Formaldehyde	1
		Fragrances	1
		Neomycin	1

s : European standard series; c : cosmetic series; NT : not tested

rate (38.5%). No one demonstrated a positive reaction to nail cosmetics and masks (Table 4).

(2) Comparison of positive reactions by age group

The positive rate was lowest in the first decade (0%) and highest in the seventh decade (12.0%). Over 10 years of age, the older the higher positive rate, but it was not statistically significant (Table 6).

(3) Comparison of positive reactions by atopic diseases

Of the 240 patients, 149 (62.1%) had no atopic diseases or history, whereas 52 (21.7%) had atopic diseases or a history. The others were not reviewed about personal or family history of atopic diseases. The atopics showed a higher positive rate (9.0%) than non-atopics (8.0%) to their own cosmetics, but statistically not significant ($p > 0.05$).

(4) Correlation of as is test result and standard or cosmetic series results

Of the patients who showed a positive reaction in as is test, a few revealed positive reactions to common allergens of each cosmetic product (Table 7).

DISCUSSION

Relative to their wide usage, serious adverse effect from cosmetics and toiletries are infrequent. Prevalence rates of sensitization to these products in dermatological clinics were 2.2% in Denmark in 1939-1958⁶, 3.5% in Spain⁷, approximately 4% in France in 1973-1980⁸, and 4.4% in the USA in 1977-1983³. In these studies most reactions were caused by skin care products.

In cosmetic allergic dermatitis, fragrance and fragrance ingredients were responsible for the greatest number of reactions. In this study fragrance mix showed relatively high positive rates among cosmetic-related antigens. But in the cosmetic series we used, benzyl salicylate and benzyl alcohol did not have any positive reactions, which were individual fragrance chemicals. This result was different from those of similar studies^{9,10} in Korea, which reported benzyl salicylate to be a common allergen. It would be better to add Balsam of peru and fragrance mix to cosmetic series for detection of fragrance allergy. Preservatives were the second most frequent cause of reactions. The preservative ingredients causing the greatest number of reactions were Quaternium-15, imidazolidinyl urea, parabens, 2-bromo-2-nitropropanediol and formaldehyde^{2,3,11}.

Four of the 26 positive reactions in patch test of cosmetic series were caused by imidazolidinyl urea. Positive reaction rate of formaldehyde, quaternium-15 and paraben in the standard series was 10.5%, 3.2% and 1.1%, respectively.

The patients were tested with 3403 products and the average number of cosmetics tested per patient was 14.2. More than 50% of the 3403 products were the skin care products or facial make-ups. Ninety-nine patients (41.3%) showed positive reactions to 248 products (7.3%). These positive rates were similar to previous reports in our country^{9,10,12}, but higher than those of overseas reports^{2,13}. Of the 248 positive reactions the most common cause was skin care products (26.2%), followed by facial make-ups and hair preparations, as was the case in similar studies^{2,3,13,14}. But direct comparison is difficult because of variable classification of cosmetic category e.g., some authors consider shampoos as hair products whereas others include them with soaps^{3,7,15}.

Our as is test results can be interpreted that skin care products, facial make-ups and cleanliness products are used more frequently than nail cosmetics, oral hygiene products and fragrance products, or that the latter caused lesser skin problems than the former. Or both of the above interpretations can be made.

Although the most common cosmetic categories showing positive reactions were skin care products, face make-ups and hair preparations, cosmetic categories showing high positive rates were oral hygiene products and shaving preparations. It was interesting that there were no reaction to nail cosmetics and masks even though the number of tests was small.

The older age group revealed higher positive reaction rates, which was different from a study in 1984 which peaked at 30 years of age¹⁰. It is assumed to be caused by a heavier exposure in the elderly, but further studies will be needed.

The effects of atopic diathesis (diagnosis made on the basis of personal or family history of atopic diseases) to allergic contact dermatitis is controversial. In the present study there was no statistically significant difference in the positive rate between atopy and nonatopic patients.

Concerning about relevance and detection of causative allergen, positive correlation of as is test results with standard and cosmetic series results is

important. Although exact ingredients of as is tested cosmetics are not known, the positive correlation rate of as is test with standard and cosmetic series is relatively low (Table 7). In a previous study, only a few showed positive reactions to related antigens¹⁶. Even though the standard series and cosmetic series were reported to detect more than 80% of cosmetic allergy¹⁷, our results revealed the importance of as is patch test with the addition of new common allergens to current cosmetic series to improve the sensitivity.

Cosmetics remain a large potential source of allergens to the consumer. Ingredients are not listed on product packages or are listed under different names. So it makes it difficult to detect the causative allergen, even though there are positive reactions to both the screening tray and the patient's own cosmetics. Therefore, cosmetics are now required by law to list their ingredients to avoid causative allergens. This law without doubt will facilitate dermatologists in their investigations, which are often difficult and deceptive.

REFERENCES

1. De Groot AC, Nater JP, Van der Lende B, Rijken B: A large-scale enquiry into adverse effects of cosmetics. *Ned T Geneeskd* 131:863-865, 1987.
2. De Groot AC: Contact allergy to cosmetics: causative ingredients. *Contact Dermatitis* 17:26-34, 1987.
3. Adams RM, Maibach HI: A five-year study of cosmetic reactions. *J Am Acad Dermatol* 13:1062-1069, 1985.
4. Broeckx W, Blondeel a, Dooms-Goossens A, Achten G: Cosmetic intolerance. *Contact Dermatitis* 16:189-194, 1987.
5. De Groot AC: Unwanted effects of cosmetics. *Journal for Drugtherapy and Research* 10:793-797, 1985.
6. Hjorth N: Cosmetic allergy. *J Soc Cosm Chem* 10:96-97, 1959.
7. Romaguera C, Camarasa JMG, Alomar A, Grimalt F: Patch tests with allergens related to cosmetics. *Contact Dermatitis* 9:167-168, 1980.
8. Ngangu Z, Samsoen M, fousseureau J: Einige aspekte kosmetika-allergie in Strassburg. *Dermatosen* 31:126-129, 1983.
9. Eun HC, Lee YS: A study of patch test with cosmetic related antigens in patients with contact dermatitis. *Kor J Dermatol* 22:187-190, 1984.
10. DH Kim, HI Kim, Hy Park, S Lee: Patch test in the suspected cosmetic contact dermatitis. *Kor J Dermatol* 25:161-168, 1987.
11. Rietschel RL, Fowler JF JR: Fragrance allergy. In *Fisher's Contact Dermatitis*. Williams & Wilkins, Baltimore, 1995, pp448-460.
12. KB Myung: Patch test in cosmetic contact dermatitis. *Ewha Med J* 15:217-222, 1992.
13. De Groot AC, Beverdam EGA, Ayong CT, Coenraads PJ, Nater JP: The role of contact allergy in the spectrum of adverse effects caused by cosmetics and toiletries. *Contact Dermatitis* 19:195-201, 1988.
14. KJ Kim, BK Lee, KY Kim, HJ Kang: Cosmetic dermatitis in patch test clinic. *J Koryo Gen Hosp* 13:29-36, 1990.
15. Eiermann HJ, Larsen W, Maibach HI, Taylor JS: Prospective study of cosmetic reactions. *J Am Acad Dermatol* 6:909-917, 1982.
16. Skog Erik: Incidence of cosmetic dermatitis. *Contact Dermatitis* 6:449-451, 1980.
17. De Groot AC, Bruynzeel DP, Bos JD: The allergens in cosmetics. *Arch Dermatol* 124:1525-1529, 1988.