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Nail injuries induced by nail care procedures

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To date, literature reports various cases of nail injury associated with gel manicure, including contact-allergic reactions, periungual eczematous dermatitis, severe onychodystrophy with psoriatic lesions in nail plates, onycholysis, and subungual hyperkeratosis. The article presents medical aspects of using the materials containing acrylate and methacrylates, as well as the mechanical effects observed during nail care procedures. We substantiated the importance of differential diagnosis of nail lesions induced by methacrylates and the similarity between the clinical symptoms of these conditions and onychodystrophy resulting from other causes and common diseases. Five clinical cases of nail injuries resulting from manicure using gel lacquer were reported. The data obtained by visual examination, dermatoscopy, and microscopic examination of nail plate scraping were used. The reported cases are expected to contribute to increasing alertness during meticulous history taking in terms of application of gel lacquer in patients with onychodystrophy and in the cases of nail psoriasis in particular. We provided recommendations for patients regarding the required preventive measures before and after nail treatment aimed at reducing the risk of nail injury associated with manicure or pedicure using gel lacquer.

Keywords: *onychodystrophy, onycholysis, acrylates, methacrylates, gel lacquer, manicure, onychoscopy.*

Artificial nails help camouflage any nail plate abnormalities. In 1970, the first fingernail extension procedure using acryl, originating from dental industry, was carried out in the global fashion industry. Since then, it has been becoming more and more popular. Today, there are four main technologies for nail extension: using acrylic or gel-based material, a combination of gel and acryl, and gel lacquers. The principle of hardening of gel lacquers is based on the ability of UV light to initiate polymerization of oligomeric materials having a certain structure.

In all the currently available technologies for applying artificial nails, such active solvents of monomers as acrylic acid esters (and most often, methacrylates) are employed. These components are used to maintain the required consistency and viscosity of gel lacquers, as well as to ensure their stable fixation on the nail surface, making the decorative coating durable. Tri(propylene glycol) diacrylate (TPGDA), hexandiole diacrylate (HDDA), dipropylene glycol diacrylate (DPGDA), or trimethylolpropane triacrylate (TMPTA) are compounds most frequently used for this purpose [1–3]. Acrylates and methacrylates are salts and esters of acrylic acid; they undergo either spontaneous or UV-induced polymerization. Acrylic monomers are considered potent sensitizers. Although this property is either completely lost or significantly decreases after polymerization, these agents may cause dermatitis, which is more frequently observed among employees in nail salons, who are directly exposed to these materials, rather than among clients [4–6].

The key procedures and damage-inducing factors of manicure

Literature reports various cases of nail injury associated with gel manicure, including contact-allergic reactions, periungual eczematous dermatitis, severe onychodystrophy with psoriatic lesions in nail plates, including onycholysis and subungual hyperkeratosis. The common nail diseases induced by manicure include nail lesions due to infection (bacteria, fungi, or viruses), nail plate discoloration, traumatic onycholysis, keratin degranulation, peripheral neuropathy, excessively filed nails, weakening and fragility of the nail plate, and onychoschisis.

Nail extension is one of the most popular types of services offered by beauty salons. Over the past years, the classical nail extension using the acrylic or gel-based technology as well as their combination has given way to application of gel lacquers as the latter coating is durable (up to 4 weeks), can be of various shades and textures (jelly, crème, metallic, holographic, etc.). Other advantages of using gel lacquers are as follows:

- injury done to the nail plate as the nail technician prepares for apply a gel lacquer is minimal (only the superficial nail layer is removed);
- the coating is more smooth and glossy;
- the coating enhances nail hardness as the gel lacquer is more flexible and durable than the conventional nail polish; furthermore, whereas the conventional nail polish forms microcracks that make nails more brittle as early as on day 2 after being applied, for the gel lacquer this happens only 10–15 days after application.

Applying a gel lacquer is preceded by manicure to shape the nails. Next, the uppermost keratin layer is filed and primer is used to dehydrate the nail plate. The base coat, one or two layers of pigmented nail polish, and the top coat are then applied. Each layer is polymerized for a certain time. At the end of the procedure, a dispersion layer is removed from the top coating using special liquid.

The CND company was a pioneer in producing polymerizable nail coating compositions: launched in 2010, Shellac later became a registered trademark. The company has combined the best properties of gel-based coatings and nail polish in the classical nail polish bottles: the new coating was durable, had a variety of shades, was easy to use and relatively safe for nails. OPI Inc. followed the lead and launched GelColor gel lacquer in 2011. Today, there are many new products on the market, including those of unprofessional brands.

Nail injuries induced by manicure

Injuries due to infections. The known risks of nail injuries induced by manicure include lesions caused by infections, such as bacteria, fungi, and viruses (human papillomavirus and herpes simplex virus) [7, 8]. Not properly sanitized tools (scissors, blades, abrasive attachments, electric nail drills, foot soak basins), micro- and macrotraumas resulting from nail cleaning and filing or cuticle removal may facilitate the infection. Microbial infection manifests clinically as erythematous spots and papules developing approximately 2 weeks after the manicure or pedicure. The lesions can be progressing during several weeks and can even result in abscess formation and eventual depigmentation and cicatrization [9–11].

Contact-allergic reactions. The risk of allergic contact dermatitis is justified, since the frequency of cases of acryl-associated contact dermatitis goes up as acrylic gels are used more and more often. Nail polish and nail-hardening agents contain chemicals (acrylates, formaldehyde, and toluene sulfonamide formaldehyde resins) that can act as contact sensitizers and induce contact dermatitis and chronic paronychia [12–15].

Clinical manifestations typically include periungual eczematous dermatitis (Fig. 1), but there have also been reports on eczematous lesions of the proximal portions of

arms and even face, which was allegedly caused by airborne nail dust. Case reports of paronychia, nail dystrophy, and onycholysis are less frequent [16–19].

Base coatings and solvent-based nail cleansers may contribute to nail dryness and make them more brittle.

Nail plate discoloration. Nail plate discoloration caused by keratin staining is one of the most common sequelae of using nail polish. Staining can be of any color, but red or yellow staining is observed most frequently. This phenomenon is often observed if the nail was coated with nail polish for a week or longer and disappears approximately 2 weeks after nail polish was removed [10].

Traumatic onycholysis is a common phenomenon caused by traumatic detachment of nail plate from the nail bed.

Patients often deny having an independent nail trauma, so the information about patient's nail cleaning procedures and hygiene habits (such as inserting a sharp object between the distal edge of the nail plate and the nail bed when cleaning the space under the free margin of nail plate) is valuable for the medical record.

When gel lacquers are applied as a coating, traumatic onycholysis is a very common injury, especially if nails are long and if adhesion to the nail plate is stronger than adhesion between the nail plate and the nail bed.

Keratin degranulation. Nail polishing and cleaning the nail plate may cause keratin degranulation. Clinical manifestations of this condition include white lines, spots, and inclusions on the nail plate. Onychoscopy demonstrates that the white areas correspond to the zones of nail plate splitting. Keratin degranulation is pseudoleukonychia and results from the interaction between nail polish and nail keratin.

Peripheral neuropathy is a rare complication of manicure. Several cases of this condition among patients showing positive results in the test for methacrylate have been reported. Its pathogenesis is unknown; there is a hypothesis that this condition is associated with local neuropathy induced by toxicity of methyl methacrylate [20, 21].

Worn-down (excessively filed) nails result from a mechanical injury made by the patient or a nail technician. Nails are filed tangentially to remove remnants of gel lac-



Fig. 1. Contact dermatitis.

quer, reduce surface roughness, and improve nail texture and appearance. Clinical manifestations include distal nail thinning, expanding from the middle of the plate in the form of a triangle or a crescent so that an inverted image of the lunula is formed. The excessively filed portion of the nail is typically red, since the thinned nail plate allows one to see the nail bed beneath it. The linear ridges can sometimes be seen during visual examination, but it is easier to detect them upon onychoscopy (Fig. 2). Other dermatoscopic signs include broadened capillaries and pinpoint-size hemorrhages [22].



Fig. 2. Onychoscopy in a patient with excessively filed nails.

Pseudopsoriatic nails. Case reports of psoriasiform lesions in patients wearing artificial nails are available in literature. The clinical manifestations, including onycholysis and severe subungual hyperkeratosis, remind nail psoriasis. This may result in misdiagnosis and administration of topical or systemic corticosteroids and even immunosuppressive drugs if a patient has joint pain. An increased sensitivity to acrylates can probably cause clinical symptoms of pseudopsoriatic nails.

Other adverse effects. Since gel lacquer has a strong adhesion to the nail plate, its removal may cause nail thinning, weakening, and fragility, as well as pseudoleukonychia and onychoschisis [22].

The recommendations to reduce the risk of nail damage provided by R. Chang et al. are as follows [8]:

To avoid using pedicure bowls if they are not subjected to regular cleaning of the filtration system using chlorine-containing agents.

To bring one's own tools or make sure that the tools have undergone autoclave sterilization.

To avoid shaving or epilating legs 24 h before having a pedicure.

Not to allow the nail technician to cut back or manipulate the cuticle.

Not to allow the nail technician to clear the subungual space with sharp tools.

To limit the frequency and duration of exposure to UV radiation when having a gel manicure. To use UV safety glasses and fingerless gloves if one frequently un-



Fig. 3. General view and the dermatoscopic pattern of nail lesions in a 54-year-old patient S.

dergones these procedures. LED lamps should be preferred if possible.

Case history # 1

Patient S., 54 years old, complained of nail plate lesions on the first, second, and third fingers of both hands, which were revealed after the long-lasting UV-curable nail coating had been removed. Visual examination discovered nail plate deformities in the first, second, and third fingers of both hands, with mild pain and pruritus and signs of paronychia (Fig. 3). The results of microscopic and mycological examination of nail plate scraping were repeatedly negative.

Case history # 2

Patient T., 38 years old, complained of lesions in the nail plate of the first finger of her right hand, which were detected about 1 month earlier, after the long-lasting gel lacquer was removed. The patient used the UV-curable gel lacquer on a regular basis and previously had no complaints. Visual examination revealed distal lateral onychodystrophy

of the nail plate. The results of microscopic examination of nail plate scraping were repeatedly negative. Nail dermatoscopy (onychoscopy) revealed distal onycholysis and subungual hemorrhage (Fig. 4).

Case history # 3

Patient B., 37 years old, complained of lesions in nail plates of great toes that have appeared 1 month earlier. Dark subungual spots appeared after using long-lasting gel lacquer. The patient had no history of allergies, did not receive any medicinal agents over the past month, and denied having an injury to her toenails. The results of microscopic and mycological examination of nail plate scraping were negative.

Visual examination revealed distal lateral onycholysis of the nail plate and subungual hemorrhages.

Onychoscopy showed nail plate opacification, nail discoloration, and subungual hemorrhages (Fig. 5).

Case history # 4

Patient N., 31 years old, complained of lesions in nail plates of the third and fourth fingers of her left hand, which were revealed after the long-lasting UV-curable gel lacquer had been removed. The patient used the UV-curable gel lacquer on a regular basis and previously had no complaints. Visual examination showed distal lateral onycholysis of the nail plate (Fig. 6). The results of microscopic and mycological examination of nail plate scraping were negative.

Case history # 5

Patient K., 42 years old, complained of changes in the nail plate of the first finger of her right hand. She detected the first changes in the distal portion of the nail a year ago, after UV-curable nail polish had been removed. The patient vehemently denied having an injury. The nail plate lesion was progressively spreading in the proximal direction during a year.

Visual examination revealed opacification of the nail plate; its color changed to light brown. No nail pitting was

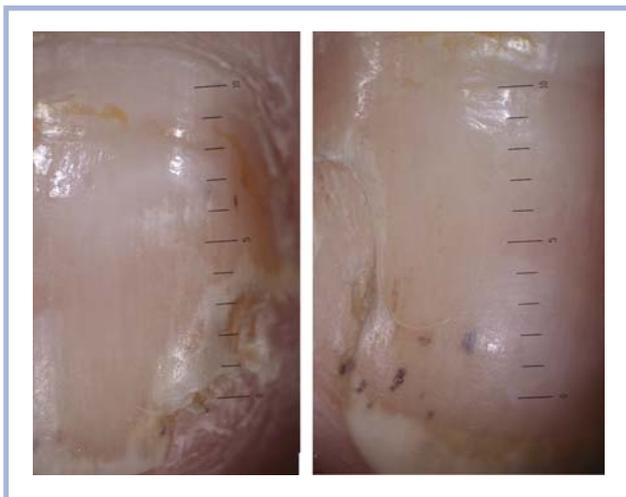


Fig. 4. Onychodystrophy in a 38-year-old patient T.

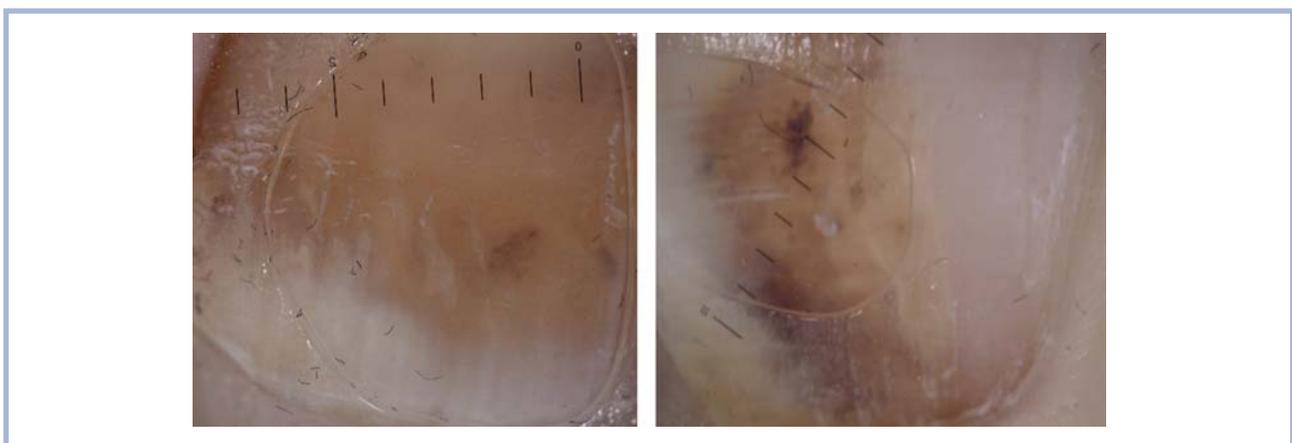


Fig. 5. Onychodystrophy in a 37-year-old patient B.



Fig. 6. Traumatic onycholysis in a 31-year-old patient N.

observed. The remaining nail plates were intact. The results of microscopic and mycological examination of nail plate scraping were negative.

Onychoscopy revealed nail plate discoloration and distal onycholysis. An oblong curved foreign body (a hair

or a thread) was visualized in the central portion of the nail, under the nail plate.

Two foreign body fragments were retrieved during machine-assisted removal of the central altered plate portion. Microscopic examination allowed us to identify them as thread (Fig. 7).

Conclusions

Regular application of gel lacquer may cause contact dermatitis, as well as nail fragility and thinning. Taking into account the wide use of manicure and gel lacquer, the dermatologists need to hold information about the methods and materials used in the nail salon industry to make adequate diagnosis and prevent cosmetically induced nail disorders. Studying the case reports allows the clinicians to differentiate between these disorders and choose the required treatment approach.

Nevertheless, if patients take the respective safety precautions, they can continue to use services provided by nail salons.

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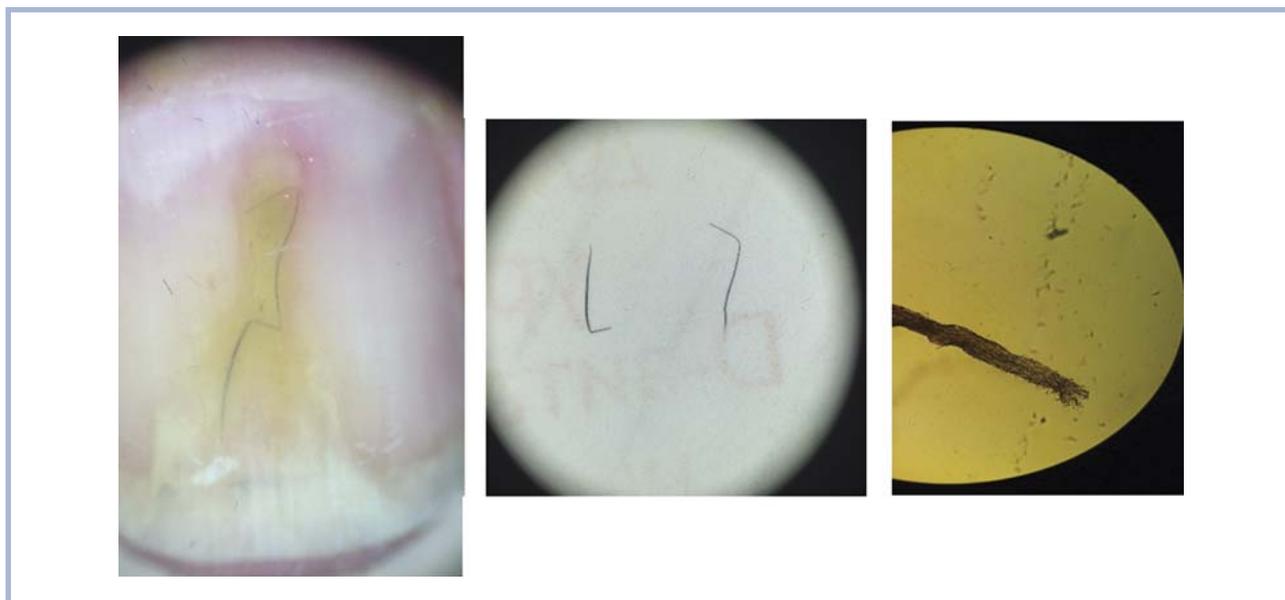


Fig. 7. A foreign body in the nail bed in a 42-year-old patient K.

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