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Metal Hypersensitivity in Dentists: a Patch Test Study

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ABSTRACT

Patch test of dental alloys was conducted on dentists in the Department of Prosthetic Dentistry, Hiroshima University School of Dentistry. The positive rate of the first patch test in the test group was 47.1%, and that in the control group was 10.0%, showing a large difference between the two groups. Furthermore, a second patch test was conducted on those who showed a positive response together with pustular or follicular reaction. As neither positive response nor pustular or follicular reaction was observed in the second patch test, the results were regarded as negative. Only a very slight difference in the positive rate could be observed when the results of the two tests were combined. The results of the present study suggest that the possibility is small for dentists to develop metal hypersensitivity in normal clinical practice.

Key words: *Metal hypersensitivity, Dental alloy, Patch test*

Dental alloys containing various elements are used to reconstruct decayed and missing teeth in the form of inlays, crowns, bridges and dentures. Recently, case studies and research have cumulatively suggested that hypersensitive reactions such as dermatitis, urticaria and lichen planus are attributable to dental alloys[4,5,7]. It is a general rule that dental alloys used in dental treatment must not be harmful. However, it has been reported that even precious metals may corrode and dissolve in the oral environment[9]. In routine dental practice the dentist is very liable to become sensitized to metal ions that may cause allergic reaction. It has not been confirmed, however, that the rate of such dermatologic responses attributable to the use of alloys in general practice is high.

The purpose of this investigation was to examine the positive reaction in patch test of dental alloys in order to determine whether dentists in prosthetic dentistry develop metal hypersensitivity.

MATERIALS AND METHODS

1. Test group

The test group consisted of 17 members of the staff of the Second Department of Prosthetic Dentistry, Hiroshima University School of Dentistry: 16 males and one female with a mean age of 28.1 years.

For the control group, 20 fourth year students of this School of Dentistry were used: 14 males and 6 females with a mean age of 23.7 years.

2. Test substances and patch test

The test substances used in the patch test are listed in Table 1. They were produced in accordance with the metal M-7 series reported by Nakayama (1974)[8]. Substances having strong irritation were adjusted to two concentration levels to enable evaluation of whether the reaction was allergic or irritant.

Table 1. Test substances used in patch test of dental alloys

1	$CuSO_4$	5 % aq
2	$CuSO_4$	2 % aq
3	$K_2Cr_2O_7$	0.4 % aq
4	$NiSO_4$	5 % aq
5	$NiSO_4$	2 % aq
6	$CoCl_2$	2 % aq
7	$HgCl_2$	0.1 % aq
8	$HgCl_2$	0.05% aq
9	$SnCl_4$	2 % aq
10	$SnCl_4$	1 % aq
11	$CdSO_4$	1 % aq
12	$AuCl_3$	0.2 % aq
13	H_2PtCl_6	0.5 % aq
14	$PdCl_2$	2 % aq
15	$PdCl_2$	1 % aq
16	$FeCl_3$	2 % aq
17	AgCl	2 % pet
18	$SbCl_3$	2 % pet
19	$ZnCl_2$	2 % pet
20	$MnCl_2$	2 % pet
21	Petrolatum	
22	Distilled water	

As patch test, Finn chambers (Epitest Co., Ltd. Hyrylä, Finland) were used for epicutaneous testing. This tape, producing little irritation, is widely

used in patch test. After filter papers 7 mm in diameter were placed on top of the aluminum chambers attached to the tape, one drop of the aqueous solution or the same volume of the petrolatum vehicle was placed on each chamber. The tapes with 22 test substances were attached on the underside of the upper arm of the testees. Sites with eczema and dermatitis were avoided. The testees were requested not to bathe or exercise during the test in view of the possible effect on determinations. The tapes were removed 48 hr after they were attached. The first determination was done 30 min after cleaning the skin with alcohol cotton and the second determination was conducted 24 hr after removal of the tape.

3. Evaluation of positive reaction

The international standard of I.C.D.R.G. was used in evaluating the positive reaction of the patch test as shown in Table 2[3,6]. Reactions exceeding + were evaluated as positive.

Table 2. Standard of I.C.D.R.G. used for evaluation of positive reaction

−	negative reaction
?+	doubtful reaction; faint erythema
+	weak (non-vesicular) positive reaction; erythema, infiltration, papules, vesicles
++	strong (vesicular) positive reaction; erythema, infiltration, papules, vesicles
+++	extremely positive reaction; bullous reaction
I R	irritant reaction
N T	not tested

RESULTS AND DISCUSSION

1. Evaluation of patch test

Subjects with positive reaction 48 hr after removal of tape but with negative reaction 72 hr after removal were evaluated as irritation. Subjects with negative reaction in 48 hr after removal but with positive reaction 72 hr after removal were evaluated as positive.

Table 3. Results of first patch test showing positive reaction

		test group	control group
$HgCl_2$	0.1 %	1/17 (5.9%)	1/20 (5.0%)
$HgCl_2$	0.05%	1/17 (5.9%)	1/20 (5.0%)
$ZnCl_2$	2 %	5/15 (33.3%)*	—
$MnCl_2$	2 %	2/15 (13.3%)*	1/20 (5.0%)*

*: pustular or follicular formation

In the first patch test, 2% zinc chloride showed a positive rate of 33.3% and 2% manganese chloride showed a positive rate of 13.3% in the test group. As shown in Table 3, the positive rate of the test group including pustular reaction was 47.1%, but the positive rate of the control group was 10.0%, showing a large difference between the two groups. Some with positive reactions showed aseptic pustular or follicular reaction. The same reaction was also observed in a control group case with positive reactions to 2% manganese chloride.

The overall results of the two patch tests in both groups are shown in Table 4. The test substances showing positive reaction in the test group were 0.1% mercuric chloride and 0.05% mercuric chloride with both showing a positive rate of 5.9%. These substances also showed a positive rate of 5% in the control group.

Table 4. Overall results obtained by two patch tests

		test group	control group
$HgCl_2$	0.1 %	1/17 (5.0%)	1/20 (5.0%)
$HgCl_2$	0.05%	1/17 (5.9%)	1/20 (5.0%)

2. Irritant reaction

According to Fisher et al (1959, 1986)[2,3], Becker et al (1959)[1] and Stone et al (1967)[10], pustular or follicular reaction is clinically insignificant, being neither an allergic reaction nor an irritant reaction. On the other hand, Wahlberg et al (1971)[11] have reported that when either pustular or follicular reactions coexists with positive reaction, it is a characteristic case of metal allergy. Thus, there are two conflicting views regarding pustular or follicular reaction in metal patch test. A second patch test had to be made, therefore, using the same test substance on testees who showed pustular or follicular reaction. The second test was carried out with manganese chloride in two testees and with zinc chloride in three of the five testees because of migration or other reasons. Pustular or follicular reaction and positive response could not be observed in any of the testees in the second patch test. The earlier findings could not be reproduced.

The important point in evaluating a positive response in this test is not the number of positive reactions but whether it is a true positive reaction caused by allergy or a nonspecific irritant reaction[3]. This is because pustular or follicular reaction is not a specific reaction of metal allergy but an irritant reaction of a different type.

In this study no remarkable difference in the positive rate between the test group and control group could be demonstrated even though reports have been made regarding metal hypersesitivity induced by dental alloys. This study suggests that possibility is small for dentists in prosthetic dentistry to develop metal hypersensitivity in normal clinic practice.

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REFERENCES

1. **Becker, S.W. and O'brien, P.** 1959. Value of patch tests in dermatology; Special study of follicular reactions. Arch. Derm. **79**: 569–577.

2. **Fisher, A. A., Chargin, L., Fleischmajer, R. and Hyman, A.** 1959. Pustular patch test reactions with particular reference to those produced by ammonium fluoride. Arch. Derm. **80**: 742–752.
3. **Fisher, A. A.** 1986. The role of patch testing, p. 25–26. Contact dermatitis, 2nd ed. Lea & Febiger, Philadelphia.
4. **Frykholm, K. O., Frithiof, L., Fernstram, A. I. B., Moberger, G., Blohm, S. G. and Bjorn, E.** 1969. Allergy to copper derived from dental alloys as a possible cause of oral lesions of lichen planus. Acta. Derm. Venereol. (Stockh) **49**: 268.
5. **Jones, H. K., Hansen, C. A., Singer, M. T. and Kessler, H. P.** 1986. Dental implications of nickel hypersensitivity. J. Prosthet. Dent. **56**: 507–509.
6. **Magnusson, B. and Hersle, K.** 1965. Patch test methods. I. A comparative study of six different types of patch tests. Acta Dermatovener. **45**: 123.
7. **Miller, E. G., Perry, W. L. and Wagner, M. J.** 1987. Prevalence of mercury hypersensitivity in dental students. J. Prosthet. Dent. **58**: 235–237.
8. **Nakayama, H., Murata, M. and Morito, M.** 1974. Possibility of sensitization by dental alloys. Dental Outlook. **43**: 382–389 (in Japanese).
9. **Shigeto, N., Suzuki, S., Deki, K., Mori, H., Yanagihara, T. and Hamada, T.** 1985. Clinical observation of corrosion of crown restorations. J. Hiroshima Univ. Dent. Soc. **17**: 373-378 (in Japanese).
10. **Stone, J. S. and Johnson, D. A.** 1967. Pustular patch test-experimentally induced. Arch. Derm. **95**: 618–619.
11. **Wahlberg, J. E. and Skog, E.** 1971. Nickel allergy and atopy, Threshold of nickel sensitivity and immunoglobulin E determinations. Br. J. Derm. **85**: 97–104.