

Occupational methacrylate and acrylate allergy from glues

KRISTINA AALTO-KORTE, KRISTINA ALANKO, OUTI KUULIALA AND RIITTA JOLANKI

Finnish Institute of Occupational Health, Control of Hypersensitivity Diseases, FI-00250 Helsinki, Finland

Background: Glues and sealants are important causes of methacrylate and acrylate allergy.

Aim: This study aimed to analyse patterns of allergic patch test reactions to acrylic monomers in relation to exposure in patients sensitized from glues.

Patients/Methods: We screened the patch test files at the Finnish Institute of Occupational Health from 1994 to 2006 for allergic reactions in the 'Methacrylate series' and analysed the clinical records of sensitized patients. Only patients who had handled acrylic glues at work were included.

Results: 10 patients had allergic reactions to acrylic monomers and had been sensitized from glues at work. 9 of them had used anaerobic sealants, 3 cyanoacrylate-based instant adhesives, and 1 patient a bi-component instant adhesive. All the patients reacted to 2-hydroxyethyl methacrylate (2-HEMA) and ethyleneglycol dimethacrylate (EGDMA); reactions to 2-hydroxypropyl methacrylate, triethyleneglycol dimethacrylate, and tetrahydrofurfuryl methacrylate were also common. The first 4 methacrylates were found in the glues used by the patients. Ethyl cyanoacrylate (ECA) gave no reactions, but 1 patient reacted weakly to her own ECA-based glue.

Conclusion: 2-HEMA and EGDMA are good screeners for contact allergy to anaerobic sealants and also detected a single case deriving from bi-component acrylic glue.

Key words: 2-HEMA; 2-HPMA; anaerobic sealants; EGDMA; ethyl cyanoacrylate; isobornyl acrylate; pipe sealant; plumber; TETEGDMA; TREGDMA. © Blackwell Munksgaard, 2008.

Accepted for publication 18 December 2007

Background

Glues, sealants, and adhesives are a relatively common occupational source of sensitization to methacrylates and acrylates in addition to dental restorative materials and artificial nails (1–3). Anaerobic sealants have most often been reported to cause contact allergy (2–6). These mono-component products polymerize rapidly in the absence of oxygen, and the reaction is catalyzed by metals. They are used mainly for screw thread locking or retaining and locking flat metal surfaces (5). There are also reports of sensitization from cyanoacrylate-based glues (7–9), which polymerize when exposed to air. They are used to bond human tissues and artificial nails and as mono-component instant adhesives in industry. mono-component ultraviolet (UV)-cured acrylic glues have also caused contact allergy (10–12), while bi-component

acrylic glues form another potentially sensitizing group of products (13). Non-occupational sources of sensitization include nail glues, adhesives in electrosurgical grounding plates (14), and glues in insulin pump infusion sets (15, 16).

We have recently reported the 12-year patch test results of acrylates and methacrylates from the Finnish Institute of Occupational Health (FIOH) in dental personnel (17). The present study aimed to analyse the same 12-year material for patterns of allergic reactions to various acrylates and methacrylates in relation to exposure in patients sensitized from acrylic glues.

Patients and Methods

We screened FIOH test files from September 1994 to August 2006 for allergic reactions in our

'Methacrylate series'. The patch tests were performed using the Finn Chambers[®] (Epitest, Tuusula, Finland) according to the recommendations of the International Contact Dermatitis Research Group. We read the tests 2 or 3 times on D2–(D3)–D4/5/6 depending on the day of their application. Our series is based on the allergens provided by Chemotechnique (Vellinge, Sweden), but several preparations of Trolab (Hermal, Reinbek, Germany) and in-house test substances have also been used. The vehicle is petrolatum (pet.) in all the test substances. The composition of the series varied during the study period, and different test substances were tested on a different number of patients. The different test substances are presented in Table 1. In addition, triethyleneglycol diacrylate [(TREGDA), 0.1% pet.; Chemotechnique] was tested in our standard series during the same time period.

The clinical records of patients with allergic reaction (+/++/+++) to at least one acrylic monomer in the Methacrylate series were reviewed. We analysed their clinical records for occupation, symptoms, safety data sheets (SDSs), the results of the chemical analyses of the actual products used by the patients, patch test reactions to patients' own acrylate products, and the diagnosis. In the present series, we included only those who had handled acrylate glues at work.

During the study period (between September 1994 and August 2006), a total of 473 patients were tested with the Methacrylate series. 61 patients had allergic reaction to at least one allergen. Of these, 32 patients working in dental professions have been reported recently (17). The files of 10 patients showed present occupational exposure to acrylic glues.

Table 1. Allergens of the Methacrylate series, their concentrations in petrolatum, providers, and abbreviations, and patch test results of the 10 patients sensitized from acrylic glues

Test substance	Concentration (%), provider	Abbreviation	Patch tests		
			+ / + + / + + +	? +	Total
2-Hydroxyethyl methacrylate	1, T	2-HEMA	10	0	10
Ethyleneglycol dimethacrylate	2, T	EGDMA	10	0	10
2-Hydroxypropyl methacrylate	2, C	2-HPMA	9	0	10
Triethyleneglycol dimethacrylate	2, T	TREGDMA	7	2	10
Tetrahydrofurfuryl methacrylate	2, C	THFMA	7	0	10
Ethyl methacrylate	0.1, C	EMA	5	1	10
Triethyleneglycol diacrylate (in the standard series)	0.1, C	TREGDA	5	0	9
Methyl methacrylate	2, C/T	MMA	4	1	10
1,4-Butanediol dimethacrylate	2, C	BUDMA	4	1	10
Diethyleneglycol diacrylate	0.1, C	DEGDA	4	0	10
Glycidyl methacrylate	0.1, O	GMA	3	1	9
Urethane dimethacrylate	2, C	UEDMA	2	0	10
1,4-Butanediol diacrylate	0.1, C	BUDA	2	1	10
1,6-Hexanediol diacrylate	0.1, C	HDDA	2	1	10
Ethyl acrylate	0.1, C	EA	2	1	10
Phenoxyethyl acrylate	0.1, O	PEA	1	1	9
Trimethylolpropane triacrylate	0.1, C	TMPTA	1	0	10
Pentaerythritol triacrylate	0.1, C	PETA	1	0	10
Urethane diacrylate, aromatic	0.05, C	ar-UDA	1	0	10
2,2-bis[4-(2-hydroxy-3-methacryl-oxypropoxy) phenyl] propane	2, T	BIS-GMA	1	0	10
N,N-dimethylaminoethyl methacrylate	0.2, C	DMAEMA	1	0	2
N-butyl methacrylate	2, C	BMA	0	3	10
Butyl acrylate	0.1, C	BA	0	0	10
2-Ethylhexyl acrylate	0.1, C	2-EHA	0	0	10
Ethoxyethyl acrylate	0.1, O	EEA	0	1	9
Isobornyl acrylate	0.1, O	IBA	0	0	10
Dipropylene glycol diacrylate	0.1, O	DPGDA	0	2	7
Tripropylene glycol diacrylate	0.1, C	TPGDA	0	0	10
Oligotriacrylate 480	0.1, C	OTA480	0	0	10
Urethane diacrylate, aliphatic	0.1, C	al-UDA	0	0	10
N,N-methylenebisacrylamide	1, C	MBAA	0	0	10
Ethyl cyanoacrylate	10, O	ECA	0	0	10
2,2-bis[4-(methacryl-oxyethoxy)phenyl] propane	1, C	BIS-EMA	0	1	10
2,2-bis[4-(methacryloxy)phenyl] propane	2, C	bis-MA	0	0	9
Etoxylated methacrylate of bisphenol A (bis-EMA)	2, O	EBADMA	0	0	6
Epoxy diacrylate (epoxy acrylate)	0.5, C	EDA	0	0	10

C, Chemotechnique, Vellinge, Sweden; O, in-house preparation; T, Trolab, Hermal, Reinbeck, Germany.

The glue analyses were performed by gas chromatography with a mass selective detector at FIOH in Turku as previously described (18, 19).

Results

The number of positive reactions to different acrylic monomers in the 10 glue patients is presented in Table 1, and each patient's positive reactions are displayed in Table 2. All 10 patients had occupational allergic contact dermatitis from methacrylates in the glues. Their occupations and available exposure data are presented in Table 2. One of the patients, an optician, (no. 6 in Table 2) has been reported in detail previously (6).

Discussion

In the present 12-year material, the most common source of sensitization was anaerobic sealants (patient nos. 1–9 in Table 2), which is in accordance with the relatively large number of similar cases in the literature (2–6). Anaerobic sealants are usually based on dimethacrylates (18), although polyurethane dimethacrylates may also be used (5). In a prior chemical analysis at FIOH, the main component of these products was triethyleneglycol dimethacrylate (TREGDMA), and diethyleneglycol dimethacrylate (DEGDMA) and 2-hydroxypropyl methacrylate (2-HPMA) were used as reactive diluents (18). Regarding these 3 methacrylates, the compositions of the anaerobic sealants were similar in the present study. The TREGDMA content in 3 of the 4 analysed products was significant (10–15%), but larger oligomers, such as tetraethyleneglycol dimethacrylate (TETEGDMA) and pentaethyleneglycol dimethacrylate, were also detected in comparable amounts. In the present study, DEGDMA was present (0.6–3.7%) in all 4 anaerobic sealants analysed, and 2-HPMA was declared in the SDSs of 2 products and was found in the analysis of 1 product. The analysed concentration of 2-hydroxyethyl methacrylate (2-HEMA) was high (17.8%) in one anaerobic pipe sealant, and small concentrations (0.01–0.12%) were found in the analysis of 2 other anaerobic products. Some ethyleneglycol dimethacrylate [(EGDMA); 0.2%]) was analysed in the pipe sealant with the high 2-HEMA content. In the past analyses at FIOH, 0.5% EGDMA was found in one anaerobic sealant, which also contained some methyl methacrylate (MMA).

Three patients had used cyanoacrylate-based glues (nos. 8–10), and 2 of them were tested with their own cyanoacrylate glues. We had no reactions to ethyl cyanoacrylate (ECA) in the present series, but one of the patients (no. 8) had a weak

allergic reaction to an ECA-based glue. The specificity of this weak reaction was doubtful as 10% ECA remained negative. The test was not repeated, probably because contact allergy to anaerobic sealant was considered more important. Our results are in line with the relatively small number of ECA-sensitive cases in the literature. The recent reports of ECA allergy consist of individual cases with sensitization from nail glues (20–22). At FIOH, we have investigated one similar patient, a hairdresser, who had been sensitized non-occupationally. She had allergic reactions to 10% ECA (++) and 10% nail glue in a polypropylene-coated Finn-Chamber (++; pet.), but the rest of the Methacrylate series was not tested.

One patient (no. 10) from an engine laboratory had used a bi-component acrylic glue for many purposes, including the gluing of wires and magnets. According to the SDS, the bi-component instant adhesive contained MMA and 2-HEMA. The patient reacted to these two allergens, but her pattern of positive reactions to various methacrylates did not essentially differ from those of other patients who had handled mono-component anaerobic sealants. Before the study period, a similar patient was investigated at FIOH (13). The patient investigated during the study period (no. 10) reacted largely to the same methacrylates as the previous case, but the reactions to acrylates were less extensive.

Tetrahydrofurfuryl methacrylate (THFMA) is the main component of some bi-component acrylic adhesives (18), but we are not aware of any reported clinical patients sensitized to THFMA from such products. In the present series, reactions to THFMA were detected in 7 patients with wide methacrylate allergy (7–10 reactions to different methacrylates), while the 3 THFMA-negative patients reacted only to 3 or 4 methacrylates each (Table 2). The reactions to THFMA were probably because of cross-allergy to other methacrylates. Reactions to MMA, EMA, and *N*-butyl methacrylate were seen only in the THFMA-positive patients.

None of the patients in the present study had used UV-cured acrylic glues. There are at least 4 previous reports of allergic contact dermatitis in windscreen repairers, with 3 cases reacting to 2-HEMA (1, 23) and the fourth reacting to his own polyurethane/methacrylate product but untested for 2-HEMA (12).

2-HEMA and EGDMA produced allergic reactions in all our patients. Reaction to 2-HPMA, TREGDMA, and THFMA was also common. These reactions derived mainly from exposure to anaerobic sealants. THFMA has not been detected in the analysis of anaerobic products

Table 2. Data on 10 patients who had contact allergy to methacrylates or acrylates and had used acrylic glues at work: profession, patch test results to methacrylates, acrylates, epoxyacrylates, and products actually used at the workplace, and exposure data from safety data sheets and chemical analyses^d

Patient no.	Occupation	Patch test results					Own product	Exposure
		Methacrylates		Acrylates		Epoxyacrylates		
1	Assembler of harvesters	2-HEMA ++ 2-HPMA ++ EGDMA ++ EMA ++	THFMA + BMA ?+ TREGDMA ?+	EA ?+			Loctite 542 ^a (2%) ++	Loctite 542 ^a (SDS): polyethyleneglycol dimethacrylate < 70%
2	Assembler of hydraulic devices	TREGDMA ++ 2-HEMA + EGDMA +		TREGDA +		bis-GMA + (Epoxy resin ++)	NT	Several anaerobic sealants based on dimethacrylates (SDS)
3	Machinist assembler	2-HEMA +++ 2-HPMA +++ EGDMA +++ TREGDMA +++	BUDMA +++ THFMA +++ MMA +	TREGDA +++ DEGDA +++ HDDA +++ PEA +++	BUDA ++ EA + DPGDA ?+	GMA + (Epoxy resin +++)	NT	Several anaerobic sealants, e.g. Loctite 28728 ^a (SDS): urethane glycol diMA-based HPMA 4–15%
4	Plumber	2-HEMA ++ 2-HPMA ++ TREGDMA ++ EGDMA ++ BUDMA ++	THFMA ++ UDMA + EMA + MMA ?+	TREGDA +++ DEGDA ++ BUDA ?+		GMA +	Loctite 577 ^a (2%, 1%, and 0.5%) EGDMA-based oligomers 22%, TREGDMA 10%, Lauryl MA 4%, and DEGMA 3%	HPMA 1%, metacryl acid 0.06%, and HEMA 0.01%
5	Plumber	EGDMA ++ 2-HEMA + 2-HPMA +					Pipe sealant ^a 5% ++, 2% +, and 1% +	EGDMA 0.2%, dodecyl acrylate 7.9%, and tetradecyl acrylate (probably) 6.8%
6	Optician (6)	2-HEMA ++ 2-HPMA ++	EGDMA ++ TREGDMA ?+	HDDA +			Screw securing no. 317800 ^a , (2% and 1%) ++, screw lock 2% –, and lauryl MA –	DEGMA 2.7%, lauryl MA 4.1%, tetradecyl MA 2.0%, hexadecyl MA 1.2%, and octadecyl MA 1.8%
7	Sewing-machine mechanic	2-HPMA +++ EGDMA +++ TREGDMA +++ THFMA +++ 2-HEMA ++	MMA ++ EMA ++ BUDMA ++ UDMA + BMA ?+	DEGDA ++ TREGDA + BUDA + HDDA ?+ DPGDA ?+	EEA ?+ PEA ?+	GMA ?+ (Epoxy resin +)	Loctite 542 ^a (5%) ++, Loctite 577 ^a (5%) ++, Loctite 603 ^a (2%) ++, and lauryl MA –	Loctite 603 ^a (SDS): HPMA 2–5%, 4-tert-butylcyclohexyl MA 30–60%, acrylic acid 5–10%, and butylenglycol diMA 10–15%
8	Assembler of fireworks and explosives	TREGDMA ++ 2-HEMA + 2-HPMA + EGDMA +	THFMA + EMA ?+ BMA ?+	PETA ++ TREGDA + DEGDA + TMPTA + and ar-UDA +			Loctite 275 ^a 5% +++, 2% +, Loctite 401 ^b (dried) +, (ECA < 95% SDS), Loctite 415 ^b (dried) – (MCA < 95% SDS)	Loctite 275 ^a (analysis): 2-HEMA 0.12%, TREGDMA 15%, TETEGDMA 18%, PEGDMA 11%, and HEGDMA 1.9%

(Continued)

Table 2. Continued

Patient no.	Occupation	Patch test results			Own product	Exposure
		Methacrylates	Acrylates	Epoxyacrylates		
9	Assembler in a foundry	2-HEMA +++ 2-HPMA +++ EGDMA +++ TREGDMA ++ EMA ++	MMA + THFMA + DMAEMA + BUDMA ?+	GMA ++ (Epoxy resin +)	NT	An ECA-based glue ^b (SDS) anaerobic sealants (Various epoxy resins)
10	Measurement technician	2-HEMA ++ MMA ++ EMA ++ 2-HPMA ++	EGDMA ++ TREGDMA ++ BUDMA ++ THFMA ++		X 60 component B ^c (2%) ++, Z 70 ^b (dried) –, M bond 200 ^b (dried) –, and Loctite 495 ^b (dried) –	Loctite 495 ^b (SDS): ECA < 95%, Z 70 ^b (SDS): MCA 70%, ECA 20%, and polymeric MA 10%

DEGDMA, diethyleneglycol dimethacrylate; DEGMMA, diethyleneglycol monomethacrylate; HEGDMA, hexaethyleneglycol dimethacrylate; MA, methacrylate; MCA, methyl cyanoacrylate; NT, not tested; PEGDMA, pentaethyleneglycol dimethacrylate; PEGMMA, pentaethyleneglycol monomethacrylate; SDS, safety data sheet; TETEGDMA, tetraethyleneglycol dimethacrylate; TMPTMA, trimethylolpropane trimethacrylate; TETEGMMA, tetraethyleneglycol monomethacrylate; TREGMMA, triethyleneglycol monomethacrylate.

^aAnaerobic sealant.

^bCyanoacrylate glue.

^cbi-component glue.

^dPatients nos. 1–9 had used anaerobic sealants, patient no. 10 had used a bi-component glue, and patient nos. 8–10 had also used cyanoacrylate glues. The vehicle in dilutions was always petrolatum. Names of the abbreviated methacrylates, acrylates, and epoxyacrylates are mentioned in Table 1.

at FIOH, but specific exposure to TREGDMA, 2-HPMA, 2-HEMA, EGDMA, and MMA is possible when handling anaerobic sealants. In animal studies, strong cross-allergy has been found between 2-HEMA, 2-HPMA, MMA, and EGDMA (25); so, all the reactions in the present study need not be because of specific sensitization but may represent cross-allergy to other acrylic monomers. In two recent Swedish series of acrylate contact allergy, patch test reactions to 2-HEMA were generally stronger than those to EGDMA (26, 27). In the present series, the reactions to 2-HEMA and EGDMA were similar, but two patients had stronger reactions to EGDMA. The difference might be only incidental or have something to do with the exposure of the patients.

If we compare the present sealant-derived cases with our recently reported dental workers (17), the top 3 allergens were exactly the same, 2-HEMA, EGDMA, and 2-HPMA, and 9 of the 10 most common allergens were the same in the two groups (Table 1). Reactions to acrylates were relatively more frequent among the sealant cases than in the dental workers (70% and 38%, respectively). In the present study, no evidence of specific exposure to acrylates (except cyanoacrylates) was detected in connection with the sealants, but the difference might be linked to the fact that the sealant cases generally had stronger and wider reactions to methacrylates: all of them had at least 1 strong (++) reaction, while 28% of the dental workers had only weak reactions. Also, 70% of the sealant cases had concomitant allergic reactions to at least 5 different methacrylates compared with only 19% of the dental workers. The reactions to acrylates, such as TREGDA and DEGDMA, in the present series possibly derive from cross-allergy to methacrylates. However, it should also be noted that UV-cured glues might contain only acrylates and cause sensitization to acrylates without methacrylate allergy (10, 28). The detection of these cases has required testing with TREGDA, DEGDMA, or tetraethyleneglycol diacrylate.

Isobornyl acrylate (IBA) is a glue component that was positive in 2 cases with contact allergy from insulin pump infusion sets (15). We have tested IBA (0.1% pet.) in 428 patients with negative results. IBA was an ingredient in a UV-cured acrylic glue, which caused an epidemic of acrylate contact allergy in 12 workers in Poland, but the patients did not react to 0.1% IBA (10). The previously reported case of bi-component acrylic glue, which had caused wide methacrylate and acrylate allergy in a patient at FIOH, contained 62% IBA, but this patient also remained negative to IBA (13). We have now ceased to test IBA in our acrylate series.

2-HEMA has been the most frequent reactor in some previous studies (2, 5) that, like the present material, have comprised mostly of anaerobic sealant-derived cases. There are, however, also 2-HEMA-negative anaerobic sealant-derived cases in the literature who have reacted to EGDMA, TREGDMA, and/or TETEGDMA (1, 3, 4). We did not test TETEGDMA, so we are unable to tell whether our patients would have reacted to it, but lauryl methacrylate was tested in 3 patients (nos. 4, 6, and 7) with negative results.

In a recent Singaporean–Swedish paper, a short screening series for industrial acrylate workers was proposed: TREGDA, 2-HPMA, and 1,4-butanediol diacrylate/1,6-hexanediol diacrylate (27). All of our 10 glue patients would have been picked up by the recommended allergens. In southern Sweden, a late reading on D7 was found important when patch testing acrylates and methacrylates (26, 27). All the present 10 patients were positive to methacrylates on D3, but we did not perform any reading on D7 – our last reading was on D4, D5, or D6.

Testing the actual glues used by the patients was found highly useful. In the present material, 7 patients were tested with their own glues, and all of them reacted positively to at least 1 product. We have used 2–5% concentration of anaerobic and bi-component glues in pet. We usually test cyanoacrylate glues as is, dried in Finn Chambers because of the simplicity of the procedure, although 10% dilution to pet. is the recommended test method for these products (8). The concentration of the methacrylate/acrylate product should be adjusted to the concentrations of the monomers in the product so that 2% for any sensitizing methacrylate monomer or 0.1% for any sensitizing acrylate monomer is not exceeded (29). From our previous analyses, we have learned that certain anaerobic products can be tested with the 5% concentration without exceeding the limits. We have not observed any active sensitizations to patients' own products (30).

In conclusion, 2-HEMA and EGDMA are good screeners for contact allergy to anaerobic sealants and also detected the single case deriving from bi-component acrylic glue. Our suggestion for an occupational acrylic glue series includes 2-HEMA, EGDMA, 2-HPMA, TREGDMA, MMA, ECA, TREGDA, DEGDA, and TETEGDMA.

References

- Geukens S, Goossens A. Occupational contact allergy to (meth)acrylates. *Contact Dermatitis* 2001; 44: 153–159.
- Sood A, Taylor J S. Acrylic reactions: a review of 56 cases. *Contact Dermatitis* 2003; 48: 346–347.
- Guerra L, Vincenzi C, Peluso A M, Tosti A. Prevalence and sources of occupational contact sensitization to acrylates in Italy. *Contact Dermatitis* 1993; 28: 101–103.
- Holme S A, Statham B N. A cluster of 6 cases of occupational allergic contact dermatitis from (meth)acrylates. *Contact Dermatitis* 2000; 43: 179–180.
- Conde-Salazar L, Guimaraens D, Romero L V. Occupational allergic contact dermatitis from anaerobic acrylic sealants. *Contact Dermatitis* 1988; 18: 129–132.
- Kanerva L, Estlander T, Jolanki R. Optician's occupational allergic contact dermatitis, paresthesia and paronychia caused by anaerobic acrylic sealants. *Contact Dermatitis* 2001; 44: 117–119.
- Tomb R R, Lepoittevin J P, Durepaire F, Grosshans E. Ectopic contact dermatitis from ethyl cyanoacrylate instant adhesives. *Contact Dermatitis* 1993; 28: 206–208.
- Bruze M, Bjorkner B, Lepoittevin J P. Occupational allergic contact dermatitis from ethyl cyanoacrylate. *Contact Dermatitis* 1995; 32: 156–159.
- Belsito D V. Contact dermatitis to ethyl-cyanoacrylate-containing glue. *Contact Dermatitis* 1987; 17: 234–236.
- Kiec-Swierczynska M, Krecisz B, Swierczynska-Machura D, Zaremba J. An epidemic of occupational contact dermatitis from an acrylic glue. *Contact Dermatitis* 2005; 52: 121–125.
- Brooke R C, Beck M H. A new source of allergic contact dermatitis from UV-cured (meth)acrylate adhesive. *Contact Dermatitis* 2002; 47: 179–180.
- Le Coz C J. Occupational allergic contact dermatitis from polyurethane/methacrylates in windscreen repair chemical. *Contact Dermatitis* 2003; 48: 275–276.
- Kanerva L, Jolanki R, Leino T, Estlander T. Occupational allergic contact dermatitis from 2-hydroxyethyl methacrylate and ethylene glycol dimethacrylate in a modified acrylic structural adhesive. *Contact Dermatitis* 1995; 33: 84–89.
- Borelli S, Nestle F O. Sensitization and development of allergic contact dermatitis caused by a single contact with an electrosurgical grounding plate containing acrylates. *Dermatology* 1998; 197: 381–382.
- Busschots A M, Meuleman V, Poesen N, Dooms-Goossens A. Contact allergy to components of glue in insulin pump infusion sets. *Contact Dermatitis* 1995; 33: 205–206.
- Jolanki R, Kanerva L, Estlander T, Henriks-Eckerman M L, Suhonen R. Allergic contact dermatitis from phenoxyethoxy ethylacrylates in optical fiber coating, and glue in an insulin pump set. *Contact Dermatitis* 2001; 45: 36–37.
- Aalto-Korte K, Alanko K, Kuuliala O, Jolanki R. Methacrylate and acrylate allergy in dental personnel. *Contact Dermatitis* 2007; 57: 324–330.
- Kanerva L, Henriks-Eckerman M L, Jolanki R, Estlander T. Plastics/acrylics: material safety data sheets need to be improved. *Clin Dermatol* 1997; 15: 533–546.
- Henriks-Eckerman M L, Kanerva L. Gas chromatographic and mass spectrometric purity analysis of acrylates and methacrylates used as patch test substances. *Am J Contact Dermat* 1997; 8: 20–23.
- Constandt L, Hecke E V, Naeyaert J M, Goossens A. Screening for contact allergy to artificial nails. *Contact Dermatitis* 2005; 52: 73–77.
- Lazarov A. Sensitization to acrylates is a common adverse reaction to artificial fingernails. *J Eur Acad Dermatol Venerol* 2007; 21: 169–174.
- Isaksson M, Siemund I, Bruze M. Allergic contact dermatitis from ethylecyanoacrylate in an office worker with artificial nails led to months of sick leave. *Contact Dermatitis* 2007; 57: 346–347.
- Bang Pedersen N. Allergic contact dermatitis from acrylic resin repair of windscreens. *Contact Dermatitis* 1998; 39: 99.
- Banerjee P, White I R. Allergic contact dermatitis at the application site of an electrosurgical earthing plate occurring in a windscreen repairer. *Contact Dermatitis* 2001; 44: 97–98.

25. Rustemeyer T, de Groot J, von Blomberg B M, Frosch P J, Scheper R J. Cross-reactivity patterns of contact-sensitizing methacrylates. *Toxicol Appl Pharmacol* 1998; 148: 83–90.
26. Goon A T, Isaksson M, Zimerson E, Goh C L, Bruze M. Contact allergy to (meth)acrylates in the dental series in southern Sweden: simultaneous positive patch test reaction patterns and possible screening allergens. *Contact Dermatitis* 2006; 55: 219–226.
27. Teik-Jin Goon A, Bruze M, Zimerson E, Goh C L, Isaksson M. Contact allergy to acrylates/methacrylates in the acrylate and nail acrylics series in southern Sweden: simultaneous positive patch test reaction patterns and possible screening allergens. *Contact Dermatitis* 2007; 57: 21–27.
28. Whittington C V. Dermatitis from UV acrylate in adhesive. *Contact Dermatitis* 1981; 7: 203–204.
29. Jolanki R, Estlander T, Alanko K, Kanerva L. Patch testing with a patient's own materials handled at work. In: *Handbook of Occupational Dermatology*, Kanerva L, Elsner P, Wahlberg J E, Maibach H I (eds): Berlin, Springer, 2000: pp. 375–384.
30. Aalto-Korte K, Alanko K, Kuuliala O, Jolanki R. Late reactions in patch tests: a 4-year review from a clinic of occupational dermatology. *Contact Dermatitis* 2007; 56: 81–86.

Address:

Kristiina Aalto-Korte
Finnish Institute of Occupational Health
Control of Hypersensitivity Diseases
Topeliuksenkatu 41 a A
FI-00250 Helsinki
Finland
Tel: +358 30 4741
Fax: +358 9 5875 449
e-mail: kristiina.aalto-korte@ttl.fi