

## CASE REPORT

## Severe dermatitis might be caused by a cross-reaction between nickel and palladium and dental amalgam resolved following removal of dental restorations

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### Key Clinical Message

This report demonstrates a case of atopic dermatitis that was unresponsive to topical steroid therapy. This clinical report highlights the fact that metals used in dental treatment, such as mercury, as well as cross-reactions between nickel and palladium, may cause systemic hypersensitivity or toxicity.

### Keywords

Dental amalgam, dermatitis, mercury, nickel, palladium.

## Introduction

The construction of restorative and prosthetic dental appliances comprises a wide range of metals. The corrosion of these appliances releases metal ions into the body, and the linings of the mouth and the digestive system can absorb these metal ions [1]. Many dental metals may become allergens [2]. Dermatitis caused by allergic reactions to mercury in dental amalgams are well known in the medical community [3–11]. This study examines a case of widespread and persistent dermatitis that started as nickel contact dermatitis and was not resolved despite ceasing contact with the nickel. A cross-reaction between nickel and palladium may have contributed to the onset of the subject's symptoms. A reaction to the mercury contained in a dental amalgam filling may have contributed to the deterioration of the subject's symptoms [12]. This is suggested by the improvement of the subject's condition following the replacement of her dental metals with palladium-free materials.

## Clinical Report

### Subject

The subject was a 34-year-old Japanese woman.

### Chief complaint

Dermatitis spread over the patient's entire body.

### Clinical history

The subject first reported symptoms of dermatitis after playing her flute for several months approximately 20 years before the commencement of this study. At the time, her symptoms were attributed to a metal contact allergy, and she was treated with steroid ointment by her dermatologist. Despite quitting playing the flute and undergoing medical treatment, her symptoms continued to spread. Another dermatologist later diagnosed her with

atopic dermatitis and also prescribed steroid ointments. This had a limited effect, and her treatment was discontinued 1 year before this study. The rash became significantly worse approximately 2 weeks after the steroid treatment was discontinued; as a result, it spread over her entire body. Over the course of the year prior to this study, her condition remained relatively unchanged. The subject's dermatologist performed various blood tests. The percentage of eosinophils in her hemogram (differential white blood count) was higher than the standard value (Table 1). The dermatologist also performed allergic blood tests, and no abnormalities were observed in her nonspecific immunoglobulin E antibody levels (128 IU/mL, radioimmunosorbent test [RIST], normal <170 IU/mL). However, a specific immunoglobulin E antibody examination (radioallergosorbent test [RAST], normal <0.34 PRU/mL) showed a high value (0.74 PRU/mL) for cedar pollen (Table 2).

A hair analysis was performed by Doctor's Data Laboratories ([http://www.chelationmedicalcenter.com/doctors\\_data.html](http://www.chelationmedicalcenter.com/doctors_data.html)). According to the report, the patient's mercury and arsenic levels were very high (Table 3).

### Initial physical condition

The rash covered her whole body but was the most severe on the patient's back. She also complained of intense itching (Fig. 1).

**Table 1.** Hemogram (differential white blood count).

	Measured value (%)	Standard value (%)
Neutrophils	51.0	43–75
Eosinophils	18.0	1–6
Basophils	1.0	0–2
Lymphocytes	25.0	25–45
Monocytes	5.0	2–8

**Table 2.** Specific immunoglobulin E antibody (fluorescence enzyme immunoassay; Radioallergosorbent test).

Allergen	Measured value (PRU/mL)
Ticks	0.04
House dust	0.20
Cedar pollen	0.74
White egg	0.07
Soybeans	0.02
Cat (waste of skin)	0.03
Dog (surface of skin)	0.02
Wheat	0.07
Candida	0.11

**Table 3.** Hair analysis results.

Metal	Concentration (ppm)	Reference interval (ppm)
Aluminum (Al)	4.5	<7.0
Antimony (Sb)	0.034	<0.05
Arsenic (As)	3.093	<0.06
Cadmium (Cd)	0.013	<0.1
Lead (Pb)	0.23	<1.0
Mercury (Hg)	5.61	<1.1
Nickel (Ni)	0.07	<0.4
Tin (Sn)	0.05	<0.3
Beryllium (Be)	<0.01	<0.02
Bismuth (Bi)	<0.02	<0.1
Platinum (Pt)	<0.003	<0.005
Silver (Ag)	<0.06	<0.2
Copper (Cu)	20.6	12.0–35.0
Zinc (Zn)	197	140–220
Iron (Fe)	5.2	5.4–14.0
Manganese (Mn)	1.24	0.15–0.65
Chromium (Cr)	0.26	0.20–0.40
Cobalt (Co)	0.014	0.013–0.050



**Figure 1.** At the first examination, the rash was spread out over the patient's whole body. The symptoms on the subject's back were extremely severe. She also reported severe itching.

### Initial oral condition

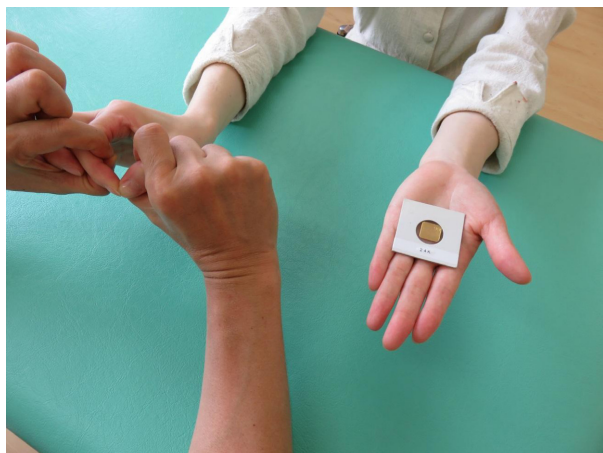
The subject had 28 adult teeth, including the lower left wisdom tooth. She had an amalgam filling, 12 metal inlay restorations, one porcelain bond-to-metal full cast crown, and one porcelain bond-to-metal bridge. The inlays, crown, and bridge were most likely made from silver alloy containing gold, silver, copper, and palladium. She had

these restorations and prostheses since elementary school; however, she had no dental caries.

The subject's gums and oral membranes appeared healthy; she had no lichenoid lesions caused by contact with the amalgam or other metals in her mouth. Moreover, she reported no oral discomfort.

### Treatment and progress

The author used the Bi-Digital O-Ring Test (O-Ring Test) to distinguish between harmful and beneficial substances for the subject [13, 14]. In this case, the O-Ring Test was performed with the following method: The substance was placed on the subject's palm and then the subject made an O-Ring with her thumb and another finger of her opposite hand, which the author tried to split (Fig. 2). When the strength of the subject's grip increased, the substance was judged as beneficial, and vice versa. The result of the O-Ring Test showed that amalgam and palladium were harmful to the patient (Table 4). As a result, her amalgam filling was removed first. Every



**Figure 2.** Bi-Digital O-Ring Test. The substance was placed on the subject's palm. Then, the subject made an O-Ring with her thumb and another finger of her opposite hand, which the author tried to split.

**Table 4.** Results of the O-Ring Test.

Pure gold (Au)	+
Amalgam	-
Copper (Cu)	±
Palladium (Pd)	-
Silver (Ag)	+
Nickel (Ni)	-
Zeometal 87	+
Aurofluid CPF	+
Fuji IX	+

+, Grip strength increased; -, Grip strength decreased; ±, No change in grip strength.

precaution was taken to avoid further exposure to mercury during the removal of the amalgam filling. A rubber dam [15] and an external suction were used to prevent the subject from swallowing the amalgam debris or inhaling any mercury vapor (Fig. 3) [16–18]. The amalgam filling was replaced with glass ionomer cement (GC Fuji IX, GC, Tokyo, Japan: SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, polyacrylic acid, and others). Her symptoms improved after 1.5 months, albeit slightly (Fig. 4). Next, all dental alloys containing palladium were replaced with palladium-free alloys, namely Aurofluid CPF (Metalor Technologies SA, Neuchâtel, Switzerland: Au, 71.5%; Ag, 13.0%; Pt, 11.5%; Ir, 0.6%; Rh, 0.4%; other, 3.0%) and Zeometal 87 (Yamamoto Precious Metal Co., Ltd., Osaka, Japan: Au, 87.0%; Pt, 11%; Zn; Ir). The author selected Aurofluid CPF first, but this metal was discontinued during the treatment, so Zeometal 87 was selected next. These alloys were shown to be beneficial to the patient based on the results of the O-Ring Test (Table 4) [13, 14]. Replacing all the palladium inlays, crown, and bridge took approximately 1 year. However, after three metal inlays were replaced, the patient's symptoms improved considerably. This occurred about 4 months after the initial treatment (Fig. 5). When the treatment was completed, her condition improved dramatically (Fig. 6). Over the 14 years after this study, her skin continued to improve, despite not undergoing any other treatment (Fig. 7).

### Discussion

The author hypothesized that the onset of the patient's dermatitis was caused by a cross-reaction between the nickel in her flute [19] and the palladium in her dental



**Figure 3.** The amalgam removal procedure. A rubber dam and external suction were used in order to prevent the patient from swallowing any of the amalgam debris or inhaling any mercury vapor.



**Figure 4.** A small effect was seen about 1.5 months after the replacement of an amalgam filling with glass ionomer cement; however, the effect was insufficient.

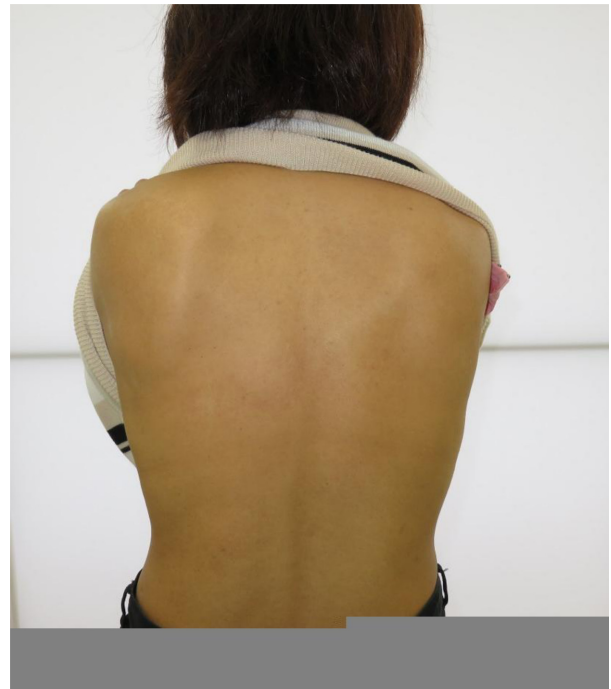


**Figure 6.** When all the metals were replaced (1 year and 3 months after the initial treatment), her skin condition improved dramatically.



**Figure 5.** After replacing three metal inlays (4 months after the initial treatment), her skin condition improved considerably.

metals. Her symptoms first began when she started to play the flute, which plausibly contained nickel, and her symptoms did not subside after she quit playing the flute. This suggests that the nickel was a catalyst but not the singular cause of her symptoms.



**Figure 7.** Fourteen years after the initial treatment, her skin condition showed even more improvement, although no other treatments were performed.

Wataha and Hanks reported that palladium has toxic and allergic effects on biological systems at sufficiently high ionic concentrations. Moreover, they reported that

palladium allergies almost always occur in individuals who are sensitive to nickel [20]. This suggests that a cross-reaction between palladium and nickel was a main factor in this case.

On the other hand, mercury contained in a dental amalgam filling may have also played a role. Throughout the history of dentistry, amalgam fillings containing approximately 50% mercury have been used despite being controversial. Recent evidence that amalgam fillings continuously release small amounts of mercury fuels this controversy [21]. The mercury concentration in the blood and urine of people with amalgam restorations is higher than that in people without them. It is widely accepted that mercury released from amalgams spread throughout the body [22, 23]. There are many reports of dermatitis caused by allergic reactions to the mercury present in dental amalgams [3–5, 12]. The subject's dermatitis improved only slightly when her amalgam filling was removed, suggesting that mercury had already entered the bloodstream, possibly causing mercury allergic reaction or toxicity. However, if that is the case, the subject's symptoms should have begun when the mercury entered her bloodstream.

In recent times, the author reported that dental amalgams act as an antenna, collecting harmful electromagnetic waves, resulting in electromagnetic hypersensitivity [18]. Moreover, electromagnetic waves emitted by cell phones have been reported to enhance allergic skin wheal responses [24]. Therefore, the mercury contained in the patient's amalgam may have collected harmful electromagnetic waves, thereby enhancing her allergic skin wheal response. Because of the timing of the onset of the subject's symptoms, this is more plausible than mercury allergic reaction or toxicity.

The percentage of eosinophils in the subject's hemogram (differential white blood count) was higher than the standard value (Table 1). This result suggests that she had allergic diathesis. However, her nonspecific immunoglobulin E antibody (IgE) level was 128 IU/mL (RIST), which is not abnormal because the normal value is <170 IU/mL. Furthermore, her specific IgE level of cedar pollen was high (RAST), but her symptoms were not aggravated during the season when cedar pollen scatters. Therefore, cedar pollen appears to be unrelated to her dermatitis.

The patch test to identify metallic allergens could not be performed because there was not enough skin to use for the test. Therefore, the author performed the O-Ring Test (Fig. 2) instead of the patch test.

Amalgam contains Ag, Sn, Cu, and Hg. The subject's other dental restorations and prostheses most likely contained Au, Ag, Pt, Pd, and Cu. The author replaced all of these metals with palladium-free alloy Aurofluid CPF (Au, Ag, Pt, Ir, Rh, and other), Zeometal 87 (Au, Pt, Zn,

and Ir), and glass ionomer cement Fuji IX (SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, polyacrylic acid, and other).

The results of her hair analysis showed normal levels of copper and aluminum. However, the level of mercury was very high (Table 3) [25]. This was most likely caused by mercury leaching out of the amalgam filling into her bloodstream. Both amalgam and palladium showed detrimental effects according to the O-Ring Test (Table 4). All things considered, the most suspicious metal was palladium. However, her atopic dermatitis may not have been caused solely by an allergic reaction. The hair analysis test also showed a high concentration of arsenic. Fish and shellfish contain the highest concentrations of arsenic, but the proportion of inorganic arsenic in fish is very low, below 1%. Arsenic in food is mainly in the form of organic arsenic, which is generally thought to pose fewer health problems than inorganic arsenic [26]. Japanese people tend to have a high intake of fish, so the value of the arsenic appears to be high. However, fish contains mainly organic arsenic, so the effect of the arsenic may have been minor.

## Summary

Severe intractable dermatitis improved dramatically after replacing a dental amalgam filling, all metal restorations and prostheses with palladium-free alloys. The dermatitis in this case was likely caused by a cross-reaction between nickel and palladium and was further exacerbated by a mercury-related allergic skin wheal response. In such cases, although the causes are in the oral area, the symptoms appear in the body. Special attention and cooperation between dentistry and medicine are required in these cases.

## Authorship

YF: performed conception and design and drafted and reviewed the manuscript.

## Conflict of Interest

None declared.

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