

Acrylates as a significant cause of allergic contact dermatitis: new sources of exposure

Monika Kucharczyk¹, Małgorzata Stowik-Rylska^{1,2}, Sylwia Cyran-Stemplewska², Monika Gieróń², Grażyna Nowak-Starz¹, Beata Kręcisz^{1,2}

¹*Collegium Medicum, Jan Kochanowski University, Kielce, Poland*

²*Dermatology Department, Provincial Integrated Hospital, Kielce, Poland*

Adv Dermatol Allergol 2021; XXXVIII (4): 555–560

DOI: <https://doi.org/10.5114/ada.2020.95848>

Abstract

Acrylate monomers have a wide range of applications. Since the 1950s, many reports of occupational origin allergic contact dermatitis due to (meth)acrylate monomers have been published. During last decades, (meth)acrylate allergy has undergone an occupational shift from dentistry toward beauty industry and medical devices. The aim of the study was to conduct a literature review on acrylates as a cause of allergic contact dermatitis, current sources of exposure as well as identification of professional groups with an increased risk of this allergy and methods of effective prevention. Database review: Medline search (PubMed), Wiley Online Library and Web of Science base in years 1956–2019 using the following keywords: acrylates, manicurists, dentists, dental technicians, medical devices, occupational exposure, and allergic contact dermatitis. 204 346 articles containing the term ‘acrylates’ have been found. They include 2 042 articles with the word ‘manicurists’, 169 919 – ‘dentists’, 218 236 – ‘dental technicians’, 2 427 418 – ‘medical devices’. Fifty-nine articles were chosen based on analysis of abstracts and full texts. In the past allergy to acrylates was mainly of occupational origin and dental technicians were the most often affected professional group. Since the long-lasting manicure has become popular, this problem concerns both manicurists and their customers. Moreover, the new significant trend is non-occupational allergic contact dermatitis caused by medical devices especially dedicated to diabetes patients.

Key words: acrylates, allergic contact dermatitis, manicurists, medical devices.

Introduction

Acrylate monomers, which contain an acryl group derived from acrylic and methacrylic acid, have a wide range of applications [1–3]. Owing to their reactive double bonds, acrylates easily form polymer plastic structures spontaneously or on ultraviolet (UV) light exposure. The products containing acrylic polymers are relatively inert [4, 5]. However, sometimes active monomer particles are still released from polymer structures and are thought to act as haptens. They trigger allergic responses while high allergenic capacity have their monomeric and dimeric forms [6, 7]. The development of the methacrylate and acrylate compounds started in the 1930s. In a short time they found application in the manufacture of plastic glass used in aircrafts, paints, coatings, and printing inks [8]. Since the 1950s, many reports of occupational origin allergic contact dermatitis due to acrylate monomers have been published [3, 8]. Finally, isobornyl

acrylate has been named a contact allergen of the year for 2020 [9].

Sources of exposure

In the past most common exposures were associated with manufacturing, particularly in printing, painting, coating, metallurgical industries and dentistry [1, 10]. Among the common sources of these compounds there are floor waxes, floor coatings, surface treatments of leather, textiles and paper products [8]. Well-known examples of occupational allergy to (meth)acrylates most frequently occur among dental personnel. In the 1990s, sensitization increased considerably in this profession [11, 12]. Dental staff is exposed to a large number of materials being potential contact allergens like uncured plastic resins, mainly acrylic monomers – acrylates, methacrylates, urethane acrylates, and epoxy acrylates – used in dentistry in prostheses, dentin bonding materials, and

Address for correspondence: Monika Kucharczyk, *Collegium Medicum, Jan Kochanowski University, Al. IX Wieków Kielce 19A, 25-317 Kielce, Poland, phone: 603 390 702, e-mail: kucharczykmonik@gmail.com*

Received: 17.01.2020, **accepted:** 11.02.2020.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) License (<http://creativecommons.org/licenses/by-nc-sa/4.0/>)

glass ionomers [13, 14]. A retrospective analysis of the German Information Network of Departments of Dermatology patch test data from the years 2001–2015 stated that dental technicians (DTs), which constituted the study group with occupational contact dermatitis (OCD), are significantly more often diagnosed with allergic contact dermatitis than the dental technicians with contact dermatitis of non-occupational origin. In the study group, patch tests were most frequently positive to methacrylates and/or acrylates [13]. According to Aalto-Korte *et al.*, there is a varying frequency of allergy to particular acrylate haptens among dental staff. 2-hydroxyethyl methacrylate (2-HEMA) and methyl methacrylate (MMA) are reported to be the most important allergens among dentists and dental nurses, whereas ethyleneglycol dimethacrylate (EGDMA) have a negative influence on dental technicians mostly [15]. The typical clinical features of (meth)acrylate allergy in those occupational groups is hand eczema and pulpitis of the fingertips, especially of the first three fingers, although wide-spread dermatitis is also reported [8, 15, 16]. Sometimes there is involvement of the face and eyelids caused by airborne particles of acrylates or by allergen transport by contaminated tools or hands [17, 18]. Respiratory hypersensitivity may also be provoked by acrylates, e.g. wheezing, asthma or rhinoconjunctivitis [19]. Awareness of the sensitizing properties of acrylates has increased during last years. As a result of adequate personal protection as well as popularity of non-touch techniques, the number of methacrylate allergic dental personnel seems to decrease [15]. Another issue is allergic contact stomatitis, which was observed in some dental patients. The reason was inadequate polymerization and release of residual monomers from acrylate-based dental fillings [20]. The oral symptoms include subjective sensations like burning or soreness in the mouth, loss of taste, numbness, mucous membrane inflammation, vesiculations, erosions, lichenoid reaction confined to the area in contact with dental materials [21]. During last decades, (meth)acrylate allergy has undergone an occupational shift from dentistry toward beauty industry, and this change seems to be constantly trending upwards in many countries [22]. The most important sources of sensitisation are eyelash, hair extensions and primarily artificial nails [18, 23]. It is worth mentioning that false nail products are not a new source of acrylate allergy. The first description of such a case was published by Canizes in 1956 [24]. Currently wide availability of techniques based on acrylates, methacrylates or cyanoacrylates has resulted in increasing popularity of artificial nails among women and consequently frequency of sensitization [25, 26]. Acrylic nails were the most popular technique in the past. They are created from powder and liquid-based substance, containing acrylates, which is applied to the nail plate. The procedure does not require photocuring, however, it is rarely used because it is time consuming [23]. Today, the most common fashion trend

is the so-called permanent nail polish containing photo-bonded acrylates. This product is also known as ‘semi-permanent’, ‘long-lasting nail polish’ or ‘gel nail’ polish. It consists of a mixture of acrylate monomers, which are applied to the nail plate. Either fluorescent UV lamps or light-emitting diode (LED) lights are used for polymerization. Both the low cost and ease of application have been the factors of the aforementioned nail procedure [2, 27–29]. All types of artificial nails contain acrylates and can cause sensitization. Not only does it refer to the beauticians who apply them but also to the customers [23, 29]. It should be emphasized that the current commercialized home use kits could cause even higher degrees of allergy. ACD triggered by domestic-administered nail manicure has already been described in Australia, Sweden and Spain [18, 29, 30]. Additionally, sensitization may develop after months or even years of using false nails [31]. The clinical presentation of skin allergy includes pulpitis, finger dermatitis, acquired leukoderma in the fingertips, periungual eczematous lesions, nail dystrophy, sometimes with coexisting atypical locations like face- or neck-dermatitis [32]. Nail abnormalities can imitate psoriasis because of the presence of onycholysis and severe subungual hyperkeratosis. Nail lesions can exist without dermatitis of the digit [27, 28]. Allergic contact dermatitis induced by different types of acrylate stylisation techniques is often misdiagnosed. The patients usually do not realize the association between the use of manicure and abnormalities of nails [1, 2]. Involvement of all nails and the absence of specific signs of nail psoriasis, such as salmon patches, can be helpful in establishing the correct diagnosis. A nail biopsy is usually not necessary [31]. According to Gatica-Ortega *et al.*, the typical acrylate-allergy patient is a young, woman working as a beautician and suffering from hand and, occasionally, face dermatitis [18]. A retrospective study in 11 European Environmental Contact Dermatitis Research Group (EECDRG) showed that 67% of cases of acrylate-ACD were caused by materials used in nail stylisation. 43% of patients were exposed as consumers and 56% occupationally. Furthermore, 65% of cases with occupational ACD was revealed during the first year at work. This feature shows the high sensitizing potency of these chemicals [23, 33]. Most patients showed positive reaction to two or more acrylates. 2-hydroxyethyl methacrylate (HEMA), 2-hydroxypropyl methacrylate, ethylene glycol dimethacrylate and ethyl cyanoacrylate were identified as the most common positive allergens [23]. The literature contains descriptions of mucosal symptoms (ocular, nasal and respiratory) due to exposure to acrylates among beauticians. They include cases of induced asthma or exacerbations of pre-existing asthma, conjunctivitis and rhinitis [34–39]. Reutman *et al.* pilot findings suggested that among nail salon workers lung function and airway inflammation may be adversely influenced by working environment, possibly by contact with (meth)acrylates

[34, 36]. Work-attributed ocular, nasal and respiratory symptoms highlight strong irritant properties of these molecules [34].

Another fashionable trend in beauty industries is eyelash extensions. The false lashes are glued by a technician, lash by lash, to the customer's natural lashes. Eyelash glue often contains cyanoacrylates. The clinical manifestation is ocular disorders as blepharitis in customers or hand eczema in eyelash stylists [40]. Sometimes the first manifestations may be conjunctivitis and rhinitis from local application of acrylate-containing eyelash adhesive with eosinophil influx into the tears and subsequently into nasal lavage. Dudek *et al.* describe a case of a 35-year-old woman who was an office worker and had used acrylate-containing eyelash adhesive for artificial lash extension for 2 years. This adhesive contained a mixture of acrylates (ethyl-2-cyanoacrylate, alkoxy-2-cyanoacrylate, and polymethyl methacrylate). After topical application over 1 year (1–2 times a month), she developed blepharoconjunctivitis symptoms. Three to 4 months after the onset of ocular symptoms, the patient developed symptoms of rhinitis. When the adhesive was not used, the ocular and nasal symptoms resolved. Patch tests with European Baseline Series and Acrylate Series Nails Artificial and 10% ethyl cyanoacrylate (Chemotechnique Diagnostic, Vellinge, Sweden) showed a positive response to triethylene glycol diacrylate [7]. Previous sensitization to e.g. nail acrylates may lead to eczematous reactions after exposure to dental fillings, bone cement, hearing aids, surgical glues or insulin devices containing acrylates. Therefore, clinicians should be suitably trained to provide appropriate patient evaluation. For example, acrylate-allergic patients require uncemented arthroplasty and non-acrylate-releasing dental materials [20, 21, 23, 41].

New sources

Nowadays new sources of acrylates are constantly appearing. The case of acrylate allergic contact dermatitis triggered by hair prosthesis fixative was described in 2019 by Rodenas-Herranz *et al.* A 57-year-old male with scarring alopecia 4 weeks after using a capillary prosthesis fixed by an acrylate-based liquid glue (Ghostbond) developed a pruritic eczematous rash on the scalp. Although the patient changed the fixation to double-sided adhesive tapes (unknown composition), no improvement was noticed. The patch test showed positive reaction to hydroxypropyl methacrylate 2% pet. (2+), hydroxyethyl acrylate 2% pet. (2+), butyl acrylate (2+), adhesive tape (2+) and Ghostbond glue (2+) [42].

Currently acrylates have a wide application also in various medical purposes. They are important allergens in bone cement for orthopaedic endoprostheses, soft contact lenses, hearing aids as well as histological preparations [8]. Currently wound dressings are underlined

as emerging sources of sensitization to acrylates [1]. The literature contains case descriptions of severe dermatitis from surgical glue containing acrylates which is used by many surgeons. Because of prolonged exposure to those skin adhesive, for weeks or months after application, there is a higher risk of primary sensitization, particularly if the skin is inflamed [43].

Recently there have been several reports indicating medical devices for diabetes patients as an important cause of allergic contact dermatitis. New technologies such as flash glucose monitoring (FGM) measure the interstitial glucose levels [44]. In 2017, Herman *et al.* published results of a multicentre study that involving 15 patients. They presented a skin reaction to Freestyle Libre, which is the FGM system popular in Europe. The device is fixed on the skin for a 2-week period with an adhesive. Patients had a rash just below the adhesive part of the sensor. Twelve of 15 tested patients had a positive reaction to isobornyl acrylate that is used to combine the different components in this device [45, 46]. In another study, performed by Hyry *et al.*, seventy type 1 diabetes patients with a suspected contact allergy to glucose sensors were subjected to patch testing. The median exposure time was 6 months before first signs of sensor-associated dermatitis. Positive reactions to isobornyl acrylate were observed in 81% of Freestyle Libre users [46]. Isobornyl acrylate (IBOA) used in the past mainly in coatings, inks, cosmetics or paints was rarely a cause of contact allergy as compared with other (meth)acrylates [46]. While lately IBOA has been identified as a culprit sensitizer in the tubeless insulin pump (OmniPod) [47]. According to the present observations of increased prevalence of acrylate allergy in such devices, it is strongly recommended that manufacturers should eliminate this allergen from those systems [44]. Moreover, other acrylates recently emphasized as a significant sensitizer in devices for insulin infusion and monitoring of glucose levels are N,N-dimethylacrylamide (DMAA) or 2-ethyl cyanoacrylate present in the glue of the CGM Platinum G4 Dexcom sensor [48, 49]. In order to prevent symptoms, patients with ACD to acrylates may insert special hydrocolloid plates between the skin and the adhesive part of the sensor. Thanks to this, the allergic reaction can be limited [50, 51]. Another source of sensitisation to acrylates is transcutaneous electrical nervous stimulation (TENS) electrodes, used in the treatment of chronic back pain, and also in the adhesive layer of electrocardiogram electrodes [52, 53].

Furthermore, cases of ACD to acrylates are also reported in aesthetic medicine. In 2017, Shah *et al.* reported the case of a 28-year-old patient who developed allergic contact dermatitis caused by polymethyl methacrylate following an intradermal filler injection to correct his nose tip. In the past he had a mucosal reaction to a denture based on polymethyl methacrylate resin. Patch tests showed positive reactions (3+) to methyl methacrylate [41].

Diagnosis

Patch testing is a gold standard in confirming the diagnosis of allergy to acrylates. Nowadays, acrylic monomers are included in several different commercial patch test series like dental materials for dental patients, dental staff, artificial nails, and printing [15]. In some cases, acrylate allergy is polyvalent, patients present multiple positive patch tests reactions, although they have probably not been exposed to all of those substances. The reason may be cross-reactions between acrylic monomers and concomitant allergies due to their coexistence in particular products [3, 15]. Heratizadeh *et al.* reported, that among 67 (meth)acrylates allergic patients, 42% reacted to one or two (meth)acrylates, whereas 33% reacted to more than five (meth)acrylates [54]. The study by Raposo *et al.* showed that patch testing with HEMA was positive in more than 90% of cases of the (meth)acrylate allergy patients and patch testing to 2-hydroxypropyl methacrylate (HPMA) was positive in 64.1%. Consequently, they can be considered to be a good screening marker [6]. Recently, it has been proposed to add 2-HEMA and HPMA to the European baseline series [55].

Occupational prevention

Nitrile gloves are considered to be a more effective option than latex gloves, but only if exposure is brief (15–20 min), as shown by patch testing over glove fragments. Morgado *et al.* suggest using nitrile gloves for a maximum of 30 min, and then change if the procedure is not completed. They observed that during long-time exposure, (meth)acrylates probably diffuse from the nail gel, and therefore become the cause of dermatitis [56]. If the contact with an allergen is longer than 30 min, it is recommended to use 4H (ethylene–vinyl alcohol–polyethylene) fingerstalls below classic protective gloves or complete 4H Gloves [20, 21, 23, 41]. Unfortunately, 4 H gloves are not comfortable and limit the feeling of touch. Additionally, many mucosal and skin irritant reactions in the case of manicurists could be prevented and avoided by using efficient ventilation systems as well as personal protective equipment such as goggles, masks especially when exposure to volatile substances or dusts (e.g. nail dust) occurs [34]. The risk of sensitisation also depends on proper use of good quality UV-devices and adequate time of gel curing. This problem seems to be especially significant among women who self-apply the product at home. They are not trained enough and educated on the risks associated with handling acrylates. Necessary protective measures are not usually used by ‘home beauticians’. Moreover, they may change artificial nails too often and their skin comes into contact with nail polish more frequently causing a higher risk of sensitisation [29, 57].

Another significant issue is career counselling. Allergy to acrylates can have an important impact on

the choice of the future profession and ability to work [23]. The literature contains a description of a manicurist who developed an allergic skin reaction to acrylates after 3 months of work, manifested by bullous lesions on fingertips as well as eczema of the hands and ears. It should be emphasized that she was not correctly advised on retraining and started to work as a dental nurse. Soon after re-exposure to acrylates in dental materials, she experienced recurrence of the skin symptoms. Patch tests showed positive reactions to 2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, ethylene-glycol dimethacrylate, triethylene glycol dimethacrylate, 1,6-hexandiol diacrylate, 2-hydroxyethyl acrylate and triethylene glycol diacrylate. Because of her skin disorder, she had to change her job. In successful retraining and redeployment of individuals allergic to acrylates, the presence of these chemicals in various workplaces (e.g. in dentistry, beauty salons, printing industry and construction industry) should be considered. Otherwise, as in this case, re-exposure to acrylates in a new job may cause recurrence of the skin disorder [58].

Summary

In recent years allergy to acrylates has become an increasingly common problem. Nowadays artificial nail products are the most significant source of this allergy. Popularity, development of the beauty industry and improper usage of nail curing lamps have resulted in the epidemic of acrylate allergy. Therefore, policies regulating usage of these highly sensitizing chemicals for aesthetic procedures should be stricter. The awareness of a potential risk of sensitization to acrylates and available preventive measures need to be broadened particularly among workers of beauty industries during their apprenticeship. The new significant trend is allergic contact dermatitis caused by medical devices. Patch tests are considered to be the gold standard in establishing diagnosis. It is required to include both HEMA and HPMA in the baseline series as a good marker of acrylate sensitisation [55].

Acknowledgments

The project is supported under the programme of the Minister of Science and Higher Education under the name “Regional Initiative of Excellence” in 2019–2022, project number: 024/RID/2018/19, financing amount: PLN 11,999,000.00.

Name of the department to which the work should be attributed: Collegium Medicum, Jan Kochanowski University, Al. IX Wieków Kielc 19A, 25-317 Kielce, Poland.

Conflict of interest

The authors declare no conflict of interest.

References

- Spencer A, Gazzani P, Thompson DA. Acrylate and methacrylate contact allergy and allergic contact disease: a 13-year review. *Contact Dermatitis* 2016; 75: 157-64.
- van der Voort EA, van Neer FJ, Neumann HA. Acrylate-induced nail contact allergy. *Int J Dermatol* 2014; 53: e390-2.
- Sasseville D. Acrylates in contact dermatitis. *Dermatitis* 2012; 23: 6-16.
- Muttardi K, White IR, Banerjee P. The burden of allergic contact dermatitis caused by acrylates. *Contact Dermatitis* 2016; 75: 180-4.
- Uter W, Geier J. Contact allergy to acrylates and methacrylates in consumers and nail artists—data of the Information Network of Departments of Dermatology, 2004–2013. *Contact Dermatitis* 2015; 72: 224-8.
- Raposo I, Lobo I, Amaro C, et al. Allergic contact dermatitis caused by (meth)acrylates in nail cosmetic products in users and nail technicians—a 5-year study. *Contact Dermatitis* 2017; 77: 356-9.
- Dudek W, Wittczak T, Świerczyńska-Machura D, et al. Allergic blepharconjunctivitis caused by acrylates promotes allergic rhinitis response. *Ann Allergy Asthma Immunol* 2014; 113: 492-4.
- Piirilä P, Kanerva L, Keskinen H, et al. Occupational respiratory hypersensitivity caused by preparations containing acrylates in dental personnel. *Clin Exp Allergy* 1998; 28: 1404-11.
- Splete H. Dermatologists name isobornyl acrylate contact allergen of the year. AT ACDS. 2019. <https://www.mdedge.com/dermatology/article/195656/contact-dermatitis/dermatologists-name-isobornyl-acrylate-contact>
- Geukens S, Goossens A. Occupational contact allergy to (meth)acrylates. *Contact Dermatitis* 2001; 44: 153-9.
- Rustemeyer T, Frosch PJ. Occupational skin diseases in dental laboratory technicians (I). Clinical picture and causative factors. *Contact Dermatitis* 1996; 34: 125-33.
- Kanerva L, Alanko K, Estlander T, et al. Statistics on occupational contact dermatitis from (meth) acrylates in dental personnel. *Contact Dermatitis* 2000; 42: 175-6.
- Heratizadeh A, Werfel T, Schubert S, Geier J. Contact sensitization in dental technicians with occupational contact dermatitis. Data of the Information Network of Departments of Dermatology (IVDK) 2001–2015. *Contact Dermatitis* 2018; 78: 266-73.
- Estlander T, Alanko K, Jolanki R. Dental materials. In: *Contact Dermatitis*. Frosch PJ, Menné T, Lepoittevin JP (eds). Springer, Berlin 2006; 653-78.
- Aalto-Korte K, Alanko K, Kuuliala O, Jolanki R. Methacrylate and acrylate allergy in dental personnel. *Contact Dermatitis* 2007; 57: 324-30.
- Rustemeyer T, Frosch PJ. Occupational contact dermatitis in dental personnel. In: *Kanerva's Occupational Dermatology*. John S, Johansen J, Rustemeyer T, et al. (eds.). Springer, Cham 2019; 1-12.
- Gawkrodger DJ. Investigation of reactions to dental materials. *Br J Dermatol* 2005; 153: 479-85.
- Gatica-Ortega ME, Pastor-Nieto MA, Mercader-García P, Silvestre-Salvador J. Allergic contact dermatitis caused by (meth)acrylates in long lasting nail polish—are we facing a new epidemic in the beauty industry? *Contact Dermatitis* 2017; 77: 360-6.
- Savonius B, Keskinen H, Tuppurainen M, Kanerva L. Occupational respiratory disease caused by acrylates. *Clin Exp Allergy* 1993; 23: 416-24.
- Alamri A, Lill D, Summer B, et al. Artificial nail wearing: unexpected elicitor of allergic contact dermatitis, oral lichen planus and risky arthroplasty. *Contact Dermatitis* 2019; 81: 210-1.
- Koutis D, Freeman S. Allergic contact stomatitis caused by acrylic monomer in a denture. *Australas J Dermatol* 2001; 42: 203-6.
- Lin Y, Tsai S, Yang C, et al. Allergic contact dermatitis caused by acrylates in nail cosmetic products: case reports and review of the literatures. *Dermatol Sin* 2018; 36: 218-21.
- Gonçalo M, Pinho A, Agner T, et al. Allergic contact dermatitis caused by nail acrylates in Europe. An EECDRG study. *Contact Dermatitis* 2018; 78: 254-60.
- Canizares O. Contact dermatitis due to the acrylic materials used in artificial nails. *AMA Arch Dermatol* 1956; 74: 141-3.
- Rolls S, Rajan S, Shah A, et al. (Meth)acrylate allergy: frequently missed? *Br J Dermatol* 2018; 178: 980-1.
- Gonçalo M. Nail acrylate allergy: the beauty, the beast and beyond. *Br J Dermatol* 2019; 181: 663-4.
- Dahdah MJ, Scher RK. Nail diseases related to nail cosmetics. *Dermatol Clin* 2006; 24: 233-9.
- Rieder EA, Tosti A. Cosmetically induced disorders of the nail with update on contemporary nail manicures. *J Clin Aesthet Dermatol* 2016; 9: 39-44.
- Gatica-Ortega ME, Pastor-Nieto MA, Gil-Redondo R, et al. Non-occupational allergic contact dermatitis caused by long-lasting nail polish kits for home use: 'the tip of the iceberg'. *Contact Dermatitis* 2018; 78: 261-5.
- Gatica-Ortega ME, Pastor-Nieto MA, Silvestre-Salvador JF. Allergic contact dermatitis caused by acrylates in long-lasting nail polish. *Actas Dermosifiliogr* 2018; 109: 508-14.
- Mattos Simoes Mendonca M, LaSenna C, Tosti A. Severe onychodystrophy due to allergic contact dermatitis from acrylic nails. *Skin Appendage Disord* 2015; 1: 91-4.
- Marrero-Alemán G, Sabater-Abad J, Miquel FJ, et al. Allergic contact dermatitis to (meth)acrylates involving nail technicians and users: prognosis and differential diagnosis. *Allergy* 2019; 74: 1386-9.
- Sasseville D. Acrylates. *Dermatitis* 2012; 23: 3-5.
- Kieć-Świerczyńska M, Świerczyńska-Machura D, Chomiczewska-Skóra D, et al. Screening survey of ocular, nasal, respiratory and skin symptoms in manicurists in Poland. *Int J Occup Med Environ Health* 2017; 30: 887-96.
- Sauni R, Kauppi P, Alanko K, et al. Occupational asthma caused by sculptured nails containing methacrylates. *Am J Ind Med* 2008; 51: 968-74.
- Reutman SR, Rohs AM, Clark JC, et al. A pilot respiratory health assessment of nail technicians: symptoms, lung function, and airway inflammation. *Am J Ind Med* 2009; 52: 865-75.
- Sánchez Palacios A, Shaman F, García JA, Sánchez Palacios MA. Prevalence of cosmetic sensitivity among beauticians. *Allergol Immunopathol* 1995; 23: 148-52.
- Lazarov A. Sensitization to acrylates is a common adverse reaction to artificial fingernails. *J Eur Acad Dermatol Venerol* 2007; 21: 169-74.
- Kreiss K, Esfahani RS, Antao VC, et al. Risk factor for asthma among cosmetology professionals in Colorado. *J Occup Environ Med* 2006; 48: 1062-9.
- Pesonen M, Kuuliala O, Henriks-Eckerman ML, Aalto-Korte K. Occupational allergic contact dermatitis caused by eyelash extension glues. *Contact Dermatitis* 2012; 67: 307-8.

41. Shah V, Chaubal TV, Bapat RA, Shetty D. Allergic contact dermatitis caused by polymethylmethacrylate following intradermal filler injection. *Contact Dermatitis* 2017; 77: 407-8.
42. Ródenas-Herranz T, Navarro-Triviño FJ, Linares-González L, et al. Acrylate allergic contact dermatitis caused by hair prosthesis fixative. *Contact Dermatitis* 2020; 82: 62-4.
43. McDonald BS, Buckley DA. Severe dermatitis from Derma-bond® surgical glue. *Br J Dermatol* 2014; 170: 739-41.
44. Herman A, de Montjoye L, Tromme I, et al. Allergic contact dermatitis caused by medical devices for diabetes patients: a review. *Contact Dermatitis* 2018; 79: 331-5.
45. Herman A, Aerts O, Baeck M, et al. Allergic contact dermatitis caused by isobornyl acrylate in Freestyle® Libre, a newly introduced glucose sensor. *Contact Dermatitis* 2017; 77: 367-73.
46. Hyry HSI, Liippo JP, Virtanen HM. Allergic contact dermatitis caused by glucose sensors in type 1 diabetes patients. *Contact Dermatitis* 2019; 81: 161-6.
47. Raison-Peyron N, Mowitz M, Bonardel N, et al. Allergic contact dermatitis caused by isobornyl acrylate in OmniPod, an innovative tubeless insulin pump. *Contact Dermatitis* 2018; 79: 76-80.
48. Mowitz M, Herman A, Baeck M, et al. N,N-dimethylacrylamide – a new sensitizer in the FreeStyle Libre glucose sensor. *Contact Dermatitis* 2019; 81: 27-31.
49. Schwensen JF, Friis UF, Zachariae C, Johansen JD. Sensitization to cyanoacrylates caused by prolonged exposure to a glucose sensor set in a diabetic child. *Contact Dermatitis* 2016; 74: 124-5.
50. Oppel E, Kamann S, Reichl FX, Högg C. The Dexcom glucose monitoring system – an isobornyl acrylate-free alternative for diabetic patients. *Contact Dermatitis* 2019; 81: 32-6.
51. Kamann S, Oppel E. Hydrocolloid blister plaster decreases allergic contact dermatitis caused by Freestyle Libre and isobornyl acrylate. *Contact Dermatitis* 2019; 81: 380-1.
52. Dittmar D, Dahlin J, Persson C, Schuttelaar ML. Allergic contact dermatitis caused by acrylic acid used in transcutaneous electrical nervous stimulation. *Contact Dermatitis* 2017; 77: 409-12.
53. Foti C, Lopalco A, Stingeni L, et al. Contact allergy to electrocardiogram electrodes caused by acrylic acid without sensitivity to methacrylates and ethyl cyanoacrylate. *Contact Dermatitis* 2018; 79: 118-21.
54. Heratizadeh A, Werfel T, Schubert S, Geier J. Contact sensitization in dental technicians with occupational contact dermatitis. Data of the Information Network of Departments of Dermatology (IVDK) 2001-2015. *Contact Dermatitis* 2018; 78: 266-73.
55. Wilkinson M, Gonçalves M, Aerts O, et al. The European baseline series and recommended additions: 2019. *Contact Dermatitis* 2019; 80: 1-4.
56. Morgado F, Batista M, Gonçalves M. Short exposures and glove protection against (meth)acrylates in nail beauticians – thoughts on a rising concern. *Contact Dermatitis* 2019; 81: 62-3.
57. Dahlin J, Berne B, Dunér K, et al. Several cases of undesirable effects caused by methacrylate ultraviolet-curing nail polish for non-professional use. *Contact Dermatitis* 2016; 75: 151-6.
58. Kiec-Swierczynska M, Kręcisz B, Chomiczewska-Skora D. Occupational contact dermatitis to acrylates in a manicurist. *Occup Med* 2013; 63: 380-2.