

Occupational skin diseases among dental nurses

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Out of 923 female dental nurses in the Helsinki district, 799 were interviewed using a computer-assisted telephone interview. A structured questionnaire was used to inquire about skin, respiratory symptoms, atopy, work history and methods, and exposure at work. The 328 nurses, who reported work-related dermatitis on their hands, forearms or face, were invited to an interview by an occupational physician; 245 nurses participated. 31 nurses had previously been diagnosed with an occupational skin disease (OSD). 133 nurses with a suspected OSD were selected for further clinical examinations with prick and patch testing. Among the 107 nurses examined, 22 new cases of OSD were diagnosed. There were altogether 29 cases of allergic contact dermatitis, 15 of contact urticaria, 12 of irritant contact dermatitis, and 1 case of onychomycosis. Rubber chemicals and natural rubber latex (NRL) in protective gloves, as well as dental-restorative plastic materials [(meth)acrylates], were the most common causes of allergy. 42% of the OSD cases in the studied population had been missing from the statistics (Finnish Register of Occupational Diseases). Plastic gloves or NRL gloves with a low-protein content are recommended for dental work. Skin exposure to (meth)acrylates should be avoided.

Key words: acrylates; contact allergy; disposable gloves; natural latex rubber; questionnaire.
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Accepted for publication 19 February 2004

Dental workers are exposed to many skin irritants and allergens. Even protective gloves may cause contact allergy (1, 2). According to the Finnish Register of Occupational Diseases (FROD), the occurrence of occupational diseases among dental personnel has increased threefold in the 1990s (3, 4). At the same time, plastic materials [(meth)acrylates] have almost totally replaced the amalgam in dental restoration, and the use of protective gloves has become common practice. Most of the occupational diseases of dental personnel in Finland are hand dermatitis, but respiratory diseases have also increased (5).

Work-related skin diseases among dental workers, mostly dentists, have been studied in recent years in epidemiological studies in Sweden (6–11), Denmark (12), the USA (13) and Poland (14). In the present cross-sectional survey, the frequency and causes of occupational skin diseases were studied in a population of dental nurses with a structured telephone interview and clinical examinations.

Materials and Methods

The study population consisted of female dental nurses (dental assistants and dental hygienists) in the Helsinki metropolitan area. Of the 923 eligible

participants, 799 (87%) were interviewed using a computer-assisted telephone interview (CATI). The interview was carried out by the CATI laboratory of Finnish Institute of Occupational Health. A slightly modified and supplemented standard questionnaire (Tuohilampi) (15) was used. Dermatitis on the hands, forearms and face, as well as respiratory symptoms, were inquired of. The respondent's opinion about the association of these symptoms to work was registered. The questionnaire also addressed atopy, work history and current work, including the handling of chemicals and other materials. Those who reported work-related dermatitis were asked whether contact with certain materials, chemicals or other substances at work, aggravated their hand dermatitis.

Nurses reporting work-related dermatitis on their hands, forearms or face lasting for at least 2 weeks, or occurring repeatedly ($n = 328$) were invited to an interview by an occupational physician, and 245 (75%) attended such an interview. Of these, 31 nurses had previously been diagnosed as having an occupational skin disease (OSD). Altogether, 133 nurses with a suspected undiagnosed OSD were selected for further clinical examinations with prick and patch testing; 107 (80%) attended these

examinations. Hand dermatitis was the main clinical symptom in all cases. 4 nurses with a previous OSD were among those selected for clinical examinations. In these cases, there was a reason to suspect a new, previously undiagnosed occupational allergy.

The prick tests included a standard series and an additional series of dental chemicals previously known to induce immediate allergy (Table 1). The standard series included, e.g. 4 test substances, testing for natural rubber latex (NRL) allergy. The patch tests included a modified European standard series, a dental screening series, a (meth)acrylates series and an additional series of dental allergens, e.g. antimicrobials (Table 2). The patient's own materials, e.g. dental face mask, were tested in relevant cases. Prick tests alone were performed when immediate-type skin symptoms were reported without any history of eczema. In selected cases, prick tests were supplemented with specific serum immunoglobulin E antibody tests.

Results

Questionnaire study (self-reported symptoms and exposure)

The mean age of the surveyed dental nurse population was 38 (21–63) years, and their mean time

in dental work was 12 (0–40) years. 28% of the nurses were dental hygienists, who are not merely dentist's assistants but also do independent patient work. 84% of the nurses handled dental restoration plastic materials daily. 90% regularly used protective gloves, mostly plastic (vinyl, PVC), (81%), but also NRL (42%). 36% had changed glove type because of skin problems. Half of the interviewed dental nurses reported a history of either atopic dermatitis (24%) or respiratory atopy (asthma 7.3% and hay fever/allergic rhinitis 40%).

In the telephone interview, hand or forearm dermatitis during the past 12 months was reported by 30% and at the time of the interview by 12% of the dental nurses (Table 3). 35% of all respondents reported having ever had dermatoses of at least 2 weeks duration on their hands or forearms that they related to dental work. Those who reported never having had atopic skin or respiratory symptoms reported significantly less hand or forearm dermatoses, when compared to atopic persons ($P < 0.001$).

One fifth of the dental nurses had had facial dermatitis, which in about a third of the cases was reported to be work-related. The frequency of facial dermatoses was also significantly associated with atopy ($P < 0.001$) (Table 3).

Table 1. Dental nurse project, the additional prick test series

Number	Test substances		
1	Histamine hydrochloride 10 mg/ml	A	
2	Negative control	A	
3	Human serum albumin control	O	
4	Coca-glycerol control	O	
5	Hand glove powder (Baxter)	O	moistened
6	Hand glove powder (Elastyren)	O	moistened
7	Hand glove powder (Triflex)	O	moistened
8	2-Hydroxyethyl methacrylate-HSA	O	
9	2-Hydroxyethyl methacrylate	T	1% petrolatum
10	Methyl methacrylate-HSA	O	
11	Methyl methacrylate	T	2% petrolatum
12	Ethyleneglycol dimethacrylate	T	2% petrolatum
13	Triethyleneglycol dimethacrylate	T	2% petrolatum
14	BIS-GMA	T	2% petrolatum
15	Diurethane dimethacrylate	T	2% petrolatum
16	Triethyleneglycol diacrylate	C	0.1% petrolatum
17	Casein 1000 µg/ml	O	
18	Chloramine T-HAS (1.5% coca/glycerol)	O	
19	Chloramine T	O	1% aq
20	Glutaraldehyde	O	1% coca/glycerol
21	Formaldehyde	T	1% aq
22	Chlorhexidine digluconate	T	0.5% aq
23	Ammonium persulphate	O	2% aq
24	Potassium persulphate	O	2% aq
25	Colophony-HSA	O	
26	Colophony extract 100 mg/ml	O	
27	Glutaraldehyde-HAS (1.5% coca/glycerol)	O	

Suppliers of the test substances: A, Allergologisk Laboratorium A/S, Hørsholm, Denmark; C, Chemotechnique Diagnostics Ab, Malmö, Sweden; O, Finnish Institute of Occupational Health, Helsinki, Finland; T, Trolab[®] Hermal, Reinbek/Hamburg, Germany.

Table 2. Dental nurse project, the additional patch test series

Number	Test substances		
1	IRM [®] Intermediate restorative material (liquid) (Dentsply)	O	10% petrolatum
2	Chloramine T	O	0.5% petrolatum
3	Oleamidopropyl dimethylamine	C	0.1% aq
4	Coconut diethanolamide	T	0.5% petrolatum
5	Cocamidopropyl betaine	T	1% aq
6	3-Dimethylaminopropylamine	O	1% petrolatum
7	Beeswax	E	10% petrolatum
8	Benzalkonium chloride	T	0.1% petrolatum
9	Preventol D2	E	2% petrolatum
10	Potassium persulphate	O	2.5% petrolatum
11	Epichlorhydrin	K	0.1% petrolatum
12	1,2-benzisothiazolin-3-one (Na-salt)	T	0.1% petrolatum
13	<i>N</i> -Benzyl- <i>N</i> , <i>N</i> -dihydroxyethyl- <i>N</i> -coconut-acyl-ammonium-chloride	O	0.01% aq
14	2-Benzyl-4-chlorophenol	E	0.5% petrolatum
15	Bronopol	C	0.25% petrolatum
16	Parabens	T	16% petrolatum
17	2,5-Diazolidinyl urea	T	2% petrolatum
18	Polyvidoneiodine	O	10% petrolatum
19	Ammonium tetrachloroplatinate	T	0.25% petrolatum
20	1,4-Butanediol diglycidyl ether	O	0.25% petrolatum
21	Phenyl glycidyl ether	C	0.25% petrolatum
22	Silicate glass	O	10% petrolatum
23	Peppermint oil	T	2% petrolatum
24	Menthol	T	1% petrolatum
25	Amalgam	T	20% petrolatum

Suppliers of the test substances: C, Chemotechnique Diagnostics Ab, Malmö, Sweden; E, Epikon Oy, Helsinki, Finland; K, Brial Alergen GmbH, Greven, Germany; O, Finnish Institute of Occupational Health, Helsinki, Finland; T, Trolab[®] Hermal, Reinbek/Hamburg, Germany.

One fourth of all respondents ($n = 195$), which is about a half of those reporting work-related hand dermatitis ($n = 367$), said that using protective gloves aggravated their hand dermatitis. Frequent hand washing, dental restoration and cleaning the office were the next most commonly reported aggravators of hand dermatitis. Wearing a paper mask was the most commonly reported aggravator of facial dermatitis.

Clinical examinations (occupational dermatoses)

Among the 107 nurses participating in the clinical examinations, both patch tests and prick tests

were performed in 86 and only prick tests in 21 nurses. 22 new cases of OSD were diagnosed.

When the previously diagnosed, OCD cases (31) were also included, altogether 52 nurses with hand dermatitis ended up having 57 diagnoses of OSD (Table 4). One of the 4 patients with an OSD, diagnosed earlier and re-examined, was diagnosed with a second OSD. 4 other patients had each 2 allergic OSDs, i.e. both allergic contact dermatitis (ACD) and allergic contact urticaria (CU). The single case of occupational onychomycosis was a candidal infection, secondary to an occupational nail injury.

Table 3. Dermatoses reported by a population of dental nurses ($n = 799$) by their atopic history, in percentages throughout

	No atopy ($N = 376$)	RA** ($n = 231$)	AD* ($n = 192$)	All nurses ($n = 799$)
Dermatitis on hands or forearms for at least 2 weeks	38	58	68	51
–repeatedly	30	42	51	38
–continuously	4	8	12	7
–during the past 12 months	22	34	41	30
–at present	8	14	19	12
–related to dental work and during the past 12 months	16	24	31	22
Facial dermatitis for at least 2 weeks	12	25	31	21
–repeatedly	9	18	24	15
–at present	2	4	8	4
–during the past 12 months	7	16	20	12
–related to dental work and during the past 12 months	4	10	9	7

*AD, history of atopic dermatitis (sometimes infantile or flexural dermatitis).

**RA, respiratory atopy (sometimes allergic rhinitis or asthma) but no atopic dermatitis.

Table 4. Occupational skin diseases (OSD) in the surveyed population of dental nurses ($n = 799$)

	Diagnosed before the present study	Diagnosed in the present study	Total (%)
OSD cases	31	22	52*(6.5)
Diagnoses	33	24	57**(7.1)
Allergic contact dermatitis	18	11	29 (3.6)
Contact urticaria	11	4	15 (1.9)
Irritant contact dermatitis***	4	8	12 (1.5)
Onychomycosis		1	1 (0.1)

*One patient with an OSD was previously diagnosed with a second OSD in the clinical examination.

**4 patients had both ACD and contact urticaria (two allergic OSDs)

***No ACD present

Allergic contact dermatitis was the most common diagnosis, and its most common causes were (meth)acrylates and rubber chemicals (Table 5). Contact urticaria was in all but one case caused by NRL (Table 5). Frequent hand washing was considered the main cause of irritant contact dermatitis.

Discussion

In the telephone interview, almost one third of the dental nurses reported having suffered from hand or forearm dermatitis, during the past year. This figure is higher than the reported prevalence of hand eczema among Swedish dental personnel (6, 10, 11). One reason for the difference in prevalence may be the fact that the Finnish study also included forearms in the question on skin condition, whereas the Swedish surveys concerned only the hands. Understanding of the terms used for self-diagnosis of the skin condition may also differ in Sweden and Finland.

One fourth of the interviewed dental nurses reported having suffered from work-related derma-

tos on their hands, forearms or face, during the past 12 months. More than 70% of the nurses with hand or forearm dermatitis felt that the dermatitis was related to their work. This figure is very similar to that in the Swedish study (11). In most cases, the nurses suspected that protective gloves or frequent hand washing were the cause of their hand dermatitis.

More than a half of the interviewed dental nurses reported either respiratory or skin atopy. Hand and forearm dermatitis was associated with both skin and respiratory atopy. This is in agreement with several earlier studies on hand eczema (16–18). The high frequency of atopy could be one reason for the high prevalence of dermatitis in the studied population.

The prevalence of OSD was 6.5% in the surveyed dental nurse population. A large proportion (42%) of the OSD of the dental nurses had not been diagnosed previously and was thus missing from the occupational disease statistics (FROD) before the present study. No new allergens were detected with the additional prick and patch test series (Table 1 and Table 2).

Table 5. Contact allergy diagnosed as a cause of occupational dermatosis in the surveyed population of dental nurses ($n = 799$)

	Diagnosed before the present study	Diagnosed in the present study	Total (%)
Allergic contact dermatitis			
(Meth)acrylates	7	3*	10 (1.3)
Rubber chemicals	6	4**	10 (1.3)
Ampholyte 103G	1	6	7 (0.9)
Formaldehyde	3		3 (0.4)
Glutaraldehyde	2	1	3 (0.4)
IRM [®] liquid (eugenol)		2	2 (0.3)
Colophony		2	2 (0.3)
Epoxy resin	1	1	2 (0.3)
Bisphenol-A		1	1 (0.1)
Phenylmercuric acetate	1***		1 (0.1)
Contact urticaria			
Natural rubber latex	11	3	14 (1.8)
Chlorhexidine		1	1 (0.1)

*First case: Allergy to 2-hydroxyethyl methacrylate (HEMA), 2-hydroxypropyl methacrylate (HPMA) and ethyleneglycol dimethacrylate (EGDMA); Second case: HEMA, HPMA, EGDMA and ethyl acrylate; Third case: diethyleneglycol diacrylate (DEGDA) and triethyleneglycol diacrylate (TriEGDA).

**All 4 cases are allergic to thiuram chemicals.

***The test result could not be reproduced in the clinical examinations.

ACD is the most common occupational skin disease among dental workers in Finland according to both FROD (3, 4) and the present study. However, irritant contact dermatitis may often be overlooked as an OSD. The most important irritants in dental work are frequent hand washing, detergents and glove use.

The components of protective gloves and dental-restorative plastic materials [(meth)acrylates] were the most common causes of occupational allergy. Rubber gloves caused delayed-type allergy, ACD from rubber chemicals, as well as immediate-type allergy, CU from NRL itself. The third most common allergen was Ampholyte 103G [dodecyl-di-(aminoethyl)glycine], contained in the antiseptic Desimex I, commonly used in instrument care before 1994 in Finland. Consequently, these allergies were of past relevance. In addition, there were a few contact allergies to other antimicrobials and other chemicals used in dental restoration. The source of formaldehyde allergy in dental work can be either hand creams, hand wash products or instrument care. Glutaraldehyde is used as an antiseptic in instrument care. Epoxy chemicals are also components of plastic fillings. Colophony is used in fluoride dental coatings. Eugenol is the main component (>99%) of IRM[®] liquid, used in temporary fillings. In this study, the 2 patients with contact allergy to 10% IRM[®] liquid did not react to eugenol [1% petrolatum (pet.)] in the dental screening series. Concentrations commonly used to detect eugenol allergy (1–2%) may be too low, as also one earlier reported patient case indicated (19).

Chlorhexidine digluconate is widely used as a disinfectant. It may induce both delayed and immediate allergy (20). In our study, there was one case of CU caused by chlorhexidine. This patient was one of the 4 re-examined patients. She also had a previously diagnosed occupational ACD caused by acrylates. Among the other 4 patients with 2 OSDs, i.e. both delayed and immediate occupational allergies, all had CU caused by NRL, as well as ACD caused by rubber chemicals. Additionally, one patient had contact allergy to acrylates, one to glutaraldehyde and one to both IRM[®] liquid and Ampholyte 103G.

Another one of the 4 re-examined patients had a previously diagnosed OSD caused by phenylmercuric acetate. Her contact allergy could not be reproduced in our patch testing. Mercuric salts are known to elicit irritant patch test reactions, quite often.

One fourth (195) of the dental nurses complained about glove-related skin problems in the interview, but only 3 new cases of immediate

allergy to NRL were diagnosed. In the clinical examination, 21 nurses without any history of hand eczema were investigated only by skin-prick tests because they reported immediate-type skin symptoms related to rubber gloves. However, only one case of NRL allergy was diagnosed among them. This is in accordance with several studies where NRL allergy has been detected only in a fraction of those complaining of glove-related symptoms (6, 11, 13, 21, 23).

In the present study, all the 52 OSD cases were hand dermatoses. Even though many nurses reported facial skin symptoms in the telephone interview, no contact allergies or occupational irritant eczema were found among them. The dental face mask seems to cause mainly slight skin irritation (24).

Plastic materials [(meth)acrylates] are today used widely in dental work. They are used in fillings, for coating of teeth and in prosthetics, in dental plates and dentures. Protective gloves (thin disposable medical examination gloves, PVC or NRL) are today used regularly in dental patient work in Finland. Even when these gloves give good protection against microbials, as well as most skin irritants or allergens, small molecular acrylates can permeate them quite rapidly. To prevent acrylate allergy, which may lead to a change of occupation, direct skin contact with unhardened acrylates should be avoided. It is important to develop no-touch techniques to avoid skin exposure to these chemicals. Protection can also be improved by using nitrile rubber gloves or double gloving, e.g. a simple polyethylene glove under another glove (25, 26). To prevent NRL allergy, PVC gloves or NRL gloves with a low-protein content are recommended.

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