

ALLERGIC REACTIONS IN THE NAIL INDUSTRY: CAUSES, DIAGNOSIS, PREVENTION

Liudmila Yukhymchak
Expert in Beauty Industry, Nail Master, USA

Abstract

This article summarizes current data on the causes of allergic reactions in the nail industry, focusing on the role of (meth) acrylates, cyanoacrylates, and resins. It also examines modifying risk factors, including skin barrier damage. The main clinical manifestations of allergic reactions in clients and nail technicians are presented. Particular attention is paid to diagnostics, with patch testing considered a reference method, often requiring the use of an extended (meth) acrylate allergen panel. Based on an analysis of current clinical and epidemiological data, approaches to allergic reaction prevention are systematized, including technical, professional, and medical measures aimed at minimizing allergen exposure and maintaining the skin barrier.

Keywords: Allergic contact dermatitis, (meth) acrylates, HEMA, patch testing, nail technician, occupational dermatoses.

Introduction

The scientific novelty of the article lies in a comprehensive examination of allergic reactions in the nail industry as professionally and consumer-induced allergic contact dermatitis with an emphasis on (meth) acrylates, as well as in the systematization of modern approaches to their diagnosis and prevention based on current clinical data.

The nail service industry (gel coatings, acrylic/acrylic gels, primers, adhesives, nail extension and repair systems) involves regular skin contact with low-molecular chemicals that can act as haptens and cause allergic contact dermatitis (ACD). In recent years, the dermatological literature has noted an increase in the number of reports of ACD associated with "nail acrylates" (including methacrylates and cyanoacrylates), and the problem affects both clients and nail technicians as a professional risk group.

The leading cause of allergic reactions in the nail industry are (meth) acrylates, used as monomers and oligomers in UV/LED-curable materials. 2-Hydroxyethyl methacrylate (HEMA) occupies a special place: a clinical review de Groot shows that HEMA is a significant allergen in North America and Europe, and the majority of sensitization cases are currently associated with nail cosmetics in consumers and professional nail technicians [1]. The European multicenter study EECDRG (2013–2015) further confirms the relevance of the problem: ACD caused by nail materials is often diagnosed by targeted testing, and patients often have reactions to several (meth) acrylate monomers, which complicates subsequent elimination and relapse prevention [2].

Clinical manifestations of nail dermatitis vary: in addition to typical lesions of the nail folds and hands, "ectopic" eruptions (eyelids, face, neck) have been described, which are associated with the transfer of allergens by hands and/or aerosol exposure during filing. Illustrative clinical observations include cases of allergy to artificial nails manifesting as eyelid dermatitis in non-professional users [3].

Of diagnostic significance, allergic reactions in the nail industry are often disguised as irritant dermatitis, atopic dermatitis, or infectious processes around the nail. Therefore, identification of the causative allergen is key to verification. Patch testing is considered a reference method for diagnosing ACD and the basis for prevention through the elimination of identified allergens; this is emphasized in clinical reviews and practical publications on the management of ACD [4].

Thus, the increasing prevalence of durable coatings and home kits, the high sensitizing capacity of (meth) acrylates and a significant proportion of professional exposures necessitate a systematization of the causes, approaches to diagnosis and prevention of allergic reactions in the nail industry based on a modern evidence base.

Allergic reactions in the nail industry are most often characterized by allergic contact dermatitis (ACD), which develops through skin contact with low-molecular substances (haptens) found in nail modeling/coating products. Monomers and additives play a key role, as they can penetrate the skin barrier, especially when the material comes into contact with the nail folds, when polymerization is incomplete, and also during chronic professional exposure by nail technicians.

1. (Meth) acrylates are the main etiologic factor of ACD. The most significant group of allergens are (meth) acrylates, used in gel coatings and modeling systems. Among them, one of the key sensitizers is 2-hydroxyethyl methacrylate (HEMA): a clinical review shows that in recent years, the majority of cases of HEMA allergy are associated with nail cosmetics among consumers and professional nail technicians [1].

2. Cyanoacrylates and adhesive systems. Adhesives (e.g. for tips /false nails) may include cyanoacrylates, which are also classified as "nails" acrylates" and have been described as causes of ACD, especially with repeated exposures.

3. Resins in nail polishes: TSFR (toluenesulfonamide formaldehyde resin). For classic varnishes, toluene - sulfonamide - formaldehyde remains a significant allergen resin (TSFR) used to improve durability and gloss; contemporary reviews and clinical publications continue to describe cases of ACD associated with TSFR [2].

4. Modifying factors: irritants and barrier damage. Solvents and frequent "removals," repeated microtrauma, and maceration are not necessarily allergens in themselves, but they enhance the penetration of haptens and increase the risk of sensitization/exacerbation of ACD, especially when combined with (meth) acrylates (mixed irritant and allergic dermatitis). This mechanism follows directly from clinical observations and the occupational pathological logic of working with nail acrylates " (contact/frequency/dose) [1].

Table 1 - Main causes of allergic reactions in the nail industry

Causal group	Where it is found	A typical clinic	Comment
(Meth) acrylates (including HEMA)	gel polishes, gels/acrylic gels, primers, modeling systems	ACD of the periungual folds and hands, sometimes "ectopia" (face/eyelids)	skin contact with unpolymerized monomers; frequent co-sensitization to several monomers
Cyanoacrylates	adhesives for tips /false nails	localized dermatitis around the nail/on the fingers	repeated contact with glue, skin contact
TSFR (toluenesulfonamide formaldehyde resin)	traditional varnishes/hardeners	periungual dermatitis, sometimes hands/face	sensitization to resin in decorative coatings
Barrier "amplifiers" of risk (irritants, microtraumas)	solvents, frequent removal, filing, maceration	irritation + exacerbation of ACD	Damage to the barrier facilitates the penetration of allergens and maintains inflammation

Diagnosis of allergic reactions associated with the nail industry is primarily aimed at confirming allergic contact dermatitis (ACD) and identifying the causative allergen. The clinical picture (involvement of the nail folds, hands, and often the face and eyelids) combined with a history of exposure to nail products suggests ACD; however, a specialized examination is required to confirm the diagnosis.

Patch testing is recognized as the "gold standard" for diagnosing allergic contact dermatitis. International and national guidelines emphasize that only patch testing can reliably differentiate allergic contact dermatitis from irritant dermatitis and other dermatoses. This is especially important in the nail industry, where clinical manifestations are often nonspecific [5].

A basic allergen panel is often insufficient to identify allergies associated with nail cosmetics. Research shows that if a "nail" is suspected, acrylate allergy » it is necessary to use an extended panel of (meth) acrylates, including HEMA, HEMA, HPMA, EGDMA, TEGDMA, etc. HEMA is considered an effective screening allergen, however, a negative reaction to it does not exclude sensitization to other monomers [6].

In diagnosis, it is important to consider the occupational history (frequency of procedures, working without gloves, filing), the temporal relationship of symptoms to exposure, and the dynamics after elimination of suspected products. Laboratory tests (IgE, skin prick tests) are not informative for ACD and are not recommended for routine practice. Differential diagnosis includes irritant dermatitis, atopic dermatitis, infectious lesions of the periungual tissues, and nail psoriasis.

Table 2 - Main stages of diagnosing allergic reactions in the nail industry

Diagnostic stage	Content	Diagnostic purpose
Clinical examination	Evaluation of localization, morphology of rashes, damage to nails and skin	Assumption of ACD, exclusion of infections
Exposure history	Connection with manicure, gel coatings, professional activities	Establishing a causal relationship
Patch testing	Basic + extended (met) and acrylic series	Confirmation of ACD, identification of the allergen
Post-elimination assessment	Regression of symptoms after avoiding contact	Clinical confirmation of the allergen's significance
Differential diagnosis	Exclusion of ICD, atopy , psoriasis, infections	Correct treatment tactics

Prevention of allergic reactions in the nail industry should be multi-faceted and aimed at reducing skin contact with sensitizing substances, primarily (meth) acrylates, and maintaining the integrity of the skin barrier. Given that allergic contact dermatitis is a delayed-type reaction and develops after sensitization, the key principle of prevention is the avoidance of initial and repeated exposure to allergens.

Prevention at the level of technique and procedure organization. One of the key preventative measures is the correct technique for performing nail procedures, preventing contact of unpolymerized materials with the skin. Clinical reviews emphasize that contact of the nail folds with gel and acrylic monomers during application and insufficient polymerization is considered the leading factor in sensitization. Adequate control of the time and intensity of UV/LED polymerization reduces the amount of residual monomers and, consequently, the allergen load [6].

Professional prevention for nail technicians. Nail technicians are considered to be at high occupational risk. It is recommended to wear gloves with proven chemical resistance to (meth) acrylates (primarily nitrile), change them regularly, and use local exhaust ventilation to reduce aerosol exposure during filing . Occupational pathology studies indicate that reducing cutaneous and inhalation exposure to acrylates reduces the incidence of occupational allergic dermatitis [8].

Prevention for clients. For nail service users, prevention includes choosing a technician who adheres to the technique without material contact with the skin, refraining from using at-home kits without proper training, and immediately discontinuing treatments if signs of dermatitis appear. Once sensitization has developed, even minimal repeated exposures can cause relapses, as confirmed by clinical observations in patients with HEMA allergies.

Early diagnosis of ACD using patch testing plays an important role in secondary prevention, allowing for accurate allergen identification and the development of individualized elimination recommendations. Informing patients and practitioners about identified allergens and cross-reactions has been shown to reduce the frequency of exacerbations and professional restrictions [5].

Thus, the prevention of allergic reactions in the nail industry is based on a combination of technical, organizational, and medical measures aimed at minimizing exposure to allergens and maintaining the skin barrier, which is a key condition for reducing the incidence of both occupational and consumer allergic dermatoses.

Table 3 - Common allergens/triggers in the nail industry and practical guidelines

Group of substances	Where do they meet?	A typical clinic	Diagnostics	Prevention
(Meth) acrylates (HEMA, etc.)	gel polishes, gels/acrylic gels, primers, extension systems	ACD of the folds/hands, often the face/eyelids	patch test, often need an extended panel	avoid contact with skin, correct polymerization, PPE, ventilation
Cyanoacrylates	adhesives for tips /false nails	local dermatitis, cracks, sometimes "ectopia"	patch test with relevant allergens	minimizing contact, choosing alternatives, PPE
Resins/film formers, preservatives, flavorings	varnishes/top coats/ care products	dermatitis around the nails, hands	patch test (cosmetic series)	Selection of products without sensitizers, refusal in case of reaction
Solvents (as irritants)	removal of coatings	irritant dermatitis, dryness, cracks	Clinical examination + exclusion of ACD by patch test	contact reduction, barrier creams, gloves

Consequently, allergic reactions in the nail industry are most often represented by ACD to (meth) acrylates, with HEMA being the key marker allergen, and many patients exhibit reactions to multiple monomers. The reference diagnostic method is patch testing, often with an extended (meth) a acrylate panel. Prevention requires a multi-layered approach: correct application and polymerization techniques, minimizing skin contact with monomers, organizational safety measures and PPE for technicians, as well as early recognition of symptoms and cessation of exposure for clients and employees.

References

1. de Groot AC 2-Hydroxyethyl methacrylate (HEMA): a clinical review of contact allergy and allergic contact dermatitis-Part 1. Introduction, epidemiology, case series and case reports // Contact Dermatitis. 2023. Vol. 89, No. 6. P. 401-433. DOI: 10.1111/cod.14405. PMID: 37752620.
2. Gonçalo M., Pinho A., Agner T., Andersen K.E., Bruze M., Diepgen T. et al. Allergic contact dermatitis caused by nail acrylates in Europe. An EECDRG study // Contact Dermatitis. 2018. Vol. 78, No. 4. P. 254-260. DOI: 10.1111/cod.12942. PMID: 29266254.
3. Moreira J., et al. Eyelid dermatitis due to artificial nails: a case report and review of the literature // Dermatology Reports. 2017. Vol. 9, Article 7198. PMID : 29266254. – URL : <https://pmc.ncbi.nlm.nih.gov/articles/PMC5452630/>

4. Fonacier LF, Bernstein DI, Pacheco K., Holness DL Contact dermatitis: a practice parameter update 2015 // Journal of Allergy and Clinical Immunology: In Practice. 2015. Vol. 3, Suppl. 3 S. P. S 1- S 40. – URL : [https://www.jaci-in-practice.org/article/S2213-2198\(24\)00525-7/abstract](https://www.jaci-in-practice.org/article/S2213-2198(24)00525-7/abstract)
5. Fonacier LL Contact dermatitis: patch testing as the gold standard for diagnosis // Dermatitis. 2015. Vol . 26, No. 5. – URL : <https://pubmed.ncbi.nlm.nih.gov/26054552/>
6. Gonçalo M., Agner T., Andersen K.E., Bruze M., Diepgen T., Foti C. et al. Allergic contact dermatitis caused by nail acrylates: multicenter European study findings // Contact Dermatitis. 2018.
7. Rietschel RL, Fowler JF Fisher's Contact Dermatitis. 7th ed. – Philadelphia: Wolters Kluwer Health, 2019.
8. Patruno C., Napolitano M., Angelo F. Occupational allergic contact dermatitis to gel nails in beauticians // Occupational and Environmental Medicine. 2012. Vol. 69, No. 10. P. 772-774.

