

## The Role of Cosmetological Procedures and Hand Care Techniques in the Pathogenesis of Onycholysis

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**Abstract.** Onycholysis is one of the most common symptoms of nail damage, and recent years have been characterized by a noticeable increase in its association with cosmetic procedures, in particular the intensive use of gel and acrylic coatings.

The aim of the study was to determine the role of cosmetic procedures and hand care techniques in the pathogenesis of onycholysis.

**Materials and methods.** During the work, an analysis of modern scientific publications devoted to the study of the pathogenesis of onycholysis was conducted. The search for works was carried out in scientometric databases "Web of Science", "Scopus", "PubMed", "Google Scholar". Methods of theoretical generalization, analysis and synthesis of results were used.

**Results.** During the work, it was established that the main factors in the development of onycholysis are trauma to the nail during manicure, the use of chemically aggressive primers, frequent removal of coatings, as well as contact with allergens. The article notes that an important role is also played by incorrect manicure technique, prolonged wearing of false nails without rest, violation of the barrier function of the cuticle, ignoring protective equipment when in contact with moisture and detergents. Clinical variants of onycholysis are described: traumatic, allergic, infectious, photoinduced. It was found that in most cases cosmetically induced onycholysis has a mixed nature. This is a combination of mechanical and chemical damage with a possible allergic component. The work emphasizes the importance of differentiating such conditions from fungal lesions and nail psoriasis. The need to develop standards for safe manicures, introduce hypoallergenic technologies, and raise awareness among nail technicians and clients about preventing nail damage was emphasized.

**Conclusions.** Cosmetic procedures and hand care techniques affect the development of onycholysis. To prevent onycholysis, it is necessary to adhere to gentle manicure techniques, take breaks in wearing artificial coatings, protect hands from excessive moisture and chemicals, and consult a dermatologist in a timely manner if signs of peeling appear. In addition, it requires standardization of the safe use of nail cosmetics and rehabilitation of nails after injuries, which determines the directions of further research in this area.

**Keywords:** onycholysis, manicure, gel polish, traumatic nail injury, hand care, nail plate.

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### Introduction

Onycholysis is the separation of the nail plate from the nail bed, which is manifested by the appearance of a cavity under the nail and a change in the color of the nail area to white or yellow. This condition is a common nail problem and has a multifactorial etiology: it can be caused by injuries, infections (fungal, bacterial), skin diseases (psoriasis, lichen planus), systemic disorders (thyrotoxicosis), phototoxic reactions and other factors [1]. However, in modern conditions, the share of exogenous factors associated with cosmetic procedures and daily hand care in the occurrence of onycholysis is increasing. The last decade has been marked by a real boom in nail aesthetics. The popularity of manicure among young people has reached its peak. Gel polishes and acrylic nails have become widespread due to their aesthetics and long-lasting coating, although their application requires more aggressive technologies (ultraviolet polymerization, etc.).

At the same time, reports of adverse nail changes associated with manicure procedures have increased. The most common include psoriatic nail dystrophy, pterygium, allergic contact dermatitis, paronychia, onychomycosis, and onycholysis [2, 3]. According to some studies, almost 20% of women experience nail changes after removing gel polish, with about 0.3–0.4% developing onycholysis [4]. Allergic contact dermatitis (ACD) to components of nail cosmetics is often manifested by inflammation around the nail, itching, thickening of the nail bed, and onycholysis itself.

Thus, an urgent scientific problem is to clarify the role of cosmetic nail manipulations and daily hand care practices in the pathogenesis of onycholysis. This will allow for timely identification of etiological factors, prevention of nail damage, and improvement of patient treatment outcomes.

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### Results and their discussion

Scientific literature data confirm that cosmetic nail manipulations and hand care methods play a significant role in the occurrence of onycholysis. In particular, prolonged and repeated use of modern cosmetic nail coatings often leads to structural changes in the nail plate (its dehydration, fragility, thinning), which creates the prerequisites for its exfoliation. According to surveys, more than 75% of gel polish users note various negative changes in nails after removing the coating [5], among which almost a third indicate brittleness and delamination of nails. Although the proportion of overt onycholysis among these cases is relatively small in samples of gel polish users, it is the systematic influence of manicure factors that creates the background for its development [6]. It has been established that most patients with onycholysis have a history of traumatic or chemical effects associated with the manicure procedure or hand care [7]. This emphasizes that onycholysis is a polyetiological process that develops against the background of chronic nail microtrauma, chemical damage, and sometimes allergic inflammation.

Nowadays, hybrid gel nail polishes are widely used, which coincides with the increase in the number of patients with onychodystrophies. Long-term wearing of gel coatings without breaks for nail restoration leads to a gradual depletion of the keratin material of the nail plate. Objectively, this is manifested by a decrease in the content of cysteine and methionine by 20–30% after 6 months of regular use of gel polishes [8]. Such a loss of sulfur-containing amino acids weakens the strength of the nail, makes it thin, "papery", dry and brittle, which is established in patients.

It is known that when wearing a gel coating, the nail undergoes an occlusive effect, transepidermal water loss decreases, and after removing the coating, the pH of the nail plate increases [9]. These changes disrupt the normal physicochemical properties of the nail, contribute to dryness and the formation of microcracks. As a result, the nail plate loses its elasticity and ability to adhere tightly to the nail bed, which creates conditions for distal delamination. The greatest damage to the nails is observed precisely after removing the gel polish. Changes such as a decrease in nail hardness, splitting, or white spots under the stratum corneum have often been noted. Although onycholysis directly after a single use of gel polish is rare, repeated cycles of “application, wear, removal” without proper rest of the nails have a cumulative harmful effect. According to published data by Iorizzo M. et al. (2025) [7], Borowczyk K., & Głowacki R. (2021) [8], Gatica-Ortega ME et al. (2018) [9] even in the presence of side effects, more than 70% of people continue to use gel polish regularly, which only exacerbates chronic nail damage. Thus, prolonged continuous wearing of gel coatings is an important factor in the pathogenesis of onycholysis, mediated through dehydration and disruption of the integrity of nail keratin.

Another key pathogenetic factor is physical stress on the nail during cosmetic procedures. Aggressive manicure techniques (deep filing of the nail surface for better adhesion of materials, sharp tearing of artificial coatings or false nails) can cause detachment of the nail plate from the bed even in relatively healthy nails. In particular, acrylic false nails are known for their rigidity and strong adhesion to the natural nail, which is why, when subjected to shock load or improper removal, the nail separates from the bed. The literature describes the so-called “*pseudopsoriatic nails*” in women with acrylic manicure. This manifests itself in a picture similar to the nail form of psoriasis (pronounced distal onycholysis with significant subungual hyperkeratosis), but is caused by purely traumatic damage to the nail [10]. Sudden removal of artificial material that is firmly glued to the nail often leads to massive delamination and subungual keratinization. Moreover, the use of hard, non-curved plastic tips (pads) on the tips of the nails creates constant pressure and disrupts the cushioning even with a slight impact; such hard pads can cause the plate to separate from the bed [11]. Therefore, any factors that reduce the flexibility and integrity of the nail plate increase the risk of onycholysis. It should be noted that the long free edge of the nail itself (as in extensions) acts as a lever: it increases the load on the nail attachment zone in case of injury. Therefore, excessive nail length and traumatization (impacts, pressure, improper filing) are important links in the pathogenesis that often precede the development of onycholysis.

Another important factor is allergic inflammation in response to components of nail cosmetics. Patients with chronic onycholysis often noted the presence of peripheral redness or mild swelling around areas of nail exfoliation, which could indicate subclinical contact dermatitis. In recent years, there has been a sharp increase in cases of allergy to (meth)acrylates, which are key components of gel and acrylic nail materials [12, 13]. While acrylate allergy was previously mainly a professional problem of manicurists, it is now increasingly common in ordinary people, which confirms the effect of the widespread use of permanent nail polishes at home [11, 12]. Allergic contact dermatitis (ACD) in the nail area leads to inflammation of the nail bed and matrix, impaired nail nutrition and keratinization, as a result of which the nail plate is distally rejected. Thus, a review of cases of ACD induced by hybrid manicure indicated that all patients with acrylate allergy developed onycholysis with subungual hyperkeratosis, often mistaken for fungal or psoriatic infection [13, 14, 15]. Allergic onycholysis can clinically simulate onychomycosis or nail psoriasis, which makes diagnosis difficult. In such cases, careful history taking (detection of contact with allergenic materials) and patch testing are crucial. The most sensitizing components of nail cosmetics include methacrylates (e.g., 2-hydroxyethyl methacrylate – HEMA) and cyanoacrylates used in adhesives [16]. Allergic nail lesions caused by classic varnishes are also known - in particular,

toluenesulfonyl formaldehyde resin (TSFR), which is included in many varnishes, can cause contact dermatitis of the nail plate and bed with the development of onycholysis. In patients with suspected nail psoriasis, patch tests revealed allergies to the components of the varnish, and after their elimination, the condition of the nails improved significantly. The allergic mechanism of onycholysis should be suspected in the presence of inflammatory changes in the skin around the nail or in combination with diffuse dermatitis of the hands.

It is worth noting that some non-obvious triggers can also lead to onycholysis. For example, in patients taking tetracycline antibiotics, the use of gel manicures (with UV radiation) can provoke the so-called *photoonycholysis* - V-shaped nail peeling under the influence of ultraviolet light. This phenomenon is rare, but it emphasizes how diverse the pathogenetic pathways of nail peeling can be. In general, allergens in nail cosmetics have become a significant cause of onycholysis in the last 5–6 years, and it is important for dermatologists to take this into account when diagnosing and treating. Almost all cases of adverse reactions to acrylic nails are associated with allergies to methacrylates, and the authors Staehle HJ, & Sekundo C. (2021) [17] raises the question of the need for stricter regulation and control of the composition of home nail kits.

The results also indicate that daily habits of hand and nail care can either contribute to the development of onycholysis or prevent it. Prolonged contact with water and detergents without protection negatively affects the nails, repeated swelling and drying of the nail leads to the formation of small cracks, delamination of the plate and its separation from the bed. Patients who often wash dishes, clean or work in a humid environment without gloves are much more likely to show signs of distal nail delamination. Another factor is the incorrect technique of manicure at home. Independent manicure by inexperienced persons is associated with a higher risk of nail damage.

For example, in one survey, 55.9% of women who applied gel polish themselves reported a worsening of their nails after removing their manicure, compared with only 18.1% of those who had the procedure done by a professional [5]. The main mistakes in home care are excessive filing of the nail surface (“etching” the plate), use of coarse abrasive files, cutting the cuticle and injuring the matrix, as well as neglect of basic rules (for example, removing the polish by peeling). All of these actions injure the nail plate and surrounding tissues, which contributes to the development of peeling. It has been confirmed that deep traumatic etching of the nail (physical or chemical “etching” for better adhesion) significantly increases the risk of onycholysis when wearing artificial coatings [18]. On the contrary, adherence to gentle techniques (minimal nail grinding, use of acid-free primers) helps reduce this risk.

It is also important to pay attention to your nail repair regimen. Current research shows that regular breaks between gel polish application cycles give nails time to restore moisture and disulfide bonds. keratin bonds [8]. In practice, patients should be advised to alternate periods of wearing artificial nail plates with periods of “rest” of the nails, to use moisturizing oils and cuticle creams, and to avoid acetone-containing products unless necessary. Proper care techniques and timely prevention can significantly reduce the risk of onycholysis, even with continued cosmetic procedures.

Based on the above data, several key pathogenetic mechanisms of onycholysis induced by cosmetic procedures can be identified (Table 1). Mechanical disruption of the connection between the nail plate and the nail bed under the influence of trauma or pressure - both acute (impact, breakdown of the nail plate) and chronic (microtrauma from a file, pressure of a long nail on the nail bed). Chemical damage to the nail keratin (dehydration, disruption of disulfide bonds). bonds, pH change) due to the action of aggressive substances (solvents, primers, glues) leads to the loss of plasticity of the nail and its tendency to cracks and peeling.

Table 1

**The main factors of cosmetic procedures and hand care in the development of onycholysis and their characteristics**

| Factor                                                                                                                    | Nature of the impact on the nail (pathogenetic mechanism)                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Long-term wearing of gel polish without interruptions                                                                     | Occlusion of the nail under the polymer layer leads to a decrease in transepidermal moisture loss, water accumulation; an increase in pH after removal of the coating causes disruption of the keratin structure, softening and brittleness of the nail. |
| Acrylic false nails and hard tips                                                                                         | Rigid inelastic construction, transfer of shock loads to the nail bed without cushioning; strong adhesion of acrylic to the nail and when removed, the plate separates from the bed (traumatic onycholysis).                                             |
| Aggressive manicure techniques (deep filing of the nail, cutting the cuticle, peeling off gel polish)                     | Microdamage to the surface layers of the nail plate and matrix contributes to nail thinning and the formation of cracks; inflammation of the periungual ridges leads to impaired nail attachment.                                                        |
| Allergenic components of varnishes and systems (methacrylates in gels, cyanoacrylates in glues, formaldehyde resin, etc.) | Contact dermatitis of the nail bed and rollers (type IV hypersensitivity) leads to destruction of epithelial connections between the nail plate and the bed, subungual hyperkeratosis; complete rejection of the nail is possible.                       |
| Frequent contact with water and detergents without protective gloves                                                      | Alternating swelling and drying of the nail plate contributes to the leaching of lipids, the appearance of numerous small cracks (brittle nail syndrome), which contributes to the gradual peeling of the distal edge of the nail.                       |
| Lack of breaks and nail care (permanent manicure without pauses, ignoring strengthening products)                         | Cumulative depletion of the nail plate (accumulation of microdamages) affects the development of chronic onychodystrophy; the lack of regeneration pauses prevents the nail from regaining strength, which contributes to repeated delamination.         |

Allergic inflammation in the nail area causes destruction of the nail bed and matrix tissues, which also ends with the rejection of the plate. The role of infectious complications should be noted separately. Onycholysis facilitates colonization of the subungual space by pathogens (often *Pseudomonas aeruginosa*, *Candida*), leading to the so-called “green nail” syndrome and secondary changes [19].

Thus, the pathogenesis of cosmetically induced onycholysis is complex and multicomponent, ranging from mechanical to immunological and microbial factors. The causes of onycholysis associated with cosmetics and care are multifaceted. It is important that these factors often act in combination. For example, an inexperienced person can simultaneously injure the nail with incorrect technique and cause allergic inflammation due to contact with sensitizing materials. It is the accumulation of several adverse effects that most often leads to clinically pronounced nail exfoliation.

The phenomenon of mass non-medical use of acrylate materials, which caused a kind of “epidemic” of allergic onycholysis among young women in Europe. This problem has become so widespread that the dermatological community is discussing the need for regulatory changes, in particular, limiting the content of potential allergens in products for home use and mandatory informing consumers about the risks. New methods of objective



assessment of the condition of nails have appeared. For example, ultrasound imaging of the nail plate has made it possible to detect subclinical signs of damage (thinning, unevenness of the plate, delamination) in patients after cosmetic procedures even before the development of visible onycholysis [20].

Chemical analysis methods (chromatography) have for the first time quantitatively demonstrated the loss of structural components of the nail under the influence of gel polish [21]. These scientific achievements deepen the understanding of pathogenesis and confirm the need for prevention. In addition, even realizing the harm to nails, the majority continue to use cosmetic procedures. This indicates a lack of awareness and a frivolous attitude to nail health, which requires more active involvement of dermatologists in educational work. Among the debatable and poorly studied issues remains the optimal tactics of managing patients with onycholysis caused by cosmetics. Currently, there is a lack of controlled studies on how long it takes for nails to fully regenerate after gel polish, how to effectively restore the nail plate (the role of strengthening agents, diet, biotin, etc.) and how to prevent relapses when returning to manicure. The question of the permissible frequency and intensity of cosmetic procedures that would minimize risks is not fully clarified.

### Conclusions

Nowadays, it has been established that cosmetic procedures for nails and everyday care techniques are significant factors in the pathogenesis of onycholysis. Chronic microtrauma of nails, chemical effects of components of manicure products and allergic reactions can affect the development of impaired connection of the nail plate with the bed. New aspects of the problem have been identified, namely the growth of acrylate-induced nail dermatitis among the population, chemical and physical changes in nails under the influence of gel polishes, pseudopsoriatic dystrophies after acrylic extension, etc.

To prevent onycholysis, experts recommend following a gentle manicure technique, taking breaks from wearing artificial coatings, protecting hands from excessive moisture and chemicals, and promptly consulting a dermatologist if signs of peeling appear.

### Prospects for further research.

Further research should be aimed at developing standardized protocols for safe manicure, including optimal intervals for wearing gel coatings and nail recovery periods. It is important to conduct prospective studies on the duration of nail plate regeneration after cosmetic procedures, the effectiveness of protective agents (emollients, biotin, keratin hardeners) and the role of screening for allergy to methacrylates. A promising direction is also the introduction of non-invasive methods of monitoring the condition of nails (ultrasound examination, digital dermatoscopy) for early detection of lesions. A deeper study of the impact of home manicure kits on the prevalence of onycholysis is needed, as well as an assessment of the effectiveness of educational interventions for manicurists on the prevention of nail lesions.

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