APJAI
Asian Pacific Journal of
Allergy and Immunology

ORIGINAL ARTICLE

Rate of actual metal allergy prior to dental treatment in subjects complaining of possible metal allergy

Eriko Itoh,[1,2] Minao Furumura,[1] Masutaka Furue[2]

Abstract

Background: Dental treatment for patients with self-reported metal allergy or concern about the possibility of having such an allergy is often difficult; such patients often undergo dermatological consultations for metal patch test (PT).

Objective: This study compared PT results for metal allergens and the clinical relevance of this among patients visiting Fukuoka Dental College Hospital.

Methods: We performed PT with metal allergens on patients with oral mucosa- or skin-related symptoms, or those concerned about adverse events associated with upcoming dental treatment.

Results: Fifty-nine patients were patch-tested with metal allergens. Thirty-four cases (58.8%) had self-reported metal allergy. Regarding comorbidities, atopic dermatitis was the most common (7 cases), followed by hand eczema, palmoplantar pustulosis, lichen planus, and abnormal sensation in the mouth. Overall, 25 of 59 cases had at least one positive PT reaction. The most common positive allergen was nickel sulfate (17 cases), followed by cobalt chloride, zinc chloride, and palladium chloride. The rate of positivity of metal PT was significantly higher in the self-reported metal allergy cases than in the others ($P < 0.001$). Other comorbidities were not significantly associated with those with or without self-reported metal allergy. Five of those without self-reported metal allergy showed positive PT reaction.

Conclusion: Patients with self-reported metal allergy exhibited more metal PT reactions than those without this. One fifth of those without this showed positive metal PT reaction, implying the importance of PT for both with and without self-reported metal allergy. PT results are helpful for selecting dental metals for future prosthetic and orthodontic treatments.

Keywords: metal allergy, patch test, dental treatment, nickel, cobalt

From:
[1] Department of Dermatology, Fukuoka Dental College, Fukuoka, Japan
[2] Department of Dermatology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan

Corresponding author:
Eriko Itoh
Department of Dermatology, Fukuoka Dental College
2-15-1 Tamura, Sawara-ku, Fukuoka 814-0193, Japan
E-mail: itou@dermatol.med.kyushu-u.ac.jp

Introduction

Metals are widely present in products used in daily life; some metals are important to the body, the deficiency of which can induce skin diseases.[1] Metals can also affect cells of the skin, depending on the particle size and shape, and cause skin inflammation and allergies.[2] The release of metal ions is thought to trigger allergic reactions, the allergens of which can include microparticles from corroded metal products and ionic metal hydroxides/oxides.[3] In daily life, we are exposed to various allergens, contact with which may induce allergic dermatitis in sensitized individuals.[4] If the causative allergen is not clear, it may lead to an intractable clinical course.[5] It is thus extremely important to identify the causative allergens using patch test (PT).[5]

Many kinds of metals are used in dentistry, but nickel, chromium, mercury, palladium, and cobalt are common metal materials.[3] Dental treatment for patients with self-reported metal allergy is often difficult. Such patients are referred to dermatological clinics for PT of metals, to elucidate their sensitization status. In this paper, we describe PT results prior to dental treatments in 59 subjects complaining of self-reported metal allergy or concerned about any adverse events associated with upcoming dental treatments.

Methods

Background

All PT data are maintained at Fukuoka Dental College Hospital. PT with metal allergens was performed in 59 cases between October 2015 and March 2018. This study was approved by the ethical committee of Fukuoka Dental College (approval number: 398). Since this study involved only retrospectively review medical records, informed consent of each participants was not required.

Materials

Metal allergens and their material properties for PT are shown in **Table 1**. All substances from aluminum chloride to mercuric chloride in the table were purchased from Torii Pharmaceutical Co., Ltd. (Tokyo, Japan), while titanium and titanium (IV) oxide were obtained from Chemotechnique Diagnosis (Vellinge, Sweden).

Table 1. Allergens and contents of metal patch test at our department

Allergen	Concentration (%)	Base
Aluminum chloride	2%	Purified water
Cobalt chloride	2%	Purified water
Stannic (II) chloride	1%	Purified water
Ferrous chloride	2%	Purified water
Chloroplatinic acid	0.5%	Purified water
Palladium chloride	1%	Purified water
Manganese chloride	2%	White Vaseline
Indium (III) chloride	1%	Purified water
Iridium (IV) chloride	1%	Purified water
Silver bromide	2%	White Vaseline
Potassium dichromate	0.5%	Purified water
Chromium sulfate	2%	Purified water
Nickel sulfate	5%	Purified water
Zinc chloride	2%	White Vaseline
Chloroauric acid	0.2%	Purified water
Copper sulfate	1%	Purified water
Mercuric (II) chloride	0.05%	Purified water
Titanium	1%	Petrolatum
Titanium (IV) oxide	0.1%	Petrolatum

Methods and statistical analysis

For the PT procedure, Finn Chamber on Scanpor Tape (Smart Practice, USA) and Patch Tester Torii were used. Allergens were patch-tested on the upper arm or back for 48 h and test sites were evaluated at 72 and 168 h after initial placement. Positive reactions were evaluated in accordance with the diagnostic criteria of the International Contact Dermatitis Research Group: ICDRG standard (? +: doubtful; +: mild reaction, possible erythema, infiltration, and papules; ++: strong reaction, erythema, infiltration, papules, and vesicles; +++: very strong reaction, intense erythema, infiltration, and coalescing vesicles; IR: irritant reaction; NT: not tested). We defined + or more as PT positivity. Fisher's exact test was used to compare results. P values of less than 0.05 were considered statistically significant. Statistical analysis was performed using JMP 12 (SAS Institute, Inc., Cary, NC, USA).

Results

Fifty-nine patients (mean age: 47 years, range 7–77 years; 11 males and 48 females) were patch-tested with metal allergens. Among them, there were 34 cases of self-reported metal allergy and 25 cases of concern about possible adverse events associated with upcoming dental treatment. With regard to comorbidities, atopic dermatitis was the most common (7 cases, 12%), followed by hand eczema (6 cases, 10%), palmoplantar pustulosis (6 cases, 10%), lichen planus (3 cases, 5%), and abnormal sensation in the mouth (3 cases, 5%). Overall, 25 of the 59 cases (42.4%) had at least one positive reaction (**Table 2**).

Table 2. Demographics of 59 patients undergoing metal patch test

	Number (N = 59)
Sex	
male/female	11/48
Age (years)	
mean, range	47, 7–77
Self-reported metal allergy (male/female)	34 (7/27)
Subjects without episode of metal allergy (male/female)	25 (4/21)
Comorbidities (male/female)	
• atopic dermatitis	7 (3/4)
• hand eczema	6 (4/2)
• palmoplantar pustulosis	6 (5/1)
• lichen planus	3 (2/1)
• abnormal sensation in the mouth (glossodynia)	3 (3/0)
Positive patch test results (male/female)	
• more than one positive reaction	25 (4/21)
• all negative	34 (7/27)

Table 3 shows clinical variables for subjects with and without self-reported metal allergy. In the self-reported metal allergy cases, the rate of positivity in the metal patch test (20/34; 58.8%) was significantly higher than in the others (5/25; 20%) ($P < 0.001$). Comorbidities were not significantly associated with the cases with and without self-reported metal allergy (**Table 3**).

Table 3. Clinical variables of subjects with and without self-reported metal allergy.

	Self-reported metal allergy N = 34	No self-reported metal allergy N = 25	P value
Sex (male/female)	7/27	4/21	0.745
Age (mean, range)	46, 15–73	54, 7–77	0.399
Comorbidities			
• atopic dermatitis	4	3	1.000
• hand eczema	2	4	0.386
• palmoplantar pustulosis	1	5	0.074
• lichen planus	1	2	0.569
• abnormal sensation in the mouth	0	3	0.071
Positive patch test results			
• more than one positive reaction	20	5	0.004*
• all negative	14	20	

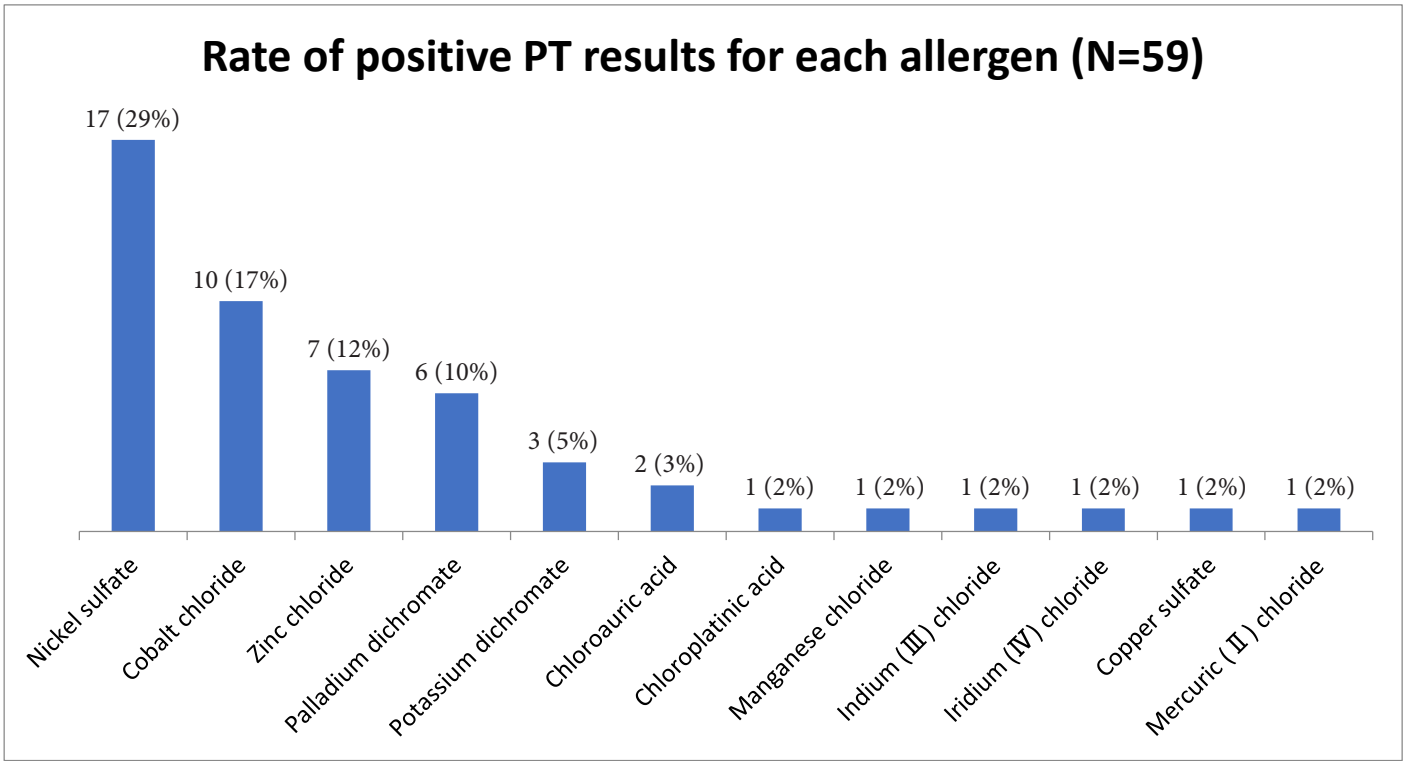

Figure1. Rates of positive PT results for each allergen

The rates of positive PT results for each allergen are shown in **Figure 1**. The most common positive allergen was nickel sulfate (17 cases, 29%), followed by cobalt chloride (10 cases, 17%), zinc chloride (7 cases, 12%), palladium chloride (6 cases, 10%), potassium dichromate (3 cases, 5%), and chloroauric acid (2 cases, 3%). Chloroplatinic acid, manganese chloride, indium (III) chloride, iridium (IV) chloride, copper sulfate, and mercuric (II) chloride were each positive in one case.

Discussion

Dental treatment for patients complaining of self-reported metal allergy or concerned about possible adverse events is often difficult. According to previous reports from Japanese dentistry,[3,6] the rates of positivity in metal PT were 50%[6] and 69.8%.[3] In the present study, the positive allergy rate was 42.4% overall (58.8% in self-reported metal allergy cases, 20% in cases without self-reported metal allergy). The rate of PT positivity was significantly higher in self-reported metal allergy cases than in the other cases. Five of 25 cases showed a positive PT reaction among the cases without self-reported metal allergy. Intriguingly, all of these positive cases were female and had a comorbidity of palmoplantar pustulosis (N = 3), hand eczema (N = 1), or lichen planus (N = 1).

Comorbidities included atopic dermatitis, hand eczema, palmoplantar pustulosis, lichen planus, and glossodynia[7] (abnormal sensation in the mouth). While previous reports described a relationship between these comorbidities and metal allergy,[8,9] the present study did not reveal a significant correlation, probably due to the limited number of cases.

In dental treatment, many kinds of metals are used.[3] Metals like amalgam have been used to dental treatment in many patients but proven dental contact allergy by using such metal appear to be very rare.[10,11] A previous report revealed that the most common positive allergen was nickel sulfate, followed by cobalt chloride,[4] which was also the case in the present study. Titanium is highly biocompatible and has been frequently used for dental implants.[12,13] However, titanium wire used for orthodontic treatments contains a nickel–titanium alloy, so it is not suitable for those with a nickel allergy.[12,13] In cases with a zinc allergy, careful selection of the luting cement is required. All dental cements utilized for root canal fillings contain zinc, so they should be avoided in those with a zinc allergy.[14]

PT is a useful test for delayed allergy, but caution is needed to consider whether PT-positive metal allergy is the real cause of symptom development.[15] Dental metal allergy can be definitively diagnosed when the symptoms improve after removing the suspected dental metals.[12] However, it should be kept in mind that symptoms may transiently deteriorate due to the ingestion of metal powder produced by scraping of metal when removing suspected dental metal allergen.[12] If the symptoms do not improve, it is unlikely that a dental metal allergy has occurred and other exacerbating factors need to be examined.

In this study, subjects with self-reported metal allergy did exhibit a higher rate of PT positivity than the other subjects. However, 20% of those without self-reported metal allergy also presented positivity for PT. PT should be more actively recommended to subjects having a possible history of metal allergy. The relevance of contact metal allergy and oral problems prior to dental restorative treatment is not yet known. In the future, PT studies comparing patients underwent dental restorative procedures with or without oral problems should be done to solve the problem.

Conflict of Interest

The authors have no conflicts of interest to declare.

References

1. Kawamura T, Ogawa Y, Nakamura Y, Nakamizo S, Ohta Y, Nakano H, et al. Severe dermatitis with loss of epidermal Langerhans cells in human and mouse zinc deficiency. J Clin Invest. 2012;122:722-32.
2. Hiroike M, Sakabe J, Kobayashi M, Shimauchi T, Ito T, Hirakawa S, et al. Acicular, but not globular, titanium dioxide nanoparticles stimulate keratinocytes to produce pro-inflammatory cytokines. J Dermatol. 2013; 40:357-62.
3. Hosoki M, Bando E, Asaoka K, Takeuchi H, Nishigawa K. Assessment of allergic hypersensitivity to dental materials. Biomed Mater Eng. 2009;19: 53-61.
4. Suzuki K, Matsunaga K, Yagami A, Adachi A, Ikezawa Y, Itoh A, et al. Annual variations of the positive rates of Japanese Standard Allergens 2008 from 2013 to 2014. J Environ Dermatol Cutan Allergol. 2017;11:234-47.
5. Zug KA, Warshaw EM, Fowler JF Jr, Maibach HI, Belsito DL, Pratt MD, et al. Patch-test results of the North American Contact Dermatitis Group 2005-2006. Dermatitis. 2009;20:149-60.
6. Kouno M, Nishiyama A, Minabe M, Iguchi N, Ukichi K, Nomura T, et al. Retrospective analysis of the clinical response of palmoplantar pustulosis after dental infection control and dental metal removal. J Dermatol. 2017;44:695-8.
7. Vellappally S. Burning mouth syndrome: A review of the etiopathologic factors and management. J Contemp Dent Pract. 2016;17:171-6.
8. Adachi A, Horikawa T, Takashima T, Komura T, Tani M, Ichihashi M. Potential efficacy of low metal diets and dental metal elimination in the management of atopic dermatitis: An open clinical study. J Dermatol. 1997;24:12-19.
9. Tokura Y. Extrinsic and intrinsic types of atopic dermatitis. J Dermatol Sci. 2010;58:1-7.
10. https://www.ada.org/en/about-the-ada/ada-positions-policies-and-statements/statement-on-dental-amalgam
11. Ramnarayan BK, Maligi PM, Smitha T, Patil US. Amalgam contact hypersensitivity lesion: an unusual presentation-report of a rare case. Ann Med Health Sci Res. 2014; 4: s320-323.
12. Ko N. Clinical characteristics of patients with dental metal allergy: The importance of the medical-dental cooperation. J Jpn Dent Assoc. 2015; 69:289-99.
13. Equsa H, Ko N, Shimazu T, Yatani H. Suspected association of an allergic reaction with titanium dental implants: a clinical report. J Prosthet Dent. 2008;100:344-7.
14. Shirakawa M, Ishigaki Y, Imai Y, Hattori M, Ogasawara T, Kawamura H, et al. Research on diagnostic and therapeutic methods for patients with metal allergy. J Jpn Assoc Dent Sci. 2015;34:39-43.
15. Bruze M, Andersen KE. Gold--a controversial sensitizer. European Environmental and Contact Dermatitis Research Group. Contact Dermatitis. 1999;40:295-9.