

Dental gold alloys and contact hypersensitivity

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A total of 172 patients referred to the Norwegian National Adverse Reaction Group were patch-tested with a dental series. Of these, 25% showed a positive reaction to gold sodium thiosulfate or potassium dicyanoaurate. There was a statistically significant correlation ($p=0.0019$) between the presence of dental gold and a positive patch test to gold. There was a statistically significant correlation between ear piercing and a positive patch test to gold ($p=0.04$). In most cases, we did not find clinical correlates to positive patch tests to gold. 2 patients with objective and subjective oral/perioral and general symptoms are described as case reports. Their symptoms disappeared when gold restorations were removed. We conclude that there is an overrepresentation of gold allergies among those with dental restorations containing gold.

Key words: contact dermatitis; gold sodium thiosulfate; potassium dicyanoaurate; patch tests; dental gold alloys; dental patients; relevance. © Munksgaard, 2000.

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In recent years, there has been increasing interest in the finding of positive patch tests to gold compounds (1–5). Ear piercing is considered a risk factor for gold sensitization (6). There remains debate as to whether materials sensitize via the mucosal route or whether there is only elicitation of pre-existing sensitivity (in those already sensitized) and induction of tolerance (in those who have not already been sensitized) (7). It is a matter of discussion whether exposure of contact allergens through oral mucosa can induce sensitization. Some authors claim that such exposure only can elicit an existing sensitivity (in individuals earlier sensitized through skin exposure), or induce tolerance in non-sensitized individuals. However, a significant overrepresentation of gold allergies among those with dental gold has been reported (4). Positive patch tests to gold were found in 8.5% of a group of 200 patients with persistent oral symptoms (2). For burning mouth syndrome (BMS), a possible etiologic role for local contact hypersensitivity has been suggested by some authors (2, 8–10). Patients with BMS complain of a burning sensation and/or pain in the oral mucosa and/or the tongue in the absence of any other specific disease (8, 11, 12).

Gold alloys used in jewelry and dental restorations are accepted as safe, non-sensitizing materials. Dental gold alloys contain various amounts

of gold, ranging from 65 to 97 weight% (ISO Standard 1562), and may contain platinum, palladium, copper, or silver.

A Dental Biomaterials Adverse Reaction Unit was inaugurated by the Norwegian Board of Health in 1992, partly as a response to public concern about the safety of dental amalgam. One of the purposes of the Unit was to see patients with potential adverse reactions to dental materials.

During the Unit's period of activity, we have observed several positive patch tests to gold salts in patients with suspect reactions to dental materials. We report 2 cases related to dental gold in which objective and subjective symptoms disappeared after removal of dental gold restorations.

The purpose of our study was to compare the frequency of positive patch tests to gold in patients admitted to the Unit, both those with and without dental gold and those with and without piercing. We also investigated whether BMS was associated with a higher frequency of positive patch tests to gold.

Case Reports

Case no. 1

A previously healthy 34-year-old woman complained of itching in the mouth, loss of taste, and a burning sensation of the oral mucosa. She also



Fig. 1. Case no. 1. Non-specific facial dermatitis.



Fig. 2. Case no. 2. Symmetrically distributed itchy lichenoid dermatitis on trunk and thighs.

had non-specific dermatitis on the face (Fig. 1). Her symptoms had persisted for some months and were increasing. Nearly 6 years earlier, she had received 5 dental inlays and 4 dental crowns made of high-gold alloys. She still had amalgam fillings as well as resin-based restorations. She had never



Fig. 3. Case no. 2. Mucosal lesion adjacent to the patient's only gold-containing restoration.

worn jewelry on a regular basis and had no history of medication with any gold compound. Patch tests with a dental screening series (Chemotechnique Diagnostics, Malmö, Sweden) and an additional patch test for potassium dicyanoaurate (PDCA) were positive to gold sodium thiosulfate (GSTS). Her symptoms decreased a few days after removal of some gold dental restorations. She became completely free of all symptoms, both subjective and objective, after replacement of all gold restorations with titanium/ceramics.

Case no. 2

A previously healthy 50-year-old man, who was first admitted to the Department of Dermatology, presented with itchy lichenoid dermatitis symmetrically distributed on the trunk and the thighs (Fig. 2). The dermatitis had lasted for about 1 year. The dermatologist also noted a mucosal lesion adjacent to his only gold-containing crown, which had an acrylic facing (Fig. 3). The restoration had been made 5 years earlier. The patient also complained of loss of taste, mucosal itching, and a burning sensation of the oral mucosa. The dental screening patch test revealed positive reactions to GSTS and PDCA. All symptoms and findings disappeared within 5 months after the crown had been replaced by a titanium crown. At follow-up 3 years later, he had no symptoms or lesions on the skin or mucosa.

Materials and Methods

From August 1993 to September 1997, 296 patients were referred to the Dental Biomaterials Adverse Reaction Unit at the University of Bergen for the evaluation of possible side-effects from dental biomaterials. Prior to admission to the Unit, their

Table 1. Patch test results (number of patients)

	With gold restorations	Without gold restorations	Whole group
patch tested	102	70	172
positive patch test to potassium dicyanoaurate (PDCA)	18	6	24
positive patch test to gold sodium thiosulfate (GSTS)	33	6	39
positive patch test to GSTS or PDCA	33	10	43
positive patch test to nickel	24	18	42
positive patch test to palladium	6	8	14
positive patch test to copper	1	1	2

physician and dentist had examined them. Patients ($n=172$) with a history of symptoms from the skin or the oral mucosa were examined by a dermatologist. Patch tests were performed with metals in polyethylene chambers (IQ Chambers, Chemo-technique Diagnostics, Malmö, Sweden). We used 0.5% gold sodium thiosulfate in petrolatum (GSTS) and 0.1% potassium dicyanoaurate in water (PDCA) as gold salts (5, 13). Additional metals tested were 5.0% nickel sulfate in petrolatum (Ni), 2.0% copper sulfate in petrolatum (Cu) and 2.0% palladium chloride in petrolatum (Pd). The chambers were removed after 2 days, and test sites were read after 3 and 6 days, according to the ICDRG criteria (14). The regional Medical Ethics Committee approved the study.

Dental investigation

Before patch testing, all patients underwent an oral and orofacial examination with a complete evaluation of teeth and mucosa, including a dental X-ray.

Medical examination

The patients underwent a medical examination consisting of a general clinical and dermatological examination, blood investigation, and the patch test described earlier. Blood analyses were performed to exclude other organic disorders. We analyzed hemoglobin, hematocrit, white blood cell count, s-ferritin, s-potassium, s-sodium, s-GOT, s-GPT, and s-creatinine. To estimate thyroid status, s-TSH (thyroid stimulating hormone) and s-T4 (free thyroxin) were measured.

Statistical methods

Medians were used to describe central tendencies. The correlation between single parameters was studied using Spearman Rank Correlation coefficients and χ^2 tests. Logistic regression analysis was applied to predict occurrence of a positive patch test to gold, regarding presence of dental

gold, age and sex. Resulting p -values less than or equal to 0.05 were considered statistically significant.

Results

In this study, 43 patients (25%) had a positive patch test to gold. A positive nickel reaction was found in 42 patients (25%). Dental restorations containing gold were present in 102 patients (59%); 32% of these had a positive patch test to one or both of the gold patch tests. Of the 70 patients without dental gold, 10 patients (14%) had a positive reaction to gold. The correlation between the presence of dental gold and a positive patch test to one or both gold salts was statistically significant ($p=0.0019$). 14 patients (8%) had a positive reaction to palladium (Table 1).

The frequency of earlobe skin symptoms from gold jewelry was higher in the individuals with a positive patch test to gold than in those with negative tests (24% versus 7%) (Table 2). There was a statistically significant correlation between pierced ears and a positive patch test to nickel ($p<0.001$) and to gold ($p=0.04$). Patients with a positive patch test to nickel were likely to react to palladium as well ($p=0.001$).

There was a predomination of females and older persons in the group with gold restorations (Table 3). Logistic regression analysis revealed that age and sex were insignificant variables ($p=0.41$ and 0.54), while the presence of dental gold was highly significant ($p=0.002$) in predicting the occurrence of a positive patch test to gold.

Patients with dental gold restorations had a significantly higher frequency of objective intraoral findings than did those without gold restorations (Table 2). Patients with a positive patch test to gold had a significantly higher frequency of intraoral stiffness and dysaesthesia, but there was no correlation between BMS and patch test results or the presence of dental gold. There was a negative correlation between orofacial symptoms and presence of dental gold (Table 2). Blood tests were within normal ranges.

Table 2. Correlation coefficients (Spearman rank correlation) with levels of significance (** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$) for gold sodium thiosulfate (GSTS) and potassium dicyanoaurate (PDCA); results from the PDCA patch testing reflect data from 59–69 patients; the other coefficients are based on data from 150–172 patients

Cu patch test	0.07	0.24*								
Pd patch test	0.14	0.12	0.17*							
Ni patch test	0.09	0.24*	0.07	0.38***						
with gold restorations	0.29**	0.17	−0.02	−0.10	−0.01					
pierced	0.17*	0.17	−0.02	0.15	0.30***	0.08				
symptoms from gold on earlobe	0.18*	0.15	0.12	0.09	0.24**	−0.04	0.31***			
symptoms from gold jewelry elsewhere	0.10	0.16	0.16*	0.07	0.13	0.08	0.23**	0.58***		
intraoral findings	−0.12	0.10	0.01	−0.01	−0.10	0.26***	−0.1	−0.09	−0.05	
intraoral symptoms	−0.01	−0.06	0.05	0.09	−0.04	−0.05	0.14	0.08	−0.05	0.17*
	GSTS patch test	PDCA patch test	Cu patch test	Pd patch test	Ni patch test	with gold restorations	pierced	symptoms from gold on earlobe	symptoms from gold jewelry elsewhere	intra-oral findings

Table 3. Age and sex distribution related to dental restorative materials (median values)

	With gold restorations	Without gold restorations	Whole group
sex male (number of patients)	21	26	47
sex female (number of patients)	79	46	125
median age (range)	49.9 (28–85)	40.9 (18–77)	46.0 (18–85)
teeth with gold restorations (range)	3.0 (1–15)	0	1 (0–15)
amalgam surfaces (range)	24 (0–62)	34.5 (0–66)	28.5 (0–66)

Discussion

We found a positive patch test to gold in 25% of patients tested. The patients tested were a referred group with a variety of complaints believed by the patients to be related to dental biomaterials. In this study, gold was the most common allergen before nickel. Other studies have shown a great variation (0.8%–10%) in the frequency of positive patch tests to gold salts in patients with contact dermatitis, when they are routinely patch tested (1, 4, 15, 16). The frequency of positive patch tests to gold in our study is still higher than that found by others, in spite of our broader inclusion criteria for patch testing.

In our study, there was a statistically significant correlation between the presence of gold in the oral cavity and a positive patch test to gold, as has also

been reported by others (4). Age and sex were insignificant variables in predicting the occurrence of a positive patch test to gold. When comparing different studies, variations in the frequencies of gold in the oral cavity correspond to differences in positive patch tests to gold (Table 4). Presence of gold in the oral cavity may be an important factor in explaining the higher frequency of positive patch tests to gold found in our study. This may indicate that dental gold is a stronger sensitizer than gold jewelry. However, further controlled studies are needed to confirm this.

The properties of dental gold, with regard to its solubility and maceration, are different from those of jewelry. The temperature in the mouth is higher than in the skin, which may enhance the reaction rate. Through food and drink, the gold restorations come in contact with chemicals (such as amino acids) that are able to produce metal salts (17). Saliva and mechanical wear of dental gold restorations may promote the release of highly insoluble gold (18). The fact that most patients with gold restorations also have dental amalgam restorations may contribute to an increased release of gold (19, 20).

A total of 24% of patients with positive patch tests to gold had or used to have symptoms associated with gold jewelry, mostly of the earlobes. The small amount of gold salts derived from gold jewelry may not, however, be sufficient to elicit al-

Table 4. Frequencies of positive patch tests related to presence of dental gold in different study populations

	Frequency of positive patch tests to gold	Frequency of dental gold in the population
Bergen (Norway) (present study)	25%	59% (102/172)
Malmö (Sweden) (4)	10%	30% (48/156)
West of Scotland (16)	2.1%	7% (25/373)
Portugal (15)	0.78%	0.6% (1/168)

lergic contact dermatitis in sensitized individuals. This may explain why the majority of patients with positive patch tests to GSTS did not react to skin exposure to metallic gold in daily life.

A correlation between pierced ears and a positive patch test to gold ($p=0.04$) was also found. This has also been shown by others, who pointed to pierced ears as a cause of contact allergy to gold (6). Skin samples taken from contact areas of gold jewelry contained gold, which is regarded as proof of absorption and which, secondarily, can cause sensitization (17).

In the present study, we found no correlation between BMS and a positive patch test to any of the metals used in the tests. Apart from stiffness/dysaesthesia and edematous changes, we found no correlation between a positive patch test to gold and oral or orofacial symptoms or objective findings.

A possible etiologic role for local contact hypersensitivity has been pointed out for BMS by some authors (2, 8, 10). It is reasonable to assume that at least some of the otherwise unexplained complaints bothering our patients may be explained by their hypersensitivity to constituents of dental biomaterials.

Observed correlations between the presence of dental gold and intraoral findings could not be explained.

Patients experiencing otherwise unexplained pain, itching, burning, or ulceration of the mucosa adjacent to cast-gold restorations should be suspected to have allergic contact reactions. Replacement should only be considered in patients with disabling symptoms, patients who respond insufficiently to therapy, and patients who have positive patch test reactions to dental metals. However, there is no certainty that the symptoms will disappear after removal of the allergens. The fact that most patients with a positive patch test for gold can carry gold restorations makes it very difficult to advise these patients. One should, however, be aware of the very few patients whose symptoms are relieved when their prostodontics are removed, even though such patients are rare.

Our case reports demonstrate 2 patients with local and general symptoms attributed to their gold restorations. Such patients are rare (21) and are only casuistically presented (22–25). Patients with objective reactions to dental biomaterials can present with systemic contact dermatitis, with or without stomatitis (26). The rapid absorption of gold through mucous membranes might be the reason that a systemic reaction rather than a local reaction occurs (27). This systemic contact dermatitis may also present as a flare-up of contact dermatitis related to finger rings or earrings (28). Patch test-

ing with GSTS is more often positive than is patch testing with PDCA. This is in accordance with other studies, which confirms that these tests were not false-positive (5, 29).

We conclude that there is an overrepresentation of gold allergies among those with dental restorations containing gold. We found no correlation between BMS and a positive patch test to gold. In our material, a positive patch test to gold is as common as one to nickel, but with few clinical implications. However, in our opinion, prospective studies are needed to evaluate the effect of replacing gold restorations with titanium or other materials in patients with positive patch tests to gold and with otherwise unexplained symptoms. This might reveal sub-populations of patients with relevant local oral symptoms or systemic contact dermatitis.

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