

Rôle of ear piercing in metal allergic contact dermatitis

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To evaluate the effect of ear piercing on sensitization to gold and other metals, diagnostic patch testing with 18 metals was performed. 377 patients (65 men and 312 women, ranging in age from 15 to 78 years; mean 34.2, S.D.±15.1 years) were patch tested; 107 had pierced earlobes. Metals were applied on the back for 2 days, and the results read with the ICDRG scoring system 3 days after application. Reactions of + to +++ were regarded as positive. There were significantly more patients reacting to gold chloride ($p<0.001$), mercuric chloride ($p<0.01$), and nickel sulfate ($p<0.05$) in patients with pierced ears than in those without. Statistical issues included: (i) a significant number of patients with pierced ears referred because of earring dermatitis; (ii) those with pierced ears represented a different age group from those without; (iii) a significant number of patients without eczema in the non-pierced ear group. However, our data suggests that ear piercing is a risk factor not only for nickel but also for gold sensitization. Gold was the second most frequent metal allergen after nickel in the pierced group.

Key words: ear piercing; allergic contact dermatitis; false-positive reactions; patch testing technique; gold chloride; mercuric chloride; nickel sulfate; product labelling. © Munksgaard, 1997.

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We have encountered 35 clinical cases of gold dermatitis, although allergic contact dermatitis from gold is considered uncommon (1). The patients were all women with pierced earlobes, ranging in age from 17 to 39 years (1). They developed edematous erythema, and subsequently intra-cutaneous nodules on the earlobes, from 1 week to 1 year after having their earlobes pierced (1, 2). Topical application of corticosteroids inhibited edematous erythema, but not nodules. Histopathologically, specimens from nodules revealed dense infiltration of lymphocytes and eosinophils in the dermis (2). These patients were patch test positive to gold chloride and revealed the specific findings described above (1, 2). We noted a tendency to cross-sensitivity to ionized, and not to non-ionized, mercury (2-4).

Ear piercing is an important risk factor for nickel sensitization (5-11). This study evaluates the effect of ear piercing on sensitization to various metals including gold.

Materials and Methods

The subjects were 377 patients (65 men and 312 women, ranging in age from 15 to 78 years; mean 34.2, S.D.±15.1 years) at the Department of Dermatology, Showa University Hospital, tested from March 1989 to June 1995. Of these, 107 patients had their earlobes pierced (Table 1). Table 2 shows the frequency of dermatologic disease in pierced versus non-pierced patients. The number of those with eczema, including a clinical diagnosis of contact dermatitis, was 259 (68%). No patients had other overt significant health problems. Patch tests with a metal series (Torii Pharmaceutical Co., Ltd., Japan, purity ~100%; or provided by Dr. Nakayama, purity ~100%), which included 18 metals (2 at more than 1 concentration; Table 3), were applied on the back for 2 days, with vinyl plaster (Mini-plaster®, Torii Pharmaceutical Co., Ltd., Japan) to avoid chemical reaction between aluminum and mercuric chloride (12). For 5 pa-

Table 1. Patient characteristics

		Pierced	Non-pierced	Total
Men	no.	4	61	65
	average age (years)	20.5	45.9	44.3
		(SD±2.5)	(SD±15.8)	(SD±16.5)
Women	no.	103	209	312
	average age (years)	23.3	36.4	32.1
		(SD±5.5)	(SD±14.7)	(SD±13.9)
Total	no.	107	270	377
	average age (years)	23.2	38.5	34.2
		(SD±5.5)	(SD±15.4)	(SD±15.1)

Table 2. Incidence of dermatologic disease in pierced versus non-pierced patients

Disease	Pierced	Non-pierced	Total
eczema	88	171	259
contact dermatitis	83	118	201
atopic dermatitis	3	14	17
nummular eczema	0	6	6
dyshidrotic eczema	1	8	9
other eczema	1	25	26
palmoplantar pustulosis	0	44	44
others	19	55	74
total	107	270	377

tients with overt mercury sensitization, we applied 0.05% (rather than 0.1%) mercuric chloride to minimize severe reactions. The results were read with the ICDRG scoring system 3 days after application (13). Reactions of + to +++ were regarded as positive. Reactions difficult to judge because of technical limitations were excluded. Differences of positive rates between those with and without pierced ears were analyzed with the standard ratio sanction, recognizing the statistical issues described above. Differences were considered significant when $p < 0.05$.

Results

Table 4 contrasts the positive rates to metals between patients with and without piercing. The metal to which the most patients reacted was 5% nickel sulfate, irrespective of piercing (the positive rates were 38.3% in patients with pierced ears, 25.6% in patients without; Table 4). The 2nd highest rates were to 0.2% gold chloride in patients with pierced ears (34.6%). Nickel, mercury and cobalt in that order exhibited the most positive reactions (25.6% to 5% nickel sulfate, 12.6% to 0.1% mercuric chloride, 12.2% to 2% cobalt chloride in those without pierced ears; Table 4). There were significantly more patients with pierced ears sensi-

Table 3. Metals, concentration and vehicle

Metals	(%)	Base
CuSO ₄	2	aq.
PdCl ₂	1	aq.
K ₂ Cr ₂ O ₇	0.4	aq.
NiSO ₄	5	aq.
NiSO ₄	2	aq.
CoCl ₂	2	aq.
HgCl ₂	0.1	aq.
HgCl ₂	0.05	aq.
SnCl ₄	1	aq.
CdSO ₄	1	aq.
HAuCl ₄	0.2	aq.
H ₂ PtCl ₆	0.5	aq.
FeCl ₃	2	aq.
InCl ₃	1	aq.
IrCl ₄	1	aq.
MoCl ₅	1	aq.
AgBr	2	pet.
SbCl ₃	1	pet.
ZnCl ₂	2	pet.
MnCl ₂	2	pet.

tized by the following 5 than patients without piercing: 0.2% gold chloride (37 of 107 patients, 34.6% versus 2 of 270 patients, 0.7%; $p < 0.001$; Table 4), 0.05% mercuric chloride (29 of 107, 27.1% versus 29 of 270, 10.7%; $p < 0.001$; Table 4), 0.1% mercuric chloride (26 of 102, 25.4% versus 34 of 270, 10.7%; $p < 0.01$; Table 4), 2% nickel sulfate (39 of 103, 37.9% versus 63 of 270, 23.3%; $p < 0.01$; Table 4), and 5% nickel sulfate (41 of 107, 38.3% versus 69 of 270, 25.6%; $p < 0.05$; Table 4). There were significantly fewer patients with pierced ears sensitized by 2% manganese chloride than patients without pierced ears (0 of 107, 0% versus 17 of 270, 6.3%, $p < 0.01$).

Discussion

This study indicates that ear piercing may be a risk factor for gold sensitization. Evidence that ear piercing increases this risk is that there were significantly more positive reactions to 0.2% gold chloride in the patients with pierced than in the patients without pierced ears ($p < 0.001$; Table 4). Compared with the positive rate in the patients with piercing (34.6%), the positive rate in the patients without piercing was only 0.7%. We suggest that gold sensitization was facilitated by ear piercing, as the reaction was mainly dermal (1, 2). Although gold is a commonly used metal, allergic contact dermatitis from gold is uncommon, presumably because of its stability (14). Gold has less tendency towards ionization than nickel. However it might be less stable in the dermis. In other words, it might ionize more in the dermis than in the epidermis (2, 15, 16). Kligman (17) found gold

Table 4. Positive rates to metals between patients with and without piercing

Metals	Pierced	Non-pierced	Total	
CuSO ₄	8.4 (9/107)	4.1 (11/270)	5.3 (20/377)	
PdCl ₂	11.7 (12/103)	6.3 (17/270)	7.8 (29/373)	
K ₂ Cr ₂ O ₇	5.6 (6/107)	8.5 (23/270)	7.7 (29/377)	
5% NiSO ₄	38.3 (41/107)	25.6 (69/270)	29.2 (110/377)	<i>p</i> <0.05
2% NiSO ₄	37.9 (39/103)	23.3 (63/270)	27.3 (102/373)	<i>p</i> <0.01
CoCl ₂	8.5 (9/106)	12.2 (33/270)	11.2 (42/376)	
0.1% HgCl ₂	25.5 (26/102)	12.6 (34/270)	16.1 (60/372)	<i>p</i> <0.01
0.05% HgCl ₂	27.1 (29/107)	10.7 (29/270)	15.4 (58/377)	<i>p</i> <0.001
SnCl ₄	4.8 (5/104)	4.4 (12/270)	4.5 (17/374)	
CdSO ₄	0 (0/104)	2.2 (6/270)	1.6 (6/374)	
HAuCl ₄	34.6 (37/107)	0.7 (2/270)	10.3 (39/377)	<i>p</i> <0.001
H ₂ PtCl ₆	2.8 (3/107)	4.1 (11/270)	3.7 (14/377)	
FeCl ₃	1.0 (1/104)	0.7 (2/270)	0.8 (3/374)	
InCl ₃	0 (0/101)	0.7 (2/270)	0.5 (2/371)	
IrCl ₄	0 (0/101)	1.9 (5/270)	1.3 (5/371)	
MoCl ₅	0 (0/101)	0.7 (2/270)	0.5 (2/371)	
AgBr	0 (0/102)	0 (0/270)	0 (0/372)	
SbCl ₃	0 (0/102)	3.3 (9/270)	1.6 (9/372)	
ZnCl ₂	3.9 (4/102)	5.9 (16/270)	5.4 (20/372)	
MnCl ₂	0 (0/102)	6.3 (17/270)	4.6 (17/372)	<i>p</i> <0.01

Probability (*p*) was calculated by utilizing the z-distribution, since both samples were independent and more than 30. The z-value was calculated as follows:

$$z = (m_1 n_2 - m_2 n_1) / \sqrt{F(1-F)(n_1 n_2)(n_1 + n_2)}$$

	pierced	non-pierced
no. patients reacted	m_1	m_2
sample size	n_1	n_2
$F = (m_1 + m_2) / (n_1 + n_2)$		

chloride to be a strong experimental sensitizer in man. Our results suggest that gold may have a strong sensitizing potential with ear piercing as an adjuvant. In patients with pierced earlobes, the positive rate resembles that of nickel. Since all subjects were patients, and a group of patients with ear piercing included 35 clinically gold-allergic earlobe patients, the positive rate to gold chloride was high and it does not predict the positive rate of the general population. However, our results suggest that gold is the second metal allergen after nickel, at least for those with pierced ears. Recent studies utilize gold sodium thiosulfate (18, 19). We do not have data to correlate the reactivity to it and gold chloride.

The dissociation of positive rates to mercuric chloride between patients with/ without ear piercing is due to the positive reaction to mercuric chloride with gold dermatitis patients. Evidence for this is that 29 patients who had their ears pierced and showed positive reactions to 0.05% mercuric chloride included 21 patients with gold dermatitis. In the 21 patients, only 3 patients had a history of sensitization to mercury: breaking thermometers. In Japan, "18k" earrings (75% gold and 25% other metals) are popular: those containing 75% gold, 12.5% silver and 12.5% copper are commonly used. Therefore, it is not likely that positive reactions to mercuric chloride were related

to ear piercing. Utilizing electron micro-probe analysis of metals, contamination was ruled out (2). It was not reasonable either that all reactions were due to "excited skin syndrome" (20). 3 gold dermatitis patients showing positive reactions both to gold chloride and to mercuric chloride were re-tested individually at a later date. At that time, we noted positive reactions to both (2). We speculate that there are 2 possible reasons why they showed positive reactions not only to gold but also to mercury: one is that those sensitized by mercury had a genetic tendency toward sensitization to gold, and another is that those sensitized by gold have a tendency to react positively to ionized mercury (2-4). The latter is more plausible because patients obviously sensitized by mercury did not have a tendency to react to gold chloride (3).

In our study, nickel was the most common metal allergen. The positive rates to nickel were the highest among 18 metals, irrespective of ear piercing (Table 4). The nickel positive rates exceeded 20% even in those without pierced ears. Also, there were significantly more patients sensitized by nickel with pierced than without pierced ears (Table 4). Although ear piercing is not the only cause of nickel sensitization, it must play an important role.

Positive reactions to tin tetrachloride, ferric chloride, indium trichloride, iridium tetrachloride,

molybdenum pentachloride, antimony trichloride, zinc chloride, and manganese chloride were considered as irritant reactions, since these reactions were weaker after 3 than 2 days. In most positive reactions to manganese chloride and zinc chloride, pustules were common.

In addition, we suggest the prospective benefit of a new international standard for the notation of components of ear piercing. It should show not only "18k" but a code for metal allergens included, enabling patients to use the results of patch testing effectively and prevent recurrences of contact dermatitis.

Our data has some statistical issues as follows. There was a bias in that a significant number of patients with pierced ears were referred because of earring dermatitis. Those with ear piercing represented a different age group than those without, and there was a significant number of patients without eczema among those without pierced ears. However, our data suggest that ear piercing is a risk factor not only for nickel but also for gold sensitization. In conclusion, gold is the second most frequent metal allergen after nickel in this pierced group.

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