

# Dental Patch Test Results and Clinical Relevance: 10 Years of Retrospective Experience

Oguz Yilmaz, Asli Bilgic, Soner Uzun

Faculty of Medicine, Department of Dermatology and Venereology, Akdeniz University, Antalya, Turkey

## Abstract

**Background:** Patch testing with dental screening series [dental patch test (DPT)] is used to detect triggers for mucositis and/or oral lichen planus as well as to detect contact sensitization due to substances and restorative materials used mostly in dentistry. **Aim:** We aimed to retrospectively evaluate the DPT results performed in our clinic in the last 10 years and to assess their clinical relevance. **Methods:** Data of 127 patients who had DPT in our allergy unit between January 2010 and July 2020 were included in our study. In our clinic, DPTs were applied to patients mostly when they have history of metal allergies, oral lichen planus especially close to dental materials, chronic mucositis, and history of allergy after dental procedures. The forms routinely used in our allergy unit were examined retrospectively. **Results:** The most common five allergens were nickel (II) sulfate hexahydrate (29.9%), palladium chloride (18.9%), sodium tetrachloropalladate (II) hydrate (18.9%), gold (I) sodium thiosulfate dihydrate (12.6%), and mercury (10.2%). Fifty-eight of 71 patients with positive PT had a current relevance according to the COADEX coding system ( $P < 0.05$ ). Of the 38 individuals with nickel sensitization, 36 were females and 2 were males, and this result was statistically significant ( $P = 0.034$ ). **Conclusion:** Nickel, palladium, sodium tetrachloropalladate, gold, and mercury, which are frequently found in dental prosthesis and materials, were the most common allergens in our study and this is in accordance with the literature.

**Keywords:** COADEX, dental serial patch test, mucositis, oral lichen planus

## INTRODUCTION

Allergic contact dermatitis (ACD) is a delayed type (type IV) hypersensitivity reaction caused by substances in contact with the skin in previously sensitive individuals. Patch test (PT) is the most important diagnostic method to confirm the diagnosis of ACD, and it enables us to find the cause of contact allergy.<sup>[1]</sup> European Standard Serial Patch Tests (ESS PTs) were created by bringing together the most common contact allergens in daily life. Generally, only 80% of common allergens can be detected with ESS PT.<sup>[2]</sup> Due to the need for different allergen series for the detection of specific allergens, besides the standard series, other special patch test series (dental, cosmetic, medicine, etc.) compatible with the patient's profession, location of dermatitis, and/or clinical findings are also used. Patch testing with dental screening series [dental patch test (DPT)] is used to detect triggers for mucositis and/or oral

lichen planus as well as to detect contact sensitization due to substances and restorative materials used mostly in dentistry.<sup>[3,4]</sup>

In our study, we aimed to retrospectively evaluate the DPT results performed in our clinic in the last 10 years and to assess their clinical relevance.

## MATERIALS AND METHODS

Data of 127 patients who had DPT in our allergy unit between January 2010 and July 2020 were included in our study. In our clinic, DPTs were applied to patients mostly when they have history of metal allergies, oral lichen planus especially close to dental materials, chronic mucositis, and history of allergy after dental procedures.

**Address for correspondence:** Dr. Asli Bilgic,

Faculty of Medicine, Department of Dermatology and Venereology, Akdeniz University, H bloc, 1st Floor, 07059 Konyaalti, Antalya, Turkey.

E-mail: aslibilgic@akdeniz.edu.tr

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The forms routinely used in our allergy unit were examined retrospectively, and the sociodemographic data of the patients, history of atopy, accompanying diseases, DPT results, and clinical relevance evaluated with the COADEX coding system were analyzed.<sup>[5-8]</sup> Patients with positive reactions in DPT were also tested with the relevant materials provided by their dentists as pure metal plaques and/or ready-to-use material. Our study was approved by the Faculty of Medicine, Akdeniz University, Clinical Research Ethics Committee (70904504/461).

**Application of DPT:** Patients who underwent DPT were not receiving topical steroid treatment for at least 1 week and systemic steroids for 2 weeks before the DPT. The DPT materials routinely used in our allergy unit are allergens imported from Chemo Technique Diagnostic (Malmo, Sweden), and their names and locations are shown in Table 1. The IQ Chambers unit consisting of 10 small squares of 9 × 9 mm size made of plastic was used to apply the test substances to the skin. The upper back of the patient was used as the test area. DPTs were duly done, and positive reactions were interpreted by a doctor with sufficient experience and were classified according to the criteria of the International Contact Dermatitis Working Group (ICDWG).<sup>[1]</sup> The DPT was considered positive if at least 1+ reaction was detected against any substance.

Data were evaluated statistically by using SPSS for Windows version 23.0 software program. Measurable variables were presented as mean ± standard deviation, and categorical variables as numbers and percentages. Pearson's  $\chi^2$  and Fisher's exact  $\chi^2$  test, among other statistical methods, were used.  $P < 0.05$  was considered statistically significant.

## RESULTS

In our study, a total of 127 patients [107 (84.3%) were females and 20 (15.7%) were males] who underwent DPT between January 2010 and July 2020 were identified. The average age was  $51.3 \pm 12.92$  (age range 7–81) years. The mean duration of complaints was  $47.35 \pm 81.03$  months. Forty patients (31.5%) had a history of personal atopy, 23 (18.1%) had a history of familial atopy, and 52 (40.9%) had a history of known contact dermatitis. The most common five allergens were nickel (II) sulfate hexahydrate (29.9%), palladium chloride (18.9%), sodium tetrachloropalladate (II) hydrate (18.9%), gold (I) sodium thiosulfate dihydrate (12.6%), and mercury (10.2%) [Table 2].

Fifty-eight of 71 patients with positive DPT had a current relevance according to the COADEX coding system ( $P < 0.05$ ) [Table 3]. Out of the 38 individuals with nickel sensitization, 36 were females and 2 were males, and this result was statistically significant ( $P = 0.034$ ). Mercury and palladium chloride sensitization were significantly more frequent in patients with a known history of contact dermatitis ( $P = 0.029$  and  $P = 0.004$ , respectively). No

relationship was observed in terms of personal atopy, familial atopy, presence of accompanying autoimmune diseases, hobbies, or professions with any allergen sensitivity. Most of the patients were housewives ( $n = 79$ , 62.2%). The professions of the individuals in our study are shown in Table 4.

In our study, a significant relationship was found between all five most frequently detected allergens and their current relevance according to the COADEX coding system ( $P < 0.05$ ). COADEX coding results are shown in Table 3. None of the 127 patients had an allergic reaction to camphor quinone, caruon, methacryloxyetoxyphehil, drometrizole, and glutaral.

## DISCUSSION

Contact dermatitis and sensitization (mucositis or stomatitis) of the oral mucosa are relatively rare. As the oral mucosa is constantly washed with saliva, the sensitizers are continuously cleared from the mucosal surface and prolonged contact is prevented. The dense vascular structure of the mucosa also provides quick cleansing and rapid absorption of the allergen.<sup>[9,10]</sup> Allergic reactions or sensitization in the oral mucosa may represent with different symptoms and signs such as erythematous, erosive, lichenoid, hypertrophic stomatitis/lesions, and/or burning mouth.

The most important allergens are basically metals used in dental treatment and dental prosthesis materials. Apart from these, mouthwashes, toothpastes, chewing gum or aromatic fragrances in foods and beverages, cinnamon, mint flavorings, preservatives, antiseptics, antibiotics, active ingredients, or formulations of topically used medications (mouthwash, sprays, gels) can also cause allergic contact sensitization in the oral mucosa.<sup>[9,10]</sup>

In our study, nickel, palladium, sodium tetrachloropalladate, gold, and mercury, which are often found in dental prostheses and materials, were the most common allergens consistent with the literature.<sup>[9-15]</sup> The most common allergen was determined to be nickel (II) sulfate hexahydrate. Nickel is found in many areas of daily life such as materials (metal buttons, zippers, metal and shoe paints, spectacle frames, etc.); it is also found in dental prostheses. Although nickel has a high potential for allergy, the risk of allergy formation of high-quality dental nickel–chromium alloys is less than allergy due to food or booger.<sup>[16,17]</sup> It is recommended to use only alloys with a chromium or molybdenum content above 20% in nickel–chromium alloys, as this ratio is necessary for resistance to corrosion. As the ion release of corrosion-resistant alloys is lower, nickel in these alloys is not expected to cause contact sensitization.<sup>[16,18]</sup> However, if the person has a nickel allergy, it is recommended to completely avoid the use of nickel–chromium alloys in dental materials and prostheses. Palladium chloride, which is the second most common allergen in our study, is used especially in dental metal alloys,

**Table 1: Dental serial patch test materials and areas of use (<https://www.chemotechnique.se/>)**

Dental materials—components	Area of use
1. Methyl methacrylate	A methacrylic monomer in plastics for dentures, bone cement, artificial nails, hearing aids, etc.
2. Triethylene glycol dimethacrylate	A methacrylic monomer used as cross-linking agent for adhesives and dental restorative materials.
3. Urethane dimethacrylate	A methacrylate based on a methacrylate aliphatic isocyanate. Used in dental bonding agents, resin veneering, and restorative materials
4. Ethylene glycol dimethacrylate	A cross-linking methacrylic monomer in dental composites, sealants, prostheses, adhesives, artificial nails, etc.
5. Bisphenol A glycerolate dimethacrylate	Common methacrylic monomer in dental composite restorative materials and dental sealants.
6. N,N-dimethyl-4-toluidine	An amine accelerator for the polymerization of e.g., dental methacrylic restorative materials.
7. Benzophenone-3	Common UV-adsorber in dental composite materials and other plastic materials. Used as a UV-adsorber in topical sunscreens, lipsticks, lip balms, nail polish, etc.
8. 1,4-Butanediol dimethacrylate	A cross-linking methacrylic monomer for use in dental composite materials, sealants, prostheses, etc.
9. Bisphenol A dimethacrylate (BIS-MA)	Methacrylic monomer based on bisphenol A. Used in dental restorative composite and adhesive materials.
10. Potassium dichromate	This hapten is a marker for contact allergy to chromium.
11. Mercury	Is a chemical reagent and can be found in thermometers and dental amalgam, but also in pharmaceuticals, antifouling paints, agricultural chemicals.
12. Cobalt (II) chloride hexahydrate	This hapten is a marker for contact allergy to cobalt. Used in various alloys (dental, etc.).
13. 2-Hydroxyethyl methacrylate	A methacrylic monomer used in UV-inks, adhesives, lacquers, dental materials, artificial nails, etc.
14. Gold(I) sodium thiosulfate dihydrate	A gold derivative used for screening of contact allergy to dental gold materials.
15. Nickel (II) sulfate hexahydrate	Nickel metal: a common hapten present in nickel plating for alloys, dentures, orthopedic plates, spectacle frames, etc.
16. Eugenol	Used as fragrance in perfumery as substitute for oil of cloves. Dental analgesic in impression materials and periodontal packings.
17. Colophonium	A yellow resin used as a component in dental impression materials and periodontal packings (rosin).
18. N-Ethyl-p-toluene sulfonamide	A resin carrier found in dental materials used for isolating cavities below restorations.
19. Formaldehyde	Used in the production of urea, phenolic melamine, and acetate resins. Used as anti-cracking agent in dental plastics.
20. 4-Tolyldiethanolamine	An amine accelerator for the polymerization of, e.g., dental acrylic composite restorative materials.
21. Copper (II) sulfate pentahydrate	This hapten is a marker for contact allergy to copper. Copper metal is used in, e.g., dental alloys.
22. Methyl hydroquinone	A stabilizer and antioxidant in acrylic monomers to prevent polymerization.
23. Palladium (II) chloride	This hapten is a marker for contact allergy to palladium. A chemical catalyst. Can be found in dental alloys.
24. Aluminum (III) chloride hexahydrate	This hapten is a marker for contact allergy to aluminum. Found in dental ceramics and topical astringents.
25. Camphor quinone-Bornane dione	An initiator for visible light-cured dental acrylic composite materials.
26. Dimethyl aminoethyl methacrylate	Used as amine activator in visible light-cured dental acrylic composite materials.
27. 1,6-Hexanediol diacrylate	A common acrylic monomer in dental composite materials.
28. Drometrizole	A UV-adsorber used in plastics, cosmetics, dental materials, acrylic materials, dyes, etc.
29. Tetrahydrofurfuryl methacrylate	A methacrylic component used in dental materials such as crown and bridge products. Also used as a component in artificial nails.
30. Tin	Metal used in tin plating, soldering and dental alloys, collapsible tubes.
31. Sodium tetrachloropalladate (II) hydrate	This hapten is a marker for contact allergy to palladium. It is an inorganic compound used in among other things in chemical synthesis as a catalyst. It is present in many alloys containing palladium.
32. Carvone %5.0	Found in several essential oils and is used for flavoring liqueurs, soaps, dental materials, and perfumes.
33. 2,2-bis(4-(2-methacryloxyethoxy)phenyl)	A methacrylic monomer based on bisphenol A. Used in dental restorative composite materials and as a reactive monomer in adhesive products.
34. Glutaral %0.2	Used in the sterilization of endoscopic instruments, dental, and barber equipment. Also known as glutaraldehyde.

electronics, medicine, and electroplating in jewelry. The incidence of palladium allergy is controversial. It is claimed that people with nickel allergy may often develop allergic reactions to the palladium.<sup>[19]</sup> Sodium tetrachloropalladate

(II) hydrate is the third most common in our series. It is suggested that patch testing with this material is more useful in detecting palladium contact sensitization than testing with palladium chloride.

Other common allergens in our study were gold (I) sodium thiosulfate dihydrate, which is a gold material in dental prosthesis, and mercury, which is a chemically reactive agent and is used in pharmacology, thermometers, the chemical industry, and dental amalgams. The degree of allergic potential of gold is controversial, and it is claimed that allergic reactions developed due to some irregularities in test materials. In the last decades, gold alloys are considered as rare allergens in the medical field.<sup>[20]</sup> Mercury and mercury compounds are the most common causes of amalgam-mediated allergy, and other metals in amalgam content are rarely blamed for amalgam sensitization. Dental amalgam is the restoration material that has been used in routine filling in dentistry since the beginning of the last century. It is formed by mixing metal powders such as silver (Ag), copper (Cu), zinc (Zn), tin (Sn) with mercury (Hg).<sup>[14,21,22]</sup> Three different reactions have been described, namely, type 4 hypersensitivity, toxic reaction, acute or generalized hypersensitivity associated with amalgam.<sup>[20,22,23]</sup> The most common reaction due to amalgam is lichenoid-type contact stomatitis that develops in the vicinity of amalgam.<sup>[23,24]</sup> In the studies conducted, it has been found that there is a strong anatomical proximity

between the filling and the lesion in 70% of the patients with a positive reaction due to amalgam. DPT should be especially considered in the presence of treatment-resistant lichen planus or mucositis, lesions adjacent to the dental materials, and asymmetrical distribution.<sup>[21,24]</sup> Toxic reactions are associated with the direct contact of amalgam filling and its components to the oral mucosa for years. It also occurs frequently in fillings with high zinc content. Toxic reactions and the clinical findings resulting from type 4 hypersensitivity reaction cannot be distinguished from each other. However, it is thought that the negative result of DPT can be interpreted in favor of a toxic reaction.<sup>[21]</sup>

Apart from this, hypertrophic allergic contact stomatitis can also occur with other metals with frequent sensitivity (nickel, palladium, gold, copper, and cobalt).<sup>[3,14]</sup> Due to the retrospective nature of our study, we could not make a clear interpretation between the allergens we detected and the clinical type of stomatitis in the mucosa, as detailed clinical examination of the oral mucosa of patients could not be reached from patient files.

In our unit, especially in patients who were consulted by the dentists for allergic sensitivity to dental prostheses and materials, the metal content of existing dental materials was determined or metal plate samples belonging to these materials were obtained from dentistry, and DPT was tested along with these materials. This application enabled the appropriate evaluation according to the COADEX coding system and the current relevance with the five most common allergens was found to be statistically significant. In cases diagnosed with ACD and/or stomatitis, not

**Table 2: The most common five allergens**

Allergens	Patients, n (%)
Nickel (II) sulfate hexahydrate	37 (29.9)
Palladium chloride	24 (18.9)
Sodium tetrachloropalladate (II) hydrate	24 (18.9)
Gold (I) sodium thiosulfate dihydrate	16 (12.6)
Mercury	13 (10.2)

**Table 3: Results of the COADEX coding system for assessing clinical relevance**

COADEX coding system	Patients, n (%)
Current relevance (the patient has been exposed to allergen prior to the current episode of dermatitis and improves when the exposure ceases)	58 (45.7)
Old/past relevance (past episode of dermatitis from exposure to allergen but not encountered before present relapse)	2 (1.6)
Exposed (a history of previous exposure but not resulting in dermatitis from that exposure)	7 (5.5)
Doubtful relevance (relevance difficult to assess, no traceable relationship between the positive test and the disease)	4 (3.1)
Negative (no reaction detected)	56 (44.1)

**Table 4: Professions of patients who underwent dental serial patch test**

Profession	Patients, n (%)
Housewife	79 (62.2)
Other (social occupations, shop, market, etc.)	17 (13.4)
Office work	6 (4.7)
Scientific-academic (engineering, lawyer, teaching, psychologist, journalism, journalism)	5 (3.9)
Metal worker, turner, jeweler	5 (3.9)
Farmer	5 (3.9)
Health worker (dentist, doctor, nurse, veterinarian, etc.)	4 (3.1)
Chef, baker	3 (2.4)
Student	2 (1.6)
Carpenter	1 (0.8)

only performing PT to determine the cause, but more importantly revealing the relationship of PT results and clinical relevance is one of the most important steps. For this purpose, the use of standardized evaluation methods is very important because it allows more accurate interpretation of test results, better statistical comparisons via using common evaluation criteria in studies, and determination of the true relationship between allergens and clinical findings.

Considering contact with dental materials, if a positive reaction is detected in the DPT, the responsible dental metal and materials must be removed, and oral lesions are expected to regress after the removal of the responsible material. The DPT is not a 100% reliable test, and false positive reactions have been reported, albeit at a low rate (3.2%).<sup>[9]</sup> Therefore, positive reactions should be evaluated using the COADEX coding system. Thus, determining the relationship between the clinical findings and allergens will guide the intervention and treatment attempts to be made after the PT.

Due to the retrospective nature of our study, the number of patients included in the analysis was relatively low. Other limitations were insufficient information about the mucosal clinical findings (stomatitis, lichen planus, etc.) obtained from the files, being without a control group, and the follow-up information of all patients could not be reached during the follow-up.

The results of DPT performed in our clinic were found to be compatible with the current literature. DPT, which is a non-invasive and practical method, is useful to identify the contact allergy of dental restoration before any procedures are planned if there is a suspicion of contact allergy.

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### Conflicts of interest

There are no conflicts of interest.

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