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ORIGINAL ARTICLE

Ten years of contact allergy from acrylic compounds in an occupational dermatology clinic

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Abstract

Background: Contact allergy from acrylic compounds is a "hot topic". Knowledge on the exact chemical composition of acrylic products is superficial.

Aims: To retrospectively describe patients with allergic reactions to acrylic compounds.

Methods: We included patients who had been tested with acrylate patch test series and displayed allergic reactions to at least one acrylic compound. Chemical analyses were often performed when safety data sheets of implicated products failed to reveal acrylic compounds to which the patient tested positive.

Results: In 2010–2019 a total of 55 patients met the inclusion criteria. Eight cases of allergic contact dermatitis were due to anaerobic sealants, seven to dental products, three to windscreen glues, seven to eyelash glues and/or nail products in the beauty sector, three to UV-cured printing inks, two to paints/lacquers, and one to polyester resin system. The origin of these contact allergies was occupational with the exception of four beauty sector workers who had developed eyelid symptoms from eyelash extensions glued onto their own eyelashes. We invariably detected methacrylate monomers in 15 chemical analyses of 12 different anaerobic sealants.

Conclusions: Safety data sheets of anaerobic sealants often lack warnings for skin sensitization, although these products regularly contain sensitizing methacrylates.

KEYWORDS

1,4-butanedioldimethacrylate (BUDMA), 1,6-hexanedioldiacrylate (HDDA), cyanoacrylate, dimethylaminoethyl methacrylate (DMAEMA), lash extension glue, polyester resin, tri (propyleneglycol) diacrylate (TPGDA), urethane diacrylate, aromatic (ar-UDA), windscreen glue

1 | INTRODUCTION

Acrylic compounds are allergens of current interest due to a large number of patients who are sensitized from nail products and medical devices.[1,2] Many patch test clinics screen with 2-hydroxyethyl methacrylate (2-HEMA) in all patients, and recommendations to include this allergen in the baseline series are emerging.[3,4] There are over 30 commonly used commercial acrylic test substances that are used in varying combinations for different patient groups, but no collectively agreed recommendations for aimed testing exist.

Acrylic compounds used in commercial products are generally rather impure and contain substantial amounts of (meth)acrylates other than the labelled compounds. Concomitant allergic reactions to several (meth)acrylates are common, especially in strongly sensitized patients, but allergies to just one compound also occur. Multiple patch test reactions may derive from concomitant exposure, but also from cross-allergy between acrylic monomers. In individual cases it is difficult to assess which of the two alternatives is more probable because data on chemical composition of implicated acrylic products are usually superficial. In the present situation without accurate exposure

data, evaluation of the performance of individual test substances has no solid base. For a patch test recommendation, we ideally want a set of primary allergens truly present in products, and not just cross-reacting substances.

At the Finnish Institute of Occupational Health (FIOH) we routinely pay a lot of attention to our patients' exposure to their patch-test-positive allergens. As a part of a wider "Acrylate project", we wanted to analyze our patient data for allergic reactions to acrylic compounds in the latest decade (2010–2019) with a focus on exposure data.

2 | METHODS

2.1 | Clinical investigations

FIOH has a clinic of occupational dermatology. All our patients have a suspected occupational skin disease. We performed patch tests using Finn Chambers (Smart Practice, Phoenix, Arizona), in accordance with the European Society of Contact Dermatitis guidelines.[5] We read the tests two to three times: on day (D)2-D3-D4, D2-D3-D6, or D2-D5, depending on the day of application (Monday, Tuesday, or Wednesday). After patch tests, exposure to positive allergens is assessed in cooperation with a dermatologist and a chemist. This assessment often includes time-consuming inquiries to the manufacturers if the safety data sheet (SDS) does not provide sufficient information. We also perform chemical analyses when we fail to show exposure by other means. The methods have been described in our previous reports.[6,7]

2.2 | Test substances

In the baseline series, we first screened using triethyleneglycol diacrylate (TREGDA) for 8.7 years. It was replaced with diethyleneglycol diacrylate [DEGDA; di(ethylene glycol) diacrylate] in August 2018. 2-HEMA was added to the baseline series in March 2017.

Test substances were acquired mainly from Chemotechnique Diagnostics (Vellinge, Sweden). In addition, some in-house preparations were used. Since January 2011 we have used three different acrylate series (A, B and C; each with 10 test substances). Their present allergens are shown in Table S1. "Acrylate series A" has been used as a short screening series for patients with a remote possibility of exposure to acrylic compounds. When TREGDA was tested in the baseline series (8.7 years), DEGDA was in "Acrylate series A." 2-Hydroxyethyl acrylate (2-HEA) is a recent addition to "Acrylate series A" in August 2018. In 2010 we used a '(Meth)acrylate series' that was described in our earlier report.[6]

We screened our test files 2010–2019 for allergic reactions to acrylic compounds. We included patients who tested positive to some acrylic compound and were tested with some acrylate patch test series at FIOH. We studied their patch test results and exposure data.

3 | RESULTS

During the 10-year period from 2010 to 2019, a total of 426 patients were tested with at least one acrylate series; this corresponded to 37% of all our patch-tested patients. "Acrylate series A" was tested in 395 patients, "Acrylate series B" in 230 patients, and "Acrylate series C" in 183 patients. A total of 31 patients were tested with our previous "(Meth)acrylate series."

During the study period, a total of 55 patients tested positive to some acrylic compound. In Table S1 we present numbers of allergic reactions to individual acrylic compounds. All the included 55 patients were tested with "Acrylate series A," 48 with "Acrylate series B," and 39 with "Acrylate series C." Table S1 also comprises numbers of cases with an allergic reaction and present exposure to the same allergen shown by SDS or chemical analysis. 2-HEMA was the most commonly positive allergen with 21 cases, and 13 of these had specific exposure to HEMA. Eighteen patients tested positive for ethylene glycol dimethacrylate (EGDMA), but we could detect specific exposure in only two of them. 2-Hydroxypropyl methacrylate (2-HPMA) was positive in 16 cases and 5 of these had shown exposure to 2-HPMA.

We diagnosed 31 cases of allergic contact dermatitis (ACD). Eight ACD cases were due to anaerobic sealants, seven to dental products (dental technicians and assistants), three to windscreen glues, seven to eyelash glues and/or nail products in the beauty sector, three to UV-cured printing inks, two to paints/lacquers, and one to a polyester resin system. The remainder of the cases had contact allergy to acrylic compounds, but we could not find relevant present exposure.

3.1 | Anaerobic sealants

At FIOH, industrial glues were the most important cause of contact allergy to acrylic compounds. We had eight clear cases of occupational allergic contact dermatitis (OACD) caused by anaerobic sealants (Table 1). One of these was a previously reported case caused by 2,2-bis[4-(2-methacryl-oxyethoxy) phenyl] propane (bisphenol A ethoxylate methacrylate; bis-EMA), an epoxy methacrylate (no. 8 in Table 1).[8] The other seven cases were patch test positive to methacrylates, most commonly to 2-HPMA, 2-HEMA, and EGDMA. Six of these seven patients also tested positive for their own anaerobic product. In every case we could show—by information in the SDS, information provided by manufacturer, or by chemical analysis—that a patient's own anaerobic product contained at least one methacrylate to which the patient tested positive. In four cases, the SDSs did not have any hazard statement for skin sensitization, although the glues contained sensitizing acrylic monomers according to our chemical analyses.

We saw three other cases, all patch test-positive to DEGDA and/or pentaerythritol triacrylate (PETA), who had used anaerobic sealants. We chemically analyzed eight of their anaerobic glues for DEGDA and PETA, but we detected only methacrylates (Table 2). Thus a relation between the allergic reactions to acrylates and occupational exposure could not be confirmed. All eight analyzed anaerobic products were

TABLE 1 Cases of occupational allergic contact dermatitis related to anaerobic glues

No	Occupation, year of investigation	Patch test reactions		Safety data sheet (SDS) and/or information from the manufacturer	Results of chemical analysis
		Routine acrylic test substances	Own products		
1.	Machinist 2012	EGDMA +++; 2-HEMA +++; 2-HPMA +++; **TREGDMA +++; tetra-EGDMA +++;** BUDMA +++; GMA +; THFMA +++; DEGDA +++; TREGDA +++		Ergo 4101 SDS 2017: not hazardous	*Ergo 4101 screw locker*: **TREGDMA 14.4%,** BMA 0.25%, **tetra-EGDMA 17.1%,** penta-EGDMA 9.9%, di-EGDMA 3.3%, diethylene glycol monomethacrylate 0.14%
2.	Plumber 2012	EGDMA + **2-HEMA +**	*Siseal pipe sealant* 10% ++, 3.2% +, 1% +	*Siseal pipe sealant* Finnish SDS: Not hazardous Italian SDS: Skin Sens., HPMA 20–40%, 2-HEMA 5–10% *Loctite 243* SDS 2010: not hazardous, still warning of possible skin sensitization; poly-EGDMA-based product, no acrylic monomers mentioned	*Siseal pipe sealant*: **2-HEMA 39%,** lauryl-acrylate 18%, tetra-decyl-acrylate 15% *Loctite 243*: TREGDMA 5.2%, tetra-EGDMA 5.6%, di-EGDMA 1.8%, penta-EGDMA 1.8%
3.	Assembler of trucks 2010	**2-HEMA ++; 2-HPMA ++; EGDMA ++; TREGDMA ++; tetra-EGDMA NT; MMA +; EMA +; THFMA +; EA +; DEGDA +; TREGDA +**	*Loctite 542* 2% ++ *Loctite 601* 2% ++, 0.64% +, 0.1% +	*Loctite 542* SDS 2010: not classified as Skin Sens., still warning that skin sensitisation is possible; contains dimethacrylate esters *Loctite 601* SDS 2010: Skin sens., **2-HEMA 10–20%,** poly-EGDMA-based (SDS 2017: **TREGDMA** 50–100% also listed)	*Loctite 542*: **TREGDMA 8.1%, tetra-EGDMA 4.4%, di-EGDMA 2.5%, penta-EGDMA 1.0%, hexa-EGDMA 1.0%, HPMA 0.19%**
4.	Assembler of hospital beds 2014	**2-HEMA + 2-HPMA +**	*Loctite 2701* 2% +, 1% + *Loctite 243* 2% –, 1% –	*Loctite 2701* SDS 2011: Skin sens., **2-HPMA 40–50%** *Loctite 243* SDS 2011: Skin sens. due to maleic acid, no acrylates mentioned	
5.	Motor mechanic 2016	**BUDMA +;** THFMA +; TREGDA +; PEA +++	*Loctite 243* 2% +	*Loctite 243 SDS*: Skin Sens., **BUDMA 25–50%** (skin Sens. 1 B)	
6.	Assembler of motor parts 2019	**2-HEMA ++; 2-HPMA ++;** EGDMA +	*Loctite 2701* 5% +, 2% +	*Loctite 2701 SDS: Skin sens*., **2-HPMA 25–50%; 2-HEMA 0.1–1%**	
7.	Machinist 2018	2-HEMA +++; EGDMA +++; MMA ++; 2-HPMA ++; **TREGDMA +++,** EA +; **Tetra-EGDMA +++;** THFMA ++; UDMA +; BUDMA ++; TREGDA ++	*Hydraulic sealant* 5% ++, 1.64% ++, 0.5% +	*Hydraulic sealant Würth* SDS: Not hazardous Information from manufacturer: >50% poly-EGDMA (CAS no 25852–47-5)	*Hydraulic sealant Würth*: 73% EGDMAs including 4% di-EGDMA, **TREGDMA 66%, tetra-EGDMA 3%**
8.	Machinist 2012	**Bis-EMA +**	*Loctite 620* 2% +++, 1% +++	*Loctite 620* SDS: Skin Sens., 2-HPMA 1 – <5%	*Loctite 620*: **Bis-EMA 73%,** 2-HPMA 2.2%, TREGDMA 0.064%, propylene and ethylene-based dimethacrylates 0.09%

Note: Patch test-positive methacrylates in the patient's products in bold.

Abbreviations: BIS-EMA, 2,2-bis[4-(2-methacryl-oxyethoxy) phenyl] propane; BMA, butylmethacrylate; BUDMA, 1,4-butanediol dimethacrylate; DEGDA, diethylene glycol diacrylate; EA, ethyl acrylate; EGDMA, ethylene glycol dimethacrylate; EMA, ethyl methacrylate; GMA, glycidyl methacrylate; HEMA, 2-hydroxyethyl methacrylate; HPMA, 2-hydroxypropyl methacrylate; MMA, methyl methacrylate; UDMA, urethane dimethacrylate; PEA, phenoxyethyl acrylate; SDS, safety data sheet; tetra-EGDMA, tetraethylene glycol dimethacrylate; THFMA, tetrahydrofurfuryl methacrylate; TREGDA, triethylene glycol diacrylate; TREGDMA, triethylene glycol dimethacrylate.

TABLE 2 Results of chemical analyses of eight anaerobic sealants [these sealants belonged to three patients who were allergic to acrylates (esters of acrylic acid) but not to methacrylates. No acrylates were detected, thus a diagnosis of allergic contact dermatitis could not be confirmed]

Safety data sheet information	Results of chemical analysis
Loctite 243 (Skin sens.): BUDMA 25–50% (Skin sens. 1 B)	*Loctite 243*: MMA 0.042%; BMA 0.068%; BUDMA 20.9%; Di-EGDMA 1.76%; TREGDMA 5.23%; TMPTMA 0.44%; tetra-EGDMA 4.56%; penta-EGDMA 1.76%
Loctite 542 (*no Skin sens. classification*): No (meth)acrylates listed in hazardous ingredients	*Loctite 542*: MMA 0.055%; BMA 0.13%; HPMA 0.64%; di-EGDMA 2.77%; TREGDMA 7.78%; tetra-EGDMA 10.3%; penta-EGDMA 7.04%
Loctite 603 (Skin sens.): 2-HPMA 5–10%; 1,3-butyleneglycol dimethacrylate 10–20%; 4-tert-butylcyclohexyl methacrylate 25–50%	*Loctite 603*: MMA 0.11%; 2-HEMA 0.9%; HPMA 8.44% TREGDMA 0.62% *Loctite 603*: 2-HEMA 1.1%; 2-HPMA 15%; BUDMA 12%; TREGDMA 0.9%
Loctite 641 (no Skin sens. classification): No (meth)acrylates listed in hazardous ingredients	*Loctite 641*: 2-HEMA 1.5%; Di-EGDMA. %; TREGDMA 14%; oligo-EGDMA 48%
Ergo 4203 hydraulic sealant (no Skin sens. classification): No (meth)acrylates listed in hazardous ingredients	*Ergo 4203*: di-EGDMA 1.5%; TREGDMA 7.0%; oligo-EGDMA 11.9%
Bentex threadlocker: SDS not available	*Bentex threadlocker:* 2-HEMA 17%; EGDMA 0.26%; di-EGDMA 1.3%; TREGDMA 5.8%; oligo-EGDMA 11%
Loctite 275 (no Skin sens. classification): No (meth)acrylates listed in hazardous ingredients	*Loctite 275*: 2-HEMA 0.12%; TREGDMA 15%; tetra-EGDMA 18%; hexa-EGDMA 1.9%
Loctite 577 (Skin sens.): 1,4-BUDMA 10–20% (Skin sens 1B); TREGDMA 5–10% (Skin sens. 1B)	*Loctite 577*: TREGDMA 10%; di-EGDMA 3%; 2-HPMA 1%; 2-HEMA 0.01%; lauryl methacrylate 4%

Abbreviations: 2-HEMA, 2-hydroxyethyl methacrylate; 2-HPMA, 2-hydroxypropyl methacrylate; BMA, butylmethacrylate; EGDMA, ethylene glycol dimethacrylate; MMA, methyl methacrylate; BUDMA, 1,4-butanediol dimethacrylate; tetra-EGDMA, tetraethylene glycol dimethacrylate; TMPTMA, trimethylol propyl trimethacrylate; TREGDMA, triethylene glycol dimethacrylate.

based on methacrylates: All contained triethylene glycol dimethacrylate (TREGDMA), six contained di-EGDMA, and five contained larger ethyleneglygol dimethacrylates such as tetra-, penta-, or hexa-EGDMAs (Table 2).

3.2 | Dental professions

We had a total of seven cases of OACD in dental professions (four dental assistants, two dental technicians, and one dental hygienist; Table S2). The two dental technicians had allergic reactions to methyl methacrylate (MMA). Products of the dental technicians were usually MMA-based, but also EGDMA, ethyl methacrylate (EMA), 1,4-butanediol dimethacrylate (1,4-BUDMA), TREGDMA, and urethane methacrylates were mentioned in their SDSs.

One of the dental assistants was sensitized to epoxy acrylates and epoxy resin. She had had work-related facial dermatitis since the year 2000. Epoxy resin oligomer (MW 340) was not detected in her five dental composite resins that contained bisphenol A glycerolate dimethacrylate (bis-GMA) and one also contained bis-EMA. The other four dental assistants/hygienists tested positive to 2-HEMA, a common methacrylate in dental resins.

3.3 | UV-cured windscreen glues and resins

Windscreens are glued and repaired with UV-cured adhesives or resins. We had three cases caused by these products (Table S3). All three patients tested positive to 2-HEMA and EGDMA, and two of them also to 2-HPMA. The products contained 2-HEMA and/or 2-HPMA.

3.4 | Cyanoacrylate glues

We had three allergic patch-test reactions to ethyl cyanoacrylate (ECA) or ECA-based glues in patients from the industrial sector, but these were not clear OACD cases (symptoms were not related to use of instant glues). In the beauty sector, conversely, there were several cases. In addition to a previously reported beautician[9] with OACD from methacrylate impurities in eye lash extension glue, we had seen two ECA-positive hairdressers who had used eyelash extensions in their own eyes and developed eyelid dermatitis. One of them tested positive to her own ECA-based eyelash glue at a 10% concentration (+). Later she developed facial dermatitis when she used the same glue for her clients. The other hairdresser tested strongly positive to ECA (++), but her own glues were not tested. She had developed eyelid

dermatitis from several brands of eyelash glue. We also investigated two other beauticians with mild allergic reactions to their own eyelash glues (ECA negative or doubtful). They had eyelid dermatitis related to lash extension use in their own eyes.

3.5 | Artificial nails

The number of artificial-nail–related occupational cases was only two (Table S4). The first of them was a pedicurist who used acrylic nail products in her work. Liquid parts of these products tested positive and contained MMA or 2-HEMA to which the patient was sensitized. The other patient was a beautician sensitized to 2-HEMA in her acrylic nail gel. Her products were analyzed and found to contain not only methacrylates (2-HEMA, EGDMA, and EMA) but also relatively high concentrations of acrylates tri(propyleneglycol) diacrylate (TPGDA) and PETA. However, the patient did not test positive to these two acrylates but tested positive to 2-HEA, which was detected at a low concentration of 0.53%.

3.6 | Printing and production of printing inks

Three cases were related to printing (Table S5). A female pre-press technician with facial and hand dermatitis was widely sensitized to various acrylates including 1,6-hexanediol diacrylate (1,6-HDDA) and to one methacrylate, 1,4-BUDMA. She had handled a cleansing product for printing roller that was composed of 1,6-HDDA.

A male printer with eyelid dermatitis in wintertime was weakly sensitized to DEGDA. He used UV-cured printing inks. Six products were analyzed at FIOH, and five contained oligo-ethyleneglycol–based acrylates at concentrations of 1.6% to 87%. Other detected acrylic compounds were trimethylolpropane triacrylate (TMPTA), 1,4-butanediol diacrylate (1,4-BDDA), and 4-hydroxybutyl acrylate. The patient tested negative to TMPTA and 1,4-BDDA.

A male worker in the production of UV-cured inks for silk printing developed dermatitis on the forearms. He was weakly sensitized to TREGDA. Three raw materials for printing inks were declared to contain poly(ethyleneglycol) diacrylates at concentrations of 5–100%, and according to the manufacturer one raw material contained TREGDA. TMPTA, 1,6-HDDA, and TPGDA were also among the ingredients, but the patient tested negative to them.

3.7 | Paints and lacquers

Two cases were related to paints and lacquers (Table S6). A car painter had work-related hand dermatitis, and he was sensitized to 2-HEMA, 2-HPMA, and EGDMA. Five of his paints were analyzed at FIOH. One paint contained 0.41% 2-HEMA and another paint contained 0.1% 2-HPMA. In addition to these results, 2-HEMA and 2-HPMA were detected in all five paints, but their concentrations were below the limit of quantitation (<0.008%).

A female worker in a parquet flooring plant had atopic dermatitis and work-aggravated hand dermatitis. She was sensitized to TREGDA, DEGDA, and tetra-EGDMA. TREGDA was declared in the SDSs of her three parquet lacquers. In chemical analysis, DEGDA was detected at low concentrations in two lacquers and one UV filler. Other acrylic compounds detected in chemical analyses of five lacquers were DPGDA, hydroxybutyl acrylate, 1,6-HDDA, TPGDA, TMPTA, 1,6-HDDA, and 2-HPMA.

3.8 | Polyester resin systems (a case report)

A 59-year-old woman worked in a company producing glass-fibre–reinforced composite parts (such as bumpers) for trams with vacuum injection method. A new polyester resin, Giralithe Ditra GL 2109-10XP, was introduced in 2018. It was packed in 200 L barrels. Workers took resin from a barrel to a bucket with a shovel and often got resin splashes on the skin and clothes. The patient developed dermatitis on the forearms after one month working with the new resin. Symptoms healed when she was moved to another department in another building. She tested positive to the new resin, 1,6-HDDA, 1,4-BDDA, and DEGDA. In the SDS of Giralithe Ditra, 1,6-HDDA was declared at a concentration of 1%–3% with a warning for skin sensitization.

4 | DISCUSSION

This study describes clinical 10-year results of 55 cases with allergic patch test reactions to acrylic compounds in a special clinic of occupational dermatology. At FIOH, we have had a very low number of artificial nail–related cases compared to recent reports from other European countries.[10,11] It is possible that structure nails and gel nail polishes are not as popular in Finland as in other countries. A more likely explanation is that, according to Finnish legislation, people working on their own (as most nail technicians) are not obliged to insure themselves for occupational disease. We cannot investigate entrepreneurs who do not have an insurance.

4.1 | Test substances

The use of three different acrylate series allows us to easily vary the number of tested acrylic compounds in relation to the possibility of exposure. Patients who were tested with the series A but not with series B or C had only a remote possibility of acrylate exposure or some other reason to reduce the number of test substances.

2-HEMA was the most commonly positive test substance together with strongly cross-sensitizing EGDMA and 2-HPMA. 2-HEMA would have screened all EGDMA- and 2-HPMA-positive cases, but not all cases reacting to other methacrylates: One 1,4-BUDMA allergy from anaerobic glue and one MMA allergy from denture products were among the six 2-HEMA-negative cases with methacrylate reactions.

In the present material, dimethylaminoethyl methacrylate (DMAEMA) reactions were few and always associated with allergic reactions to at least four other methacrylates. We are neither aware of any case reports of ACD due to this compound nor have we seen a sensitized case with shown exposure to it. At least in occupational settings, it is a candidate for deletion from (meth)acrylate patch test series.

Among the acrylates (esters of acrylic acid) DEGDA was the most commonly positive test substance, and TREGDA was the second most common. 2-HEA together with EA was in the third position. In two recent studies, 2-HEA has been the most commonly positive of all (meth)acrylates.[12,13] In an old report from FIOH, the fraction of allergic reactions of patients tested with 2-HEA was the highest, slightly higher than that of patients tested with 2-HEMA.[14] For an unknown reason, our predecessors stopped testing 2-HEA in the early 1990s. In 2011, we reintroduced 2-HEA in our acrylate-screening series. In the present study, five of our seven 2-HEA–positive cases had also allergic reactions to 2-HEMA, 2-HPMA, and EGDMA. Uter and Geier also noted marked coupled reactivity between these compounds in female patients who had contact with nail cosmetics.[15]

Aromatic urethane diacrylate (ar-UDA) contains PETA. Since 1991 at FIOH, a total nine patients have tested positive to ar-UDA, all positive to PETA. We have never been able to detect specific exposure to urethane acrylates in patients displaying positive reaction to ar-UDA. Thus ar-UDA does not seem to provide any diagnostic value independent of PETA.

4.2 | Anaerobic sealants

Over the years we have seen many methacrylate-allergic patients reacting to anaerobic sealants that lack warning for skin sensitization. In these cases, we have often analyzed the products and without exception detected sensitizing methacrylate monomers. In the present material, half of the eight anaerobic-glue–related OACD diagnoses required chemical analyses, as SDSs failed to declare the acrylic compounds to which the patients tested positive. At present, 2-HPMA, TREGDMA, 1,4-BUDMA, and tetra-EGDMA lack harmonized classification as skin sensitisers. In addition, many related derivatives not yet classified might be sensitizing. This situation allows manufacturers to classify these chemicals as "not hazardous" in their own safety assessment. "Not hazardous" chemicals are not mentioned in an SDS.

4.3 | Printing products

UV-cured printing inks are usually based on acrylates and epoxy acrylates, and skin sensitization is occasionally reported in workers exposed to these products. The present series comprises three cases related to UV-cured printing inks who were sensitized to acrylates. Exposure to either 1,6-HDDA or ethyleneglycol-based acrylates could be found matching their allergic reactions (1,6-HDDA, DEGDA, and TREGDA). There are several reports of 1,6-HDDA sensitization in the printing industry.[16,17]

4.4 | Paints and lacquers

Both workers in the manufacture of UV-curable paints, varnishes, lacquers and coatings, and workers using these products are at risk of developing contact allergy to acrylic compounds. In the present series, there was a car painter sensitized to the methacrylates 2-HEMA, 2-HPMA, and EGDMA. Our analyses revealed 2-HEMA (0.41%) and 2-HPMA (0.1%) in his car paints. 2-HPMA still lacks harmonized classification as skin sensitizer, but 2-HEMA is classified as Skin sensitizer 1. The SDSs of these paints did not bear warnings of skin sensitization. This was not against EU law, as concentrations lower than 1% do not trigger hazard statements for a Skin sens 1 chemical. However, 2-HEMA should at least have been mentioned in the hazardous ingredients (Section 3) in the SDS, because its concentration was higher than 0.1%. This example makes us doubt if the classification of 2-HEMA as Skin sens 1 is strict enough to prevent sensitization. The Skin sens 1a classification would trigger a hazard statement at 0.1% concentration and listing at 0.01%.

4.5 | Acrylates in polyester resins

It is known that acrylic monomers, especially methyl methacrylate, can be used as cross-linking agents in polyester resin systems instead of styrene. Our fibre glass worker was rapidly sensitized to 1,6-HDDA that was a crosslinker in her polyester resin. We are not aware of any previous case reports of contact allergy to any acrylic compound from polyester resin systems.

5 | CONCLUSIONS

Many anaerobic sealants lack warnings of skin sensitization and labelling of acrylic compounds although they regularly contain sensitizing methacrylates. These cases are not strictly speaking violations of current EU law, because many methacrylates lack a binding harmonized classification as skin sensitizer. However, the major manufacturers of anaerobic glues should take account of wide clinical dermatological literature on the sensitizing capacity of the methacrylates present in their products, and accordingly declare them in the SDSs.

AUTHOR CONTRIBUTIONS

Kristiina Aalto-Korte: Conceptualization; data curation; formal analysis; funding acquisition; writing-original draft. **Katri Suuronen:** Data curation; funding acquisition; project administration; writing-review and editing.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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