

## CLINICAL REPORT

# Contact Allergy to Gold is Correlated to Dental Gold

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**Questionnaire studies have indicated that patients with dental gold will more frequently have contact allergy to gold. This study aimed at investigating the relationship between contact allergy to gold and the presence and amount of dental gold alloys. A total of 102 patients were referred for patch testing because of suspicion of contact allergy. Patch tests were performed with gold sodium thiosulphate 2% and 5%. The patients underwent an oral clinical and radiological examination. Contact allergy to gold was recorded in 30.4% of the patients, and of these 74.2% had dental gold ( $p=0.009$ ). A significant correlation was found between the amount of gold surfaces and contact allergy to gold ( $p=0.008$ ), but there was no statistical relationship to oral lesions. It is concluded that there is a positive relationship between contact allergy to gold and presence and amount of dental gold alloys. Key words: eczema; dentures fixed partial; patch test.**

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Metallic gold, including jewellery alloys and dental gold alloys, has been widely accepted as a non-sensitizing material. Contact dermatitis to gold is therefore considered to be rare, as allergy to metallic gold has by tradition been difficult to demonstrate. However, Kligman found gold chloride to be a strong sensitizer in a human maximization test (1).

Fowler suggested that gold sodium thiosulphate (GSTS) 0.5% wt/wt in petrolatum would be a good screening preparation for tracing contact allergy to gold (2). This was later confirmed by Björkner et al. (3). Higher gold concentrations, such as 2.0% and 5.0% wt/wt in petrolatum, have been recommended (4).

After GSTS in 1991 was included in the standard patch test series at the Department of Occupational and Environmental Dermatology in Malmö, we found a remarkably high frequency of positive reactions, approximately 10%, in consecutive patients tested because of eczematous disease (3, 5). This finding made GSTS the second most common allergen after nickel

sulphate. One study indicated that gold allergy was overrepresented in patients having dental gold, suggesting that gold from dental restorations might be a significant sensitizer (5). This finding has been supported in two independent studies (6, 7).

The main aim of the present prospective study was to ascertain the suggested relationship between contact allergy to gold and the presence of dental gold alloys in the oral cavity. Further aims were to study if any dose-response relationship was to be found between the amount of dental gold alloy and the allergic reaction, and the possible correlation of gold alloy to symptoms and changes in the oral cavity.

## MATERIAL AND METHODS

### Patients

Patients from Malmö and immediate surroundings who were referred for suspicion of contact dermatitis were invited to participate in a parallel odontological study. Patients referred exclusively for oral complaints were not included. A total of 102 patients, 61 females and 41 males, with a mean age of 47 years (range 23–73) were included in the study. The Ethics Committee, Faculty of Medicine, Lund University, approved the study.

### Epicutaneous tests

The patients were patch-tested on the back with the European standard and the dental screening series (Chemotechnique Diagnostics, Tygelsjö, Sweden). Some patients had additional test series or patient-supplied materials. Test substances included in the standard series were excluded in the dental test series. In addition, 2.0% and 5.0% GSTS (wt/wt in petrolatum) was included, and Finn Chambers<sup>®</sup> (Epitest, Tuusula, Finland) were used. The patches were removed after 2 days by the patient and the readings done in the department on days 3 and 7 in accordance with the criteria of the International Contact Dermatitis Research Group (8).

### Odontological examination

A questionnaire was given to the patients on symptoms from the oral cavity, current dental treatment, and whether this treatment was routine or an emergency. Finally, smoking was noted.

The oral examination included registration of number of teeth and number of surfaces with reconstructions. One tooth in the posterior region of the oral cavity can have five covered surfaces, and in the anterior region four surfaces. We counted the number of surfaces of every tooth covered with gold. In addition, gold posts (i.e. the gold pin in a root canal) were registered.

The following materials were also registered: amalgam, composite or acrylic reconstructions, glass ionomer cement, gold alloys, ceramics, titanium and other alloys, including base-metal alloys (chromium, cobalt, etc.).

Clinical registration of oral mucosal lesions was carried out according to Roed-Petersen & Renshop (9) and also documented by photographs.

### Radiological examination

All patients had panoramic radiographs to confirm the clinical examination. Gold posts are easily detected because of their configuration and density. All the odontological examinations and analysis data were blind with regard to the outcome of the patch tests and vice versa.

### Statistics

We used Fisher's exact test, Pearson chi-square test, Spearman rank correlation and *t*-test depending on questions asked. A *p*-value of less than 0.05 was chosen as level of significance.

## RESULTS

### Contact allergy to gold

Contact allergy to gold was recorded in 31 (30.4%) of 102 patients. Twenty-three patients tested positively to 2.0% GSTS and 5.0% GSTS, and 8 patients tested positively to 5.0% GSTS only. There was no statistical relationship between gold allergy and allergens in the standard or dental screening series.

### Oral symptoms and lesions and contact allergy to gold

According to the questionnaire, 20 patients (19.6%) reported oral symptoms. Of patients testing positive to GSTS, 9 (29.0%) had symptoms from the oral cavity in contrast to 11 (15.5%) of the 71 patients without gold allergy. This difference was, however, not statistically significant ( $p=0.173$ , Fisher's exact test). Oral lesions were found in 46 patients (45.1%). Twelve (38.7%) of the patients allergic to gold had oral lesions, compared to 34 (47.9%) of those not allergic to gold.

We found no statistical relationship ( $p=0.517$ , Fisher's exact test) between the oral lesions and gold allergy. There was no relationship between localization of the gold alloys in the oral cavities, clinical changes in the oral mucosa and presence of gold allergy.

### Presence of dental gold alloy

Fifty-five patients (53.9%) had gold restorations covering from 4 to 84 surfaces. Forty patients (39.2%) had dental casting gold alloys, 49 patients (48.0%) metal-ceramic dental restorative systems and 39 (38.2%) patients gold posts. Two patients (2.0%) presented titanium reconstructions and 13 (12.7%) patients other alloys than gold, including base-metal alloys.

Eighty-eight patients (86.3%) had dental amalgam restorations, 85 patients (83.3%) composite restorations and 7 patients (6.9%) glass ionomer cement restorations.

Ten patients (9.8%) had all-ceramic dental reconstructions (Fig. 1).

### Contact allergy to gold and presence of dental gold alloy

Twenty-three (74.2%) of the patients with contact allergy to gold had dental gold ( $p=0.009$ , Fisher's exact test) compared with 32 (45.1%) patients with gold but no contact allergy to gold. When studying the number of gold surfaces in relation to contact allergy to gold, a statistical significance was found ( $p=0.008$ , Pearson chi-square) (Fig. 2). There was also a statistical relationship between contact allergy to gold and the number of teeth with gold posts ( $p=0.026$ , *t*-test).

When the presence of gold allergy was compared with the amount of dental gold alloy and tested with regard

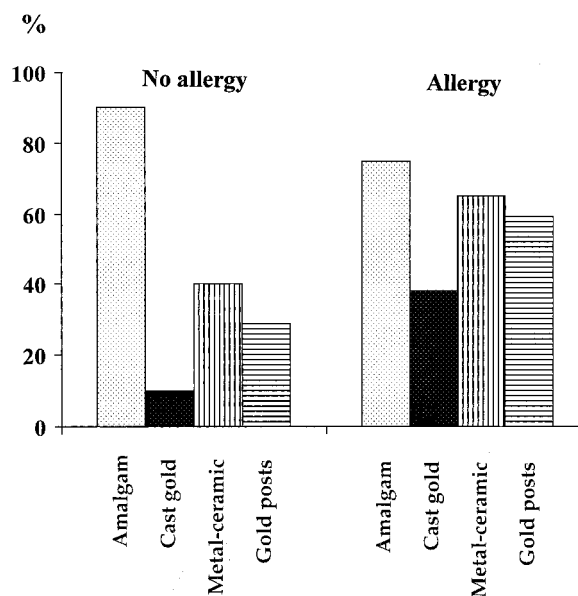


Fig. 1. Frequency of patients with (allergy) or without (no allergy) contact allergy to gold in relation to type of material in their dental restorations.

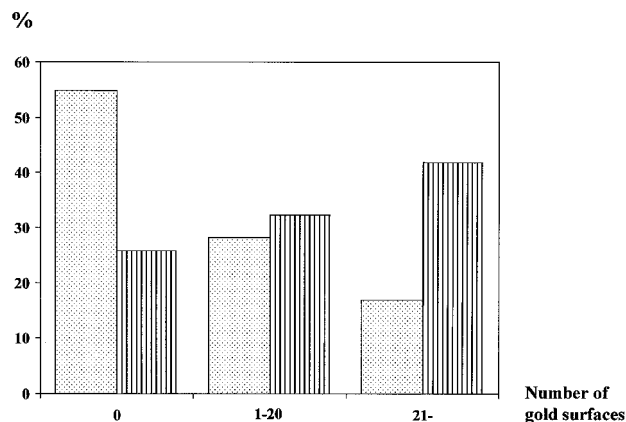


Fig. 2. Frequency of patients with (η) or without (φ) contact allergy to gold in relation to number of surfaces with dental gold restorations.

to gender, there was a statistically significant ( $p=0.018$ , Fisher's exact test) relationship among women but not among men. No significant difference was found in mean age between men and women in this material. The mean age was higher in the group with gold allergy than in the group without ( $p=0.04$ ,  $t$ -test). The mean age in the group with dental gold was 51.2 years while it was 35.6 years in the group without dental gold. There were no statistical significant differences in the number of gold surfaces between men and women.

Contact allergy to gold was found in 9 of 41 (22.0%) male patients and in 22 of 61 (36.1%) females. Thirty-five patients were smokers, and there was a statistically significant relationship between allergy to gold and smoking ( $p=0.002$ , Fisher's exact test). However, there was no correlation between smoking and presence of dental gold ( $p=0.673$ ).

## DISCUSSION

A high frequency of contact allergy to GSTS has recently been recorded in patients routinely patch-tested for eczematous disease (3, 5, 10, 11) and other studies have confirmed the allergic nature of the positive patch tests (12–14). It is still not known how the patients have become sensitized, but gold jewellery, ear piercing and dental gold have been discussed.

Clinical hypersensitivity to gold jewellery was not assessed in the present work. In a controlled experimental study (15), however, we have shown a statistically significant correlation between exposure to gold jewellery and skin reactions. In our previous questionnaire study, there was a statistically significant overrepresentation of gold allergy among those who according to the questionnaire had dental gold (5), a finding that initiated this study. Schaffran et al. (6) also confirmed this positive correlation between gold allergy and dental gold. The studies quoted can be criticized for their reliance on the patients' opinion alone, for the dermatologist's inspection demonstrating the presence of dental gold and for the absence of a radiological examination (5, 6).

Therefore, in the present study, dentists made the clinical oral and radiological examination of all patients because we wanted to elucidate the relationship between gold allergy and dental gold. Patients referred for oral signs and/or symptoms were therefore excluded, since their problem could be suspected as being connected with allergy to dental materials. In patients referred to a Dental Biomaterials Adverse Reaction Unit, Vamnes et al. (7) found, in an open study, 25% of the patients patch test positive to GSTS. There was a positive correlation between presence of dental gold restorations and development of positive patch test to gold. Their study thus differs from the present one, as the patients apparently were referred for oral, and not dermatological complaints.

The mean age was found to be higher in the positive patch test group, which agrees with a higher age of our patients with dental gold. When the amount of dental gold was compared with contact allergy to gold and gender, there was a statistical significance for women. The size of the material, however, did not allow a logistic regression analysis.

Both Nakada et al. (16) and Sabroe et al. (11) have shown a correlation between ear piercing and gold allergy. Fleming et al. (17) found no causal relationship between a positive patch test and dental gold, therapeutic gold or ear piercing. In 1998, Fleming et al. (18) studied dermatitis patients as well as a control group and found no differences between the groups with regard to atopy, exposure to gold jewellery, dental gold and therapeutic gold. In these two studies, there was a low frequency of dental gold, apparently less common in Scotland than in Sweden. No dentist's examination was performed in these two Scottish studies.

Among 35 smokers, we observed a statistical significance between allergy to gold and smoking. However, there was no correlation between smoking and presence of dental gold. This indicates a factor independent of dental gold but of possible significance for the sensitization process. Previous studies on rheumatoid arthritis patients treated with gold have also shown differences between smokers and non-smokers. Smoking increases the uptake of gold into erythrocytes (19, 20) and one study showed a higher incidence of gold dermatitis in smokers following chrysotherapy (19).

All dental cast-metal alloys except titanium may cause side effects (21). Kratzenstein et al. (22) have shown that both low and high gold alloys corrode, leaving corrosion products including gold and palladium in surrounding tissue. No *in vivo* studies have been carried out indicating the release of ionic gold from dental reconstructions in contact with amalgam, but an *in vitro* study (23) suggests attacks of corrosion on gold crowns in contact with amalgam.

According to Flint (24), the electrochemical nobility of gold ensures that the pure metal is unlikely to react to sweat or saline solutions unless the solutions are contaminated with complexants or powerful oxidizing agents. Consequently, as expected, no release of gold could be detected when metal release from gold jewellery stored in artificial sweat was analysed (25). The corrosive media involved in sweat and in saliva are not comparable, but Brown et al. (26) have shown that gold can be absorbed across skin into blood in hairless rats, and that raising the pH increases the solubility of gold in solutions of thiol-containing ligands. The mechanisms of corrosion are not yet fully elucidated. Björkman et al. (27) found that gold is released into the saliva from dental high gold alloys and that individuals with high gold inlays and crowns are thus exposed to the metal. Further studies are in progress in our departments to

establish a possible relationship between the presence of dental gold alloy and blood concentration of gold.

In summary, the results of this study have conclusively shown a relationship between contact allergy to gold and the presence of dental gold as well as a dose-response relationship. As patients with a suspected allergic contact dermatitis were included while patients referred for oral lesions or complaints were excluded, these facts strongly suggest that dental gold plays a role in the sensitization process for gold.

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