

Occupational airborne allergic contact dermatitis from methacrylates in a dental nurse

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Background: There are very few reports of airborne allergic contact dermatitis from methacrylates.

Objectives: To report a dental nurse with facial eczema supposedly caused by airborne methacrylates present in the work environment.

Methods: Patch testing with serial dilutions of several methacrylates and work provocations in environments containing methacrylates was performed.

Results: Patch testing with serial dilutions of several methacrylates disclosed a high patch test reactivity. Repeated provocations when working with methacrylates resulted in facial eczema that resolved out of work. Attempts to collect the sensitizers using air pumps for the collection of vapors and filters for the collection of air-born aerosols failed.

Conclusions: The clinical presentation was that of a facial dermatitis due to airborne exposure to methacrylates. It seems likely that 1 or several of these allergens caused the dermatitis.

Key words: airborne; allergic contact dermatitis; 2,2-bis(4-[2-hydroxy-3-methacryloxypropoxy]phenyl)-propane; dental clinic; ethylene glycol dimethacrylate; methacrylates; methyl methacrylate; occupational; triethyleneglycol dimethacrylate; volatile. © Blackwell Munksgaard, 2007.

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Dental personnel are at risk of developing acrylate and methacrylate allergy (1, 2). The clinical presentation is almost always that of a fingertip eczema, but facial eczema has been reported to occur (3), even without hand eczema (1, 2). The cause has been said to be mainly contamination by hands (4) but also supposedly airborne (5, 6), even through methacrylic vapours (7). Here, we report a dental nurse who developed a facial allergic contact dermatitis from methacrylates present in the work environment, supposedly airborne.

Case Report

A 51-year-old woman had worked for the last 31 years as a dental nurse. She had hand eczema as a child but cleared during puberty. In 1985, her hand eczema reappeared, and she was patch tested. She reacted to nickel, cobalt, myroxylon pereirae, perfume mix, colophony, epoxy resin, formaldehyde, quaternium-15, and budesonide. However, her contact allergies were considered

irrelevant for her hand eczema, which was considered as irritant, that is even if consequently avoiding the positively tested allergens, her hand eczema persisted during work periods, and during vacation she improved substantially. Since then, she has worked 20 hr a week (8 hr/day Monday and Tuesday and 8 hr/day every other Wednesday), which is 50% compared with what she did before. Despite the reduction in working hours, she still suffered from mild hand eczema. Because of continuous hand eczema, she was 3 years later patch tested to a dental series including methyl methacrylate (MMA), 2,2-bis(4-[2-hydroxy-3-methacryloxypropoxy]phenyl)-propane (bis-GMA), triethylene glycol dimethacrylate (TEGDMA), and ethylene glycol dimethacrylate (EGDMA) but not including 2-hydroxyethylmethacrylate (2-HEMA), because as a dental nurse, she worked with products containing various methacrylates and prepolymers present in the dental series. The test was negative. 2 months before presentation in our clinic in May 2002, she developed

a severe facial eczema with oozing and crusts during 1 working week, but it had been preceded by an erythema on the neck for 2 months. The patient was then seen by another dermatologist, was given internal and topical corticosteroids in addition to internal antibiotics and was put on sick leave for 14 days. When returning to work, she was free of eczema. Already within 2 days of working, however, the eczema relapsed, and she was again put on sick leave. A skin punch biopsy was also performed from the face, showing a spongiotic dermatitis corresponding to eczema. She was also patch tested to the Swedish standard series and a dental series with several positives. Still on sick leave, she was referred to us. At presentation in our clinic, her facial status was normal, but a slight dermatitis was present on some lateral fingers.

At our clinic, she was patch tested to our standard series, that is the Swedish standard series plus some additional allergens and a dental personnel series with readings on D3 and D7. Finn Chambers[®] (Epitest Ltd, Tuusula, Finland) on Scanpor[®] tape (Norgesplaster A/S, Vennesla, Norway) were used for the patch tests. The test chambers were left on the back for 2 D. Additional testing on D3 was performed to formaldehyde 2.0% aqua because of a questionable reaction to 1.0% aqua and a brake down series of the perfume mix. Positive results are shown in Tables 1 and 2. A prick test to latex was negative. The patient claimed that she could hardly enter the dental office without getting a facial rash and prickly sensation of the face. A work visit disclosed the office to be a 3 room flat with natural ventilation. The dentist worked with 2 dental nurses, each working 20 hr/week. A work provocation was performed, that is the patient worked for 8 hr assisting the dentist, who had around

Table 2. Positive patch test reactions on D3 and D7 in the dental personnel series^a

Substance	Concentration %	D3	D7
Methyl methacrylate	2.0	+	+
TEGDMA	2.0	+	+
EGDMA	2.0	++	+
bis-GMA	2.0	++	++
2-HEMA	2.0	++	+++
1,4-butanediol dimethacrylate	2.0	+	+
N,N-dimethylaminoethyl methacrylate	0.2	+	+
Tetrahydrofurfuryl methacrylate	2.0	+	+

bis-GMA, 2,2-bis(4-[2-hydroxy-3-methacryloxypropoxy]-phenyl)-propane; EGDMA, ethylene glycol dimethacrylate; 2-HEMA, 2-hydroxyethyl methacrylate; pet., petrolatum; TEGDMA, triethyleneglycol dimethacrylate.

^aAll substances were tested in petrolatum.

25 patients during the day. Most of these patients were treated with bonding materials and dental composite resins based on methacrylates and the prepolymer bis-GMA. When finishing work that day, the patient had no facial erythema, but in the evening, she felt pruritus around the eyes, and in the middle of the night, she woke up with periorbital and perioral erythematous oedema. The same morning, she was seen by us (Figs 1 and 2) and given internal corticosteroids in tapering doses over 6 days that led to complete recovery. A complementary test series including work materials and serial dilutions of some of the methacrylates and a methacrylated prepolymer the patient

Table 1. Positive patch test results on D3 and D7 to substances in the standard series and some additional allergens

Substance	Concentration (%)	Vehicle	D3	D7
Methyldibromoglutaronitrile	1.0	Pet.	+	—
Isoeugenol	2.0	Pet.	++	ND
Formaldehyde	2.0	Aq.	++	ND
Textile colour mix	3.2	Pet.	+	
Cobalt chloride	0.5	Pet.	++	++
Nickel sulfate	5.0	Pet.	++	+++
Colophony	20.0	Pet.	++	++
Epoxy resin	1.0	Pet.	++	++
Myroxylon pereirae	25.0	Pet.	++	++
Fragrance mix	8.0 × 1.0	Pet.	+	+
Budesonide	0.01	Pet.	—	++
Bisphenol F resin	0.25	Pet.	++	++

aq., aqua; ND, not done; pet., petrolatum.



Fig. 1. Facial dermatitis with oedema and erythema in the dental nurse after the work provocation.



Fig. 2. Erythema and slight scaling on the neck after the work provocation.

had allergy towards were later patch tested to find out the level of reactivity (Table 3) (Fig. 3). Exact information on the composition of the dental composite resins was very difficult to obtain and from 1 company impossible, but we were informed they contained bis-GMA and di- and trimethacrylate resins, and 1 resin contained TEGDMA. Using the same test system as before, we also tested her to several work materials such as a lubricant, a corrosion inhibitor, disinfectants, cleaning agents, and peppermint and spearmint oils with negative results. Because we were uncer-

Table 3. Positive patch test reactions on D3 and D7 to serial dilutions of a methacrylic prepolymer and methacrylates present in the work materials and a dentin bonding product containing 2-HEMA

Substance	Concentration %	Vehicle	D3	D7
bis-GMA	2.0	Pet.	+++	++
	0.2	Pet.	+++	++
	0.02	Pet.	+++	++
	0.002	Pet.	—	—
TEGDMA	2.0	Pet.	+++	++
	0.63	Pet.	++	+
	0.2	Pet.	++	+
	0.06	Pet.	—	—
EGDMA	2.0	Eth.	+++	+++
	0.2	Eth.	+++	+++
	0.02	Eth.	++	++
	0.002	Eth.	—	—
2-HEMA	2.0	Eth.	+++	+++
	0.2	Eth.	+++	+++
	0.02	Eth.	+++	+++
	0.002	Eth.	—	—
Prime & Bond [®] NT [™]	6.0	Eth.	+++	++
	1.9	Eth.	+++	++
	0.6	Eth.	—	—

bis-GMA, 2,2-bis(4-[2-hydroxy-3-methacryloxypropoxy]-phenyl)-propane; EGDMA, ethylene glycol dimethacrylate; 2-HEMA, 2-hydroxyethyl methacrylate; eth., ethanol; pet., petrolatum; TEGDMA, triethyleneglycol dimethacrylate.



Fig. 3. Results from patch testing to 2,2-bis(4-(2-hydroxy-3-methacryloxypropoxy)phenyl)propan (2.0%, 0.2%, and 0.02%, bottom left), triethyleneglycol dimethacrylate (2.0%, 0.63%, and 0.2%, top middle), and a dentin bonding product containing 2-hydroxyethyl methacrylate (6.0%, 1.9%, and 0.6%, top right).

tain if her contact allergy to the methacrylates was the cause to her seemingly airborne dermatitis, we tried to collect methacrylates or other airborne materials from the working environment. To do this, we set up air pumps equipped with XAD-2 sorbent tubes for the collection of vapours and teflon filters with a pore size of 1 μ m for the collection of air-born aerosols at the dental office close to the dentist's and her working area and also collected dust samples from several places in the office where the patient worked. The collected samples represented an air volume of around 0.5 m³. Patch testing with filters as such and extracts of filters and sorbent tubes in addition to extracts of dust followed with 1 positive reaction (++) to a dust extract test from a desk top. To further elucidate the reaction, a new set of dust extracts were tested but with negative results.

To see whether working in another dental office with the same type of acrylic/methacrylic materials would cause dermatitis, a new work provocation was performed. The patient spent 2 days in a 2-dentists office, the 1st day mostly assisting at root canal fillings when no methacrylates were used and on the 2nd day mostly assisting during plastic fillings when methacrylates are always used, being in close vicinity to the dentist and his client. She did not experience any skin complaints during the 2 provocation days, but the following night she woke up because of facial pruritus, and the next day she noticed a slight oedema around the eyes. The following day (2 days after the provocation ended), she presented with an erythema and oedema periorbitally and on the upper lip and a central erythema of the face.

She also experienced facial pruritus and stinging. The hands were unaffected. Because of her work-related dermatitis, she had to cease working as a dental nurse. Attempts to find a new job has failed, and she is thus retired.

Discussion

It is well known that dental personnel are at risk of developing methacrylate allergy (1, 2). The typical clinical presentation is a pulpitis that may be difficult to heal, despite no contact with the incriminating chemicals. However, also facial eczema has been reported to occur (3), even if reports are very rare. The cause has been said to be mainly contamination by hands to the face (4) but also supposedly airborne (5, 6), even through methacrylic vapours (7). Methacrylates may also cause respiratory symptoms including asthma (8). Exposure to airborne methacrylates in dental clinics has been investigated in Finland (8). Both 2-HEMA and TEGDMA were detected in workplace air during procedures related to placing and removing of composite resin restorations. 2-HEMA is a semivolatile, which makes vapours difficult to remove from the workplace air rapidly. Bonding materials always contain 2-HEMA, and the nurse always had to help the dentist serve the bonding liquid to him, and consequently she was exposed to it each time a plastic filling was made. I could speculate whether a naturally ventilated clinic such as the case here could imply a greater risk for methacrylate vapours to linger. However, in the Finnish study no difference could be seen between mechanically or naturally ventilated clinics with respect to methacrylate concentrations. TEGDMA, which the dental nurse also reacted to, is hardly volatile and therefore likely to be present in the air as dust or mist, released into the air by high speed drilling (8). The dentist drilled in the dry, that is no water was used when drilling, and therefore the patient may have been exposed to the dust from the drilling procedure. In polish/grind-dust-exposed skin allergic eczematous reactions can occur (1). Even if results from Finland (8) showed that environmental air exposure of dental personnel to methacrylates is very low, the concentrations are still considered to be able to cause respiratory occupational asthma (8). Our attempt to collect allergenic materials through using pumps equipped with filters and gels was unsuccessful. However, the 2-plus reaction to a dust sample from a desk top in the room where dental patients were treated could imply a deposit of airborne allergenic material from the drilling of plastic fillings. Furthermore, if the patient's contact allergy to methacrylates could

fully explain her work-related facial airborne dermatitis, she was expected to react also after exposure to the same type of chemicals but in a different dental clinic, which she did, supporting our assumption. The patient reacted to fairly low concentrations of 2-HEMA, TEGDMA, EGDMA, and bis-GMA, even if the reactivity was not as low as 1 perhaps would expect if the dermatitis solely could be explained by air exposure, considering the low concentrations that were measured in the Finnish and also a Swedish study (9). In the other publications on airborne contact dermatitis from acrylates and methacrylates in dental personnel (5–7) there is no mentioning of serial dilution testing of the sensitizers nor any attempts to collect environmental allergenic materials. An airborne dermatitis must be suspected when symmetrical eczematous lesions are widespread over the face, eyelids, and neck and when an allergen is present as a vapour or as an aerosol (solid and liquid) (10). Our patient had such an eczema only when at work, she had been sensitized to methacrylates and bis-GMA, even if some patch test reactions might be cross-reactions (1), at work she was exposed to these chemicals, and measurements from Finland and Sweden have shown 2-HEMA, TEGDMA, and MMA to be present in dental office air. Thus, we propose that our patient was occupationally sensitized to several methacrylates and bis-GMA, and the clinical presentation was that of a facial dermatitis because of airborne exposure. It seems likely that 1 or several of these allergens caused the dermatitis.

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