Chapter 15
Nail Diseases in Women

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15.1 Introduction

Nail in humans have always been an important tool protecting the terminal phalanx against injury, improving manual dexterity and enabling picking up small objects. At the same time, they have been considered to be a marker of social status and the overall health and hygiene of an individual. Females have a natural inclination toward beautification of their bodies; this includes adornment of their nails. Throughout history, women have been recorded to enhance their beauty with nail cosmetics. The use of nail cosmetics dates back to 5000 BC, when women in India, China, and Egypt used henna to dye their fingernails [1, 2]. Henna is still used in some cultures to adorn nails (Fig. 15.1).

The nail in women is proposed to be constitutionally different from those in men. There is a higher risk of nail fragility in women, which could be assumed to be a result of the women being more conscious of any cosmetic impairment in their nails and seeking redressal for that. However, other factors are also probably involved. There is an age-related decrease in lipid content of the nail plate which is more common and more severe in women [3]. It is possible that nails in women are constitutionally more fragile [4, 5] as intercellular keratinocyte bridges are weaker as compared to men, and are further weakened with age. However, there is no difference with respect to the content of major trace elements [6]. A larger number of women are engaged in household chores as compared to men, and this predisposes

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R. Sarkar, S. Sinha (eds.), *Skin Diseases in Females*,
https://doi.org/10.1007/978-981-16-6065-8_15

Fig. 15.1 Henna applied on finger nails by a middle-aged woman. Note the proximal curved border of exogenous pigment

them to development brittleness, as compared to men [7]. Another important aspect of nail health in women is proportionately higher occupational risk of nail health issues as compared to men, due to the commoner involvement in household work. This includes excessive exposure to water, harsh soaps and detergents which compromises the structure and function of nails, making them more prone to certain infections and disorders like brittle nails and paronychia.

It is widely believed that a healthy nail should ideally have a shiny surface, with a pink nail bed and a white free margin that extends well beyond the nail bed. There should be a dorsal slight curve both transversally and distal to proximal [8]. The cuticle and nail folds should be well attached to the nail plate, leaving no crevices or ragged edges [9]. It is this standard of beauty that most women aspire for, especially as the nails are a very visible part of the body. Nail hygiene is also an important aspect of personal grooming, which most women try to attain to perfection. It is also an important part of hand hygiene, which all of us are trying to ensure diligently. Healthy grooming habits include cutting fingernails straight across and slightly rounding the free edges. However, an overzealous self-cleaning of nails (using files or various sharp instruments), excessive cutting or filing, or salon cleansing during procedures like manicure/pedicure, can lead to increased chances of ingrown nails or infections (due to undue manipulation of cuticle or use of unsterile instruments). As these procedures are more commonly resorted to by women, such issues are also more commonly seen in them.

Modern day nail cosmetics include a wide range of products ranging from onycho-cosmeceuticals to nail polishes, acrylics, silks, gels, and extensions. It is a global, multibillion-dollar industry, the primary consumers of which are women. In

2018, nail cosmetics became an $8.36 billion industry in the USA [10]. Globally, the retail market for nail polish increased from $3 billion in 2007 to $45 billion in 2012 [11]. It is estimated that 85–90% of women worldwide use nail care product [12]. The above figures are a clear reflection of the increasing use of nail care products. However, these products come with a risk of adverse effects and associated nail issues, which are correspondingly on the rise.

It is clear that the esthetic appearance of nails is important to women; thus awareness regarding how to maintain a healthy nail, safe practices for the use of nail cosmetics, and an early identification and treatment of nail disorders should help women use nail cosmetics and maintain functional nails throughout their lives. This chapter aims to discuss these issues in detail. We first discuss the use of nail cosmetics and nail beautification techniques. This is followed by the various issues which may be associated or are found with a higher frequency in women. The management of these conditions is also discussed in detail.

15.2 Physiologic Nail Changes in Women

Various age-related nail changes are known in women and may often be confused with pathological conditions requiring medical attention. The etiology is unclear but may be due to an impaired blood flow to the nail unit. A complete review of symptoms and, if warranted, screening laboratory studies for thyroid, kidney, and liver function should be reassuringly normal. Throughout the normal aging process, nails become more brittle and the rate of growth slows [13]. From the age of 25 years onward, nail growth rate is known to decrease by 0.5% each year [14]. Aging nail may appear pale, dull, or opaque [15]. Their calcium content is increased while iron content is decreased. Texture wise, the nail plate becomes more friable with fissuring, splitting, and longitudinal striations [16]. Neapolitan nails describe an age-related nail discoloration resulting in nails which are opaque distally, normal pink centrally, and white proximally [17]. Brittle nails also increase with age, affecting 19% of patients aged <60 years and 35% of the population aged >60 years [18]. Postmenopausal women are particularly predisposed to nail brittleness as discussed previously (Fig. 15.2) [13].

Importantly, the risk of nail disorders like onychomycosis, paronychia, and onycholysis increases with age [15]. This may be related to a decrease in nail growth rate with age [13]. Other factors may include gait abnormalities, or changes in anatomy (e.g., hallux valgus), which predispose toenails to trauma, which is a risk factor for progression of tinea pedis to tinea unguium.

Malnutrition is known to have a negative effect on nail growth. A severe nail dystrophy is observed in kwashiorkor. Soft, brittle, often fissured nails can be seen in cachexia and bulimia [19–21]. In severe vitamin B12 deficiency in dark-skinned people, multiple longitudinal pigmented bands may occur. Genetically determined nail consistency does not show any influence with any particular food, even the so-called organic or biologic.

Fig. 15.2 Increased longitudinal ridging in a postmenopausal woman—a physiological change

15.3 Nail Cosmetics and Women

Women wear nail cosmetics to enhance the esthetic appearance of their nails. Ironically, nail cosmetics may themselves lead to substantial and sometimes permanent nail changes, worsening their aesthetic appearance. An awareness of these potential complications may help avoid or at least expeditiously diagnose and treat them.

The common cosmetic procedures being done on nails include manicures/pedicures including nail cleansing and application of nail polish; or the use of artificial nails including gel nails and acrylic nails.

15.3.1 Manicure and Pedicure

These are common salon procedures, routinely done by many women almost on a monthly basis. A manicure or a pedicure is defined as cleaning, shaping, and sometimes augmenting of fingernails or toenails by the application of a nail lacquer or other nail enhancement. It also involves the smoothening or filing of any calluses, especially on soles [22]. Steps of a manicure/pedicure and their implications, especially in this COVID era, are summarized in Table 15.1 [25].

Thus, it can be seen that a fairly simple and routine procedure has the potential to sometimes irreversibly damage the cosmesis of the nail unit, or cause chronic infections with a long recovery period. At the same time, adverse consequences can be easily prevented with attention to detail and following proper procedure.

Table 15.1 Steps of a manicure/pedicure

Stepwise process	Details of the steps	Possible adverse effects	Precautions or remarks
Soaking in warm, soapy water	Soaking to remove any debris from under the nails and to soften the nails and cuticles	Pedicure tubs in which hands and feet are soaked have been reported to cause *Mycobacterium fortuitum* infections from a nail salon in California [23]	Avoid excessive soaking Clean and sterilize tubs regularly
Removal of nail paint	Existing nail paint, if any, is then removed with products which are mostly acetone based	Excessive dryness because of acetone	Use of acetone-free products or use of moisturizer afterward
Filing/ trimming	Trimmed and filed to a desired shape (rounded or pointed)—the ideal shape is a central, delicate arc without any sharp corners, so as to create the illusion of a long, slender finger [22]	Onychoschizia or lamellar nail splitting Transmission of fungal and viral infections from one nail to another and from one person to another Overzealous shaping and cutting can predispose to hang nails, nail plate fractures, and ingrown nails [24]	Distal filing is preferred over clipping of nails Do preferably with a disposable filer for reduction of transmission of infections Preferably shape with a very slight curve with corners left untouched
Scraping	Foot scraper or a pumice stone is then used to buff the rough skin of palms and soles and any thick calluses are layered off	Over vigorous scraping can sometimes lead to scratches which can get infected	Scraping should be done softly and never vigorously
Softening of cuticles	By either applying a chemical cuticle remover (an alkaline substance like 0.4% sodium or potassium hydroxide) or applying a moisturizer. Once soft and malleable, the cuticles are pushed proximally and/or clipped away with a metal or wood implement	This is the most damaging step in the whole procedure as it predisposes the nail folds to subsequent environmental insults and secondary infections	Avoid pushing or trimming cuticle at all
Buffing of the nail plate	Buffing is done to smoothen any ridges and to improve adhesion of nail lacquer or other nail enhancements to be applied subsequently	Thinning of the nail plate, which in turn can lead to frequent breakage and risk of infections	Overaggressive buffing should be avoided

15.3.2 Nail Polish and Removers

The commonest nail cosmetic available in the market is the humble nail polish, variously known as nail paint, nail enamel and nail lacquer. It serves the primary purpose of nail beautification due to various colors and finishes available [26]. However,

at the same time, it offers mechanical protection to the nail plate, improves its water binding capacity, and fills in fractures and camouflages the nail ridges effectively.

Revlon® was the first company to start manufacturing nail polishes. They were first manufactured as a by-product of automobile painting industry where a film-forming polymer was dissolved in a volatile organic solvent to form an opaque lacquer. The commonest practice among nail polish manufacturers is to dissolve nitrocellulose in butyl-acetate or ethyl acetate. The film that is created by the nail polish is oxygen permeable as against artificial nail prostheses which are oxygen impermeable [9].

Nevertheless, certain adverse reactions are known to be associated with nail polish usage. These include the following.

1. *Allergic dermatitis*: Patients allergic to nail varnish often develop dermatitis at sites distant from the fingers. It is seen in 1–3% of cases, and often presents with unilateral eyelid dermatitis or linear areas of dermatitis on the face and neck caused by habitual rubbing of these areas with freshly painted fingernails. Rarely, generalized eczema or involvement of the genitalia may also be seen. The most common allergen implicated in nail polish allergy is 7% thermoplastic resin TSFR (toluene sulfonamide formaldehyde resin) which is the commonest adhesive used in nail polishes. Hypoallergenic nail polishes have alkyl polyester resins instead. An increasing recognition of this frequent sensitizer has led to the current availability of many tosylamide/formaldehyde resin–free nail polishes and thus a reduction in patch-test positivity to this allergen over the years [27].
2. *Color changes*: A prolonged use of nail polish can lead to yellow/red discoloration of the nail plate which fades over a fortnight after removal. The proximal end of such a discoloration is parallel to the proximal nail fold, thus confirming its exogenous origin. It is advisable to have nail polish–free days to keep the nails healthy and free of this complication.
3. Nail polish removers (acetone based) cause excessive dryness and brittleness of the nail plates. Nails can develop surface keratin granulations due to the use of nail polishes and nail removers (Fig. 15.3). This condition simulates superficial white onychomycosis. It commonly happens when old nail polish is not removed before applying a fresh coat.
4. The use of nail polish (for longer than 4 days) has been documented to harbor microorganisms [28] (especially if it is chipped) (Fig. 15.4). This fact is of immense importance in certain professions like health-care workers and food handlers, who are at higher risk of transmitting these organisms.

Any discussion about nail polishes cannot be complete without discussing nail polish removers. They are used for uniformly removing nail polish from the nail plate for examining the nail or before a fresh coat can be applied. The following types are commercially available.

1. *Acetone-based* nail-polish removers are the most commonly available ones. However, they have been reported to cause irritant dermatitis and an excessive use can also lead to brittleness of nails.

Fig. 15.3 Nail discoloration and keratin granulation seen after removal of nail paint after a long time

Fig. 15.4 Chipping of the nail paint within 3–4 days. This is a sanctuary site for various microorganisms

2. *Acetone-free* nail-polish removers contain ethyl acetate, butyl acetate, or ethyl lactate. Nail polish remover pads containing gammabutyrolactone are also available and are safe and convenient to use. Rarely, they get converted to GHB (gamma-hydroxybutyrate) which can result in systemic toxicity.

15.3.3 Sculptured/Artificial Nails

Sculptured nails are applied as acrylic or gel nails, both of which contain acrylates [29]. These sculptured/artificial nails are designed to give a more shiny and lustrous appearance to the nail plate. However, they are associated with unique adverse effects as well. Artificial nails are more likely to get colonized with Gram-negative

bacilli and yeast as compared to natural nails hence these have an increased probability of transmitting infections as well [30–33]. Also, it is more difficult to clean artificial nails compared to normal nails resulting in the larger number of residual bacterial under the artificial nails. Outbreaks of various infective diseases due to artificial nails, for example, infections by *Candida albicans* and *Pseudomonas aeruginosa*, have been reported [32, 33].

15.3.3.1 Gel Nails

Gel nails refers to an ultraviolet light–curable nail lacquer. They are being used for over three decades to improve the appearance of nails by imparting luster and shine to the nail plate (Fig. 15.5a, b). They also enable nail polish to stay for a longer duration. Unlike standard nail polish, gel nails require photocuring (fixing). They have gained popularity because they are long-lasting, resistant to chipping and scratching, and are easy to apply.

Shellac® (CND, San Diego, CA) and OPI gel polishes® are examples of commercially available gel nail polish. They contain photoinitiators that are photocured with either a UV (typical wavelength of 340–380 nm) [34]; or a light-emitting diode (LED) lamp, and some are formulated to be used with either type of lamp. LED lamps accomplish photocuring more quickly because they emit a narrower spectrum of light. However, UV lamps are less expensive and are therefore more routinely used in the photocuring process.

Gel nail, though a very commonly done cosmetic procedure at nail salons, has not been utilized adequately by the dermatologists. As a matter of fact, they have been mostly shunned by us because of various reported side effects [35–37]. However, most of the reported side effects are technique dependent and can be avoided by careful application and removal.

Gel nails are an excellent tool for camouflaging superficial nail abnormalities. They improve the patient satisfaction manifold when combined with medical treatment in conditions like nail lichen planus or psoriasis where medical treatment takes

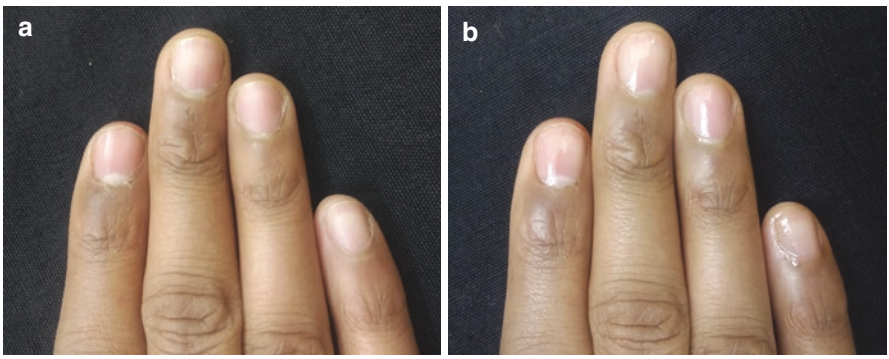

Fig. 15.5 (**a**, **b**) Gel nails imparting shine and luster to multiple nails in a patient with weathered nails and hang nails

a long time for effects to show. Gel nails are also useful for conditions like brittle nails and also for breaking the habit of nail biting. These have also been found useful by professionals like guitarist who experience damaged nails due to occupational reasons; or for improving cosmetic appearance of nails with irreversible damage, like pterygium. Gel nails are also a good option for self-limiting conditions like trachyonychia where patient is excessively concerned about the appearance of nails.

We have experience with using gel nails in various conditions like trachyonychia, nail pitting, onychorrhexis, onychoschizia, Beau's lines, nail psoriasis, nail lichen planus (including pterygium), and brittle nails with gratifying results. It seems that the use of gel nails on cosmetically disfigured nails is even more rewarding than over apparently normal nails as in most cases the rate of growth of diseased nails is slower, making gel nail last longer. For diseased nails, the nail plate is already rough; hence, minimal, if any, buffing is required. Last but not least, it is a lot easier to manage patient's expectations as any improvement in their nail condition is very gratifying to them. Nevertheless, gel nails have their own limitations like limited applicability in infectious conditions like onychomycosis, paronychia, etc. They should also be avoided in case of melanonychia (to prevent masking of changes) or in cases with known allergy to acetone or any component of gel.

Gel nails is a commonly done professional nail salon procedure, but kits are also available online for home use. Such at-home gel polish kits, using UV light, can pose a significant health threat as the usage is unregulated, and users are untrained [38]. The duration of contact with irritants found in nail cosmetics is found to be increased for consumers who use these nail kits [39]. A 2016 study of 65 consumers who developed side effects from at-home gel polish kits found that the most common complaint was painful, pruritic periungual eczematous dermatitis. Other side effects included onycholysis, lesions under the nail plate, and weak or brittle nails [40]. Thus, they are best done under supervision. Their removal through acetone wraps may potentially dry and weaken the nail plate. Patients on photosensitizing oral medications, such as tetracyclines, may experience photo-onycholysis when exposed to UV radiation required to cure the polymer. A newly recognized complication of UV light—cured polish is the formation of pterygium inversum unguium (PIU) which is the adherence of the hyponychium to the nail plate. It is responsible for morbidity and pain especially during cutting or filing of the nails [41]. Cervantes et al. reported a case series of 17 patients who all developed PIU after 2–5 years of gel polish application. In 9 of these 17 patients, both LED and UV-A light had been used. Of the remaining 8 patients, 5 had used only LED light and 3 did not know or could not recall which type of light they used. All but 2 patients had resolution within a few weeks of switching from gel to normal nail polish. Patients and providers should be educated about this potential complication so they can recognize it early and stop gel manicures immediately, thereby hopefully leading to resolution of PIU.

The UV light lamps used for curing nail cosmetics use UV-A to photocure, harden, and dry the nail cosmetic. UV-A radiation is a known carcinogen. As these lights are available for home use, consumers may be unaware of the potential risk of carcinogenesis. It has been estimated that the time of exposure to UV lamps during usual photocuring ranges from 3 to 5 min, repeated every 2–4 weeks [39]. Another

study by MacFarlane and Alonso concluded that the amount of UV-A exposure from UV nail lamp is as damaging as spending an additional 1.5–2.7 min in sunlight each day for 2 weeks [42]. They also reported on two female users of UV lamps who developed squamous cell carcinoma on their hands in the absence of a personal or family history of skin cancer. Even other studies have found that the risk of developing skin cancer with these lamps is low. Nonetheless, the current recommendation by the Skin Cancer Foundation is to avoid the use of UV lamps. If patients are going to use photocured polishes, then the use of a broad-spectrum sunscreen or nitrile gloves on the rest of the hand, before exposure is recommended [39]. Lastly, it is important to discuss that the use of nail adornments obscures the nail unit features for a long time, and therefore may lead to a delay in the diagnosis of malignancies.

Acrylic nails are a result of spontaneous polymerization of acrylate or methacrylate monomers [43]. A uniform thin layer of acrylic nail product is applied quickly to the nail plate which hardens on air exposure.

Acrylic nails, after setting, provide a transparent and robust canvas for further nail adornment. They last long and can be removed easily. However, they require more care than natural fingernails. They need filling every 2–3 weeks where the loose acrylic is clipped from the distal nail edges. At the same time, new acrylic needs to be applied proximally to fill in the defect, else a lever arm gets created, predisposing the natural nail plate to traumatic onycholysis.

Over the years, acrylic nails are losing popularity as they look less natural, especially if applied incorrectly. The application process involves strong chemicals and fumes, which precludes its use in pregnancy. They also have a real potential to damage the nail bed after 2–4 months of continued use. The natural nail plate may become yellowed, dry, and thin. For those using acrylic nails, it is highly recommended that the natural nail should be allowed to grow and act as a support by resting them every 3 months. Acrylate-based nail products are also known inducers of ACD and distant dermatitis [37]. The signs of allergy to nail products include pruritic eczematous dermatitis of the fingers, hands, and wrists, although up to 10% of patients may experience dermatitis localized only to the face or neck [44]. Other reported side effects include dryness of nails, paronychia, brittleness, masking of underlying nail disorders, and reported cases of nonmelanoma skin cancer [42].

15.3.4 Nail Hardeners

Nail hardeners are another category of nail cosmetic product which are promoted for use in cases with brittle or fragile nails. They are proposed to improve the strength of nail plate. The active ingredient in nail hardeners is up to 5% formaldehyde mostly. They are also known to cause of allergic contact dermatitis, which can involve distant sites. In sensitized individuals, a concentration of formaldehyde as low as 0.006% can trigger ACD [45]. In them, products that contain formaldehyde should be completely avoided. Prolonged usage can lead to brittle nails (cross-link density rises and flexibility is reduced). Contact allergic dermatitis, onycholysis, and subungual hyperkeratosis can also occur.

15.3.5 Onychocosmeceuticals [46]

This category includes many commercially available preparations that claim to be useful for various nail disorders. These are mostly combinations of several vitamins, minerals, sulfur-containing amino acids or proteins, hormones, medicinal yeast, crushed egg shells, and even organic food. Their efficacy has not been proven in controlled trials and anecdotal evidence is equivocal with some patients reporting miraculous improvement, while most see no effect.

One of the best known onychocosmeceuticals is biotin, also known as vitamin B7. Its Recommended Daily Allowance (RDA) is 30 mcg. Earlier, a daily dose of 2.5–10 mg was recommended for hair and nail health, but recent studies show that this can lead to a reversible alteration of thyroid profile due to an interference with immunoassays, leading to falsely low or high thyroid hormone values. This interference has the potential to affect a wide range of analytes [47].

Other such drugs reportedly responsible for nail health include pyridoxine, ascorbic acid, thiamine, calcium D-pantothenate, medicinal yeast, L-cystine, keratin, and *p*-amino benzoic acid. Both an increase or decrease of vitamin A has been implicated in brittleness of nails. The role of vitamin E, sulfur-containing amino acids and proteins, fluorides, and calcium is role is not clear [48]. Supplementation with minor elements like iron [49], zinc, selenium, silica, and rhodanides without any manifest deficiency, has been reported to benefit nail health as evidenced by the fact that their deficiency may result in several nail disorders.

15.3.6 Nail Care Oils

Various oils are commercially promoted as nail care oils. These include products containing jojoba oil, bisabolol, panthenol, vitamins, and amino acids. Some of these are proposed to work by helping to hold humidity. In general, oils as well as creams and ointments make the nails more elastic, thus prevent nail splitting.

15.3.7 Risks to Salon Employees

A discussion of nail health in women would not be complete without a discussion of the health of nail salon workers. According to the Centers for Disease Control and Prevention [50], 96% of nail salon workers are women, and 63% of these women are minority workers. This vulnerable group is potentially exposed to numerous chemicals during a routine workday. Nail salon workers are exposed for much longer periods to these chemicals and are therefore more affected than consumers. Many publications have discussed the possible associations between nail cosmetic exposures and the respiratory, neurologic, and musculoskeletal health of these female workers [51–54].

A serious risk for these workers is allergic contact dermatitis. For the last 10 years, nail technicians have been the primary occupation experiencing acrylate allergy [44], which most frequently presents in this group as pulpitis and fissures. Acrylate allergy in nail salon workers may also present as onycholysis, onychodystrophy, subungual hyperkeratosis, paresthesiae, urticarial rash, and upper respiratory tract symptoms [38, 44].

To minimize the health risks to nail salon workers, it is recommended that nail cosmetic procedures, especially the application and removal of artificial nails should be done in a well-ventilated room. Salon workers should be encouraged to wear masks and pregnant women should not be engaged in these procedures.

15.4 Nail Disorders in Women

This section deals with nail disorders which are seen more commonly in women, or have special consequences in the female sex. These include brittle nails, paronychia, onycholysis, and so on.

15.4.1 Brittle Nails

Brittle nails (BN), better referred to as nail fragility, is a common problem affecting up to 20% of population especially women over 50 years of age [18]. The female-to-male ratio is 2:1. BN are characterized by increased fragility leading to splitting, flaking, and crumbling of the nail plate presenting clinically as excessive longitudinal ridging (onychorrhexis); horizontal lamellar splitting (onychoschizia); and irregularity of the free margin of the nail plate [15, 18] (Fig. 15.6). Normal nails have 18% water and when this content becomes less than 16% the nails lose elasticity and become brittle. A reduced sulfur content and iron content may also contribute to loss of flexibility of nails [55]. Disorders associated with defective keratin like trichothiodystrophy are also associated with BN. Also, patients having fine or thinner nails are more prone to brittleness.

Environmental triggers that exacerbate brittle nails include weather, with winters causing more brittleness due to less moisture content in cold air. Although water contact increases the water content of nail plate temporarily, it also makes the nail plate more pliable, dry, and brittle. Hence, women involved in household work end up having BN (Fig. 15.6). Exposure to chemicals (solvents, acids, alkalis, etc.), nail cosmetics (nail polish removers, nail hardeners, and cuticle removers), and nail procedures (artificial nails, nail adornments) increase the chances of getting BN (Fig. 15.7). Other factors which lead to BN include fungal infections and trauma including the mechanical microtrauma due to daily work and habit tic deformities like onychotillomania and onychophagia. BN are also associated with a number of dermatologic disorders like psoriasis, lichen planus, and alopecia areata; and with systemic disorders like endocrine disorders, metabolic diseases, infections, and nutritional deficiencies [56].

Fig. 15.6 Brittle nails in an elderly lady who engages in a lot of household work. Onychorrhexis, onychoschizia and irregular free margin can be seen. The left thumb nail shows evidence of pseudomonas paronychia

Fig. 15.7 Brittle nails involving toenails subsequent to repeated application and removal of nail paints

Table 15.2 Management principles for brittle nails

1.	Limit further trauma
2.	Gentle cleansing with a pH-balanced soap
3.	Use of moisturizing creams/ointments/oils
4.	Wearing gloves to avoid contact with irritants such as water and chemicals
5.	Avoiding filing the surface of the nail
6.	Limiting the use of frequent nail cosmetics
7.	Taking timely treatment for any underlying nail disorder
8.	Supplementation of any underlying deficiency

Management of brittle nails involves a multimodal approach with removal of causative factor being the most important (Table 15.2). Patients need to be educated about the basic principles of nail care [40, 48].

Other than this, the role of various supplements has been proposed for improving the strength of such nails. Oral supplementation with biotin (2.5–10 mg orally per day) has been used to improve the quality of nails, but the need for supplementation is unclear because biotin is synthetized to a great degree by intestinal bacteria [48]. A marked biotin deficiency is associated with poor nail quality. A study by Colombo et al. [57] documented a 25% increase in nail thickness in women who took biotin supplementation for 6–9 months. Another study by Hochman et al. [58] concluded that although biotin supplementation is not consistently effective among all patients, there is a trend toward being beneficial to nail health. There may be a role for biotin in nail health, but additional studies, including investigation of dosages and the effect of biotin on brittle nails, to improve the evidence base.

Empirical biotin administration, may not be without associated side effects. Food and Drug Administration has warned that it may interfere with laboratory testing (e.g., tests for troponin levels, thyroid-stimulating hormone, and parathyroid hormone) and lead to incorrect diagnoses [59]. However, this warning applies to high-dose biotin supplementation, and there may not be any need to discontinue biotin before laboratory testing for patients taking biotin at dermatologic doses of 5 mg per day [60].

Iron supplementation is reportedly effective if ferritin levels are below 10 ng/mL. Prolonged zinc supplementation in a dose of 20–30 mg/day may be useful for some patients. Cosmetic treatments like nail moisturizers, nail enamels, nail lacquers, and nail hardeners have found to be useful. In our personal experience we have found a single coat of gel nails to be a useful treatment for brittle nails [61].

15.4.2 Paronychia

Paronychia refers to an inflammation of the nail fold(s). It can be acute or chronic and may present in isolation or in association with an ingrown nail [62]. Both acute and chronic paronychia are commonly seen in women, presumably due to excessive exposure to water, detergents, and cosmetics.

Acute paronychia is characterized by a painful swelling with pus collection involving the nail fold(s) which is of <6 weeks duration. The common presentation is acute onset pain, edema, erythema, and tenderness along the lateral and/or PNFs commonly involving a single digit (Fig. 15.8). It is a very common hand infection with a female/male ration of 3:1 [63]. The most common inciting factor for acute paronychia is trauma to the nail unit, leading to a disruption of the protective tip barrier. It can often be a result of nail tic disorders like nail biting, ingrown nail, manicure/pedicure, household wet work, frequent hand washing, or retention of a foreign body associated with penetrating trauma [64]. Acute paronychia is a bacterial infection, with *Staphylococcus aureus* being the most commonly isolated infectious organism, which may even be acquired from contaminated nail grooming instruments [65, 66].

Fig. 15.8 Acute paronychia in a house maid. The nail also shows pseudoleukonychia involving the nail plate

Management involves nonsurgical methods like warm water soaks with Burrow's solution (aluminum acetate), vinegar, diluted povidone–iodine or chlorhexidine. Topical antibiotic and corticosteroid applications have been found to be useful in cases with minimal erythema. Systemic antibiotics like trimethoprim–sulfamethoxazole/cephalexin/amoxicillin and clavulanic acid or clindamycin are needed in cases where the infection has set in, with substantial erythema [65]. Surgical management is reserved for patients not responding to medical interventions and those with well-formed abscess.

Chronic paronychia (CP) refers to an inflammation and swelling of the nail folds, conventionally >6 weeks in duration. It is often accompanied with disruption or a loss of cuticle, which provides an easier access to environmental insults/organisms to enter the cul-de-sac under the proximal nail fold. It usually involves multiple nails and periodic exacerbations are seen. Proximal nail matrix may become raised and separated from underlying nail. Several nail changes like ridging, grooving, discoloration, beau's lines, and onychomadesis may be seen due to the associated nail matrix damage [67].

The pathogenesis of chronic paronychia is multifactorial because of an unchecked influx of pathogens and allergens. It is now considered to be a form of hand dermatitis due to exposure to environmental allergens with secondary colonization of the sulcus by Candida [68–70]. Common causes include occupational exposure to moisture and chemical irritants commonly seen in homemakers.

Management involves general measures like avoidance of wet work, limiting the contact with irritants like detergents by wearing vinyl gloves over cotton gloves while doing house hold work, and strictly avoiding manipulation of nail folds especially during grooming procedures like manicure/pedicure. Topical mid-potency

corticosteroid ointments for 2–4 weeks are the mainstay of medical management. Surgical management is reserved for severe, recalcitrant cases.

15.4.3 Onycholysis

Onycholysis is defined as a distal or distal–lateral separation of the nail plate from the underlying and/or lateral supporting structures (nail bed, hyponychium, lateral nail fold). When the separation begins proximally near the nail matrix, the process is called onychomadesis.

Clinically, the area of separation appears as a white or yellow nail plate due to air trapped beneath it. It may also be discolored due to accumulation of bacteria, most commonly Pseudomonas (green color due to pyocyanin) or yeast species like *Candida albicans* (Fig. 15.9).

Pathogenesis of onycholysis can be multifactorial and often unclear. It is known that a normal nail bed lacks a granular layer. Causes that disturb the normal formation of nail bed, like psoriasis or lichen planus, often lead to an appearance of a nail bed granular layer resulting in onycholysis. It can also result due to trauma, be it physical, irritation-induced, or allergic. Depending on the cause, onycholysis can be classified as primary (idiopathic) or secondary.

1. *Idiopathic (primary) onycholysis*—This refers to a painless separation of the nail plate from the nail bed, which occurs without an apparent cause (Fig. 15.9). Overzealous manicure, frequent wetting, and cosmetic solvents may often be the inciting factors, which can be found out on extensive probing. Often, minor trauma can precipitate this condition in patients keeping abnormally long nails.

Fig. 15.9 Idiopathic onycholysis involving multiple nails in a housemaid

The affected nails tend to grow very quickly. The affected nails are mostly asymptomatic, though pain may occur if there is further separation due to trauma or if active infection supervenes. The condition is most commonly seen in women and many cases return to normal after a few months. The longer it lasts, the less likely is the nail to become reattached, due to keratinization of the exposed nail bed.

2. *Secondary onycholysis*—This type occurs associated with a well-defined cause. Onycholysis is either one of the nail manifestations or a major nail manifestation, in these disorders (Fig. 15.10). The salient etiologies associated with onycholysis are summarized in Table 15.3 [71].

Fig. 15.10 Prominent distal onycholysis with subungual hyperkeratosis and discoloration in a patient with onychomycosis

Table 15.3 Various causes of secondary onycholysis

Dermatologic causes	Psoriasis, fungal infection, Reiter's syndrome, hyperhidrosis, pemphigus vulgaris, pellagra, leprosy, syphilis, occupational trauma, psoriatic arthritis
Drug-induced	Antibiotics—most commonly tetracyclines, chemotherapeutic agents, retinoids
Systemic causes	Thyroid diseases, yellow nail syndrome, shell nail syndrome, bronchogenic carcinoma, multiple myeloma, scleroderma, anemia, peripheral vascular diseases, and diabetes mellitus
Others	Nail cosmetics, pregnancy, hereditary

15.4.4 Nail Tic Disorders

Nail tic disorders, though common, are some of the most poorly understood, less researched, and often misdiagnosed disorders. These disorders are known to be more common in females; hence, they will be discussed here briefly. They include a spectrum of changes seen in patients with obsessive or repetitive behavior centered around the nail unit. Various disorders are detailed below.

1. *Onychophagia*/nail biting is defined as "putting one or more fingers in the mouth and biting on the nail with teeth" [72]. This behavior pattern usually starts in childhood or adolescence and may persist in adulthood. The condition is usually limited to the fingernails and there is no predilection to bite any one nail (Fig. 15.11) [73]. Acute paronychia is the most common complication associated, though most patients eventually develop chronic paronychia. The skin surrounding the nails may show erythema, inflammation, excoriations, hang nails, scarring, or even keloid formation in severe cases.
2. *Onychotillomania* is an autoaggressive disorder that results from recurrent picking and manicuring of the nails [74]. It leads to visual shortening, distortion nand, in severe cases, complete extraction of the nails [75]. Patients usually use their hands/nails to pick the affected nail, although anything accessible from scissors to knives to toothpicks may be used [76].
3. *Habit-tic deformity* (washboard nails) is caused by habitual external trauma to the nail matrix [77]. Although any nail can be affected, thumbnails are often the primary targets. Most patients report manipulating the proximal nail fold or periungual area with an adjacent fingernail, often subconsciously. Characteristic nail changes include a central depression and short transverse, parallel ridges running from the nail fold to the distal edge of the nail (Fig. 15.12). In severe cases, the cuticles may disappear, and the lunulae may hypertrophy.
4. *Onychotemnomania* refers to a tendency to cut nails extremely short, with scissors, blade, or knife, sometimes going as far as up to the proximal end [78]. This

Fig. 15.11 Nails of a chronic nail biter. Onychophagia leads to shorter nails, exposed nail bed, larger lunulae, nail surface irregularities and nail fold excoriations with hang nails

Fig. 15.12 Habit tic deformity involving the left thumb nail. The short transverse, multiple ridges over the nail plate a result of the repeated manipulation of the proximal nail fold as evidenced by its hyperpigmentation, thickening, and cuticle disruption

leads to extremely small nail plates with exposed distal nail beds. It is a severe variant of factitious nail disorder.

5. *Onychoteiromania* refers to extremely thin nails that crack or split easily with excessive filing or rubbing of the nail surface. Patients may even file the nail folds and in worse cases, the nail bed epithelium may be reached.
6. *Onychodaknomania* is extremely rare, frankly psychotic behavior biting of fingernails between the teeth [79], which is extremely painful it leads to irregular and deep depressions on the nail plate surface with punctate or striate leukonychia. This self-mutilation is often denied and warrants a thorough psychiatric evaluation. It may respond well to combination therapy with anti-psychotics and antidepressants.
7. *Bidet nails* or worn-down nail syndrome refers to a triangular defect in the nail plate with its base at the thinnest free edge of the nail. It is a self-inflicted defect acquired due to trauma of cleaning the nails against a hard surface. It classically involves the second, third, and fourth fingernails of the dominant hand. They may also be considered as a variant of onychoteiromania. *Lacquer nail*, described by Rigopoulos et al. [80], has significant overlap with worn down nail syndrome. It occurs as a result of excessive rubbing of the nail plate with nail filers provided with topical antifungal nail lacquers.
8. *Perionychotillomania* is the habit of picking and tearing the periungual skin, also known as perionychophagia. The presence of hangnails may be the initiating

factor. However, this habit itself leads to the development of hangnails, creating a vicious cycle of picking and tearing the periungual skin.

9. *Onycholysis semilunaris* is a common (but underrecognized) factitious nail disorder that primarily afflicts women. It presents with a sharp, distal, asymmetric but semilunar onycholysis without inflammation, affecting one or many nails, both in dominant and nondominant hand. It often results from vigorous manicure with hard brushes, or use of chemicals to clean the distal nail fold, leading to hyponychial injury, pushing the distal nail fold backward. At times, secondary bacterial colonization, especially by *Pseudomonas* may occur. Repeated cleaning and formation of biofilms sets up a vicious cycle of worsening onycholysis. Treatment is difficult as patients usually deny habitual cleaning and biofilms interfere nail plate attachment. It involves cutting the nails short to the point of attachment and keeping the exposed bed free of microbes by daily application of antibiotics for a long period.

15.4.5 Ingrown Nail

This is also known as lateral ingrowth of nail plate or *onychocryptosis*. It is common in women related to inappropriate/tight footwear; common use of heels; and excessive cutting and cleaning of the lateral nail plates. The condition commonly affects the great toenails (Fig. 15.13). In the initial stages, advice regarding appropriate footwear, proper cutting of nails and conservative measure like taping or strapping may help. However, with advancing inflammation, lateral nail fold hypertrophy or formation of granulation tissue (Fig. 15.13), the need for surgical intervention becomes unavoidable. The commonly used surgical method is partial lateral nail plate avulsion and lateral matricectomy.

Fig. 15.13 Ingrown toe nail in a woman due to tight shoes and improper nail cutting

Retronychia refers to proximal ingrown nail and is being increasingly recognized to be a common entity on young women, again related to tight footwear or repeated microtrauma [81]. Patients present with proximal nail fold inflammation and elevation of the proximal nail plate which is often discolored and opaque. There is absence of distal nail growth signified by the patient's history of not needing to cut the nails. In extreme cases, granulation tissue may be formed over the proximal nail fold.

The pathogenesis involves proximal detachment of the nail plate which is then pushed upward inciting inflammation while a new nail plate grows beneath it, further pushing the old nail plate upward. It may result in multiple nail plates getting sandwiched beneath the old nail plate and the proximal nail fold. Definitive treatment involves total nail plate avulsion which relieves and reverts the nail fold inflammation. The new nail plate growth is often normal and recurrences are not seen.

15.4.6 Subungual and Periungual Warts

Warts (verrucae) due to Human Papilloma Virus (HPV) subtypes 1, 2, 4, 27 are the most common type of benign tumors affecting the nail unit. Infection is more commonly seen in nail biters, occupations involving wet work, and so on, hence more common in women [82]. This can be attributed to higher chances of trauma to skin barrier during household work or cosmetic procedures like manicure, pedicure, and artificial nails.

The incubation period is difficult to determine, but may range from few weeks to more than a year. The lesions appear as skin colored, rough papules initially arising in the proximal and lateral nail folds and hyponychium (Fig. 15.14). The diagnosis can be aided by dermoscopic examination which shows frog spawn appearance with whitish structureless areas and vessels or pink clods suggestive of thrombosed vessels, in the center [83].

Fig. 15.14 Multiple periungual warts in a nail biter

Treatment for ungual warts is challenging as a large part of the lesion may be subungual, hence not approachable [84]. Topical therapies like keratolytic agents (salicylic acid, lactic acid, and trichloroacetic acid), virucidal agents (glutaraldehyde, cidofovir), and immunotherapy (imiquimod, contact sensitizers, and BCG) have been found to be useful. Intralesional therapies with cytotoxic drugs like bleomycin and fluorouracil are increasing becoming the favored treatment modality [85]. Systemic treatment in form of immunotherapy (cimetidine, levamisole, zinc, BCG, etc.), virucidal agents (cimetidine), and antiproliferative agents like acitretin is also useful in some cases. Electrocautery is not advocated in this area due to a higher risk of scarring. Fractional CO_2 laser and cryotherapy are recommended as second line treatment for periungual warts [86].

15.4.7 Onychomycosis

Onychomycosis is the most common nail infection, accounting for up to 50% of all nail dystrophies [87]. It is most commonly caused by dermatophytic fungi, specifically *Trichophyton rubrum*, but in some series up to 30–40% of onychomycosis may be due to nondermatophyte molds and yeast [88].

Transmission of fungal species to the nail unit is often a result of tinea pedis or mannum or through contact with contaminated objects like contaminated nail grooming instruments [89]. Cuticle abrasion, paronychia, and contact dermatitis can also facilitate entry for fungi. It was reported in a study that 67/68 women who developed a nail concern after removal of artificial nails were diagnosed to have onychomycosis [90]. Another study found the nail polish top coat to act as fomite and thus be a nidus for onychomycosis [89].

Treatment of onychomycosis requires prolonged oral antifungal therapy with the gold standard being oral terbinafine. The effects are better if combination therapy with topical, surgical or device-based measures are used as adjuvants. Prevention of onychomycosis includes gentle nail care, use of clean instruments during nail care, and early treatment of tinea pedis for toenails.

15.4.8 Nail Tumors

Women are equally predisposed as men to develop various nail unit tumors; however, glomus tumors are disproportionately commoner in women than men (up to four times). These are smooth muscle hamartomas arising from glomus bodies (specialized arteriovenous anastomoses for temperature regulation). They constitute 1–5% of soft tissue tumors of the hands and up to 75% of them are found in the subungual location [91]. These arise commonly in middle-aged women (30–50 years of age).

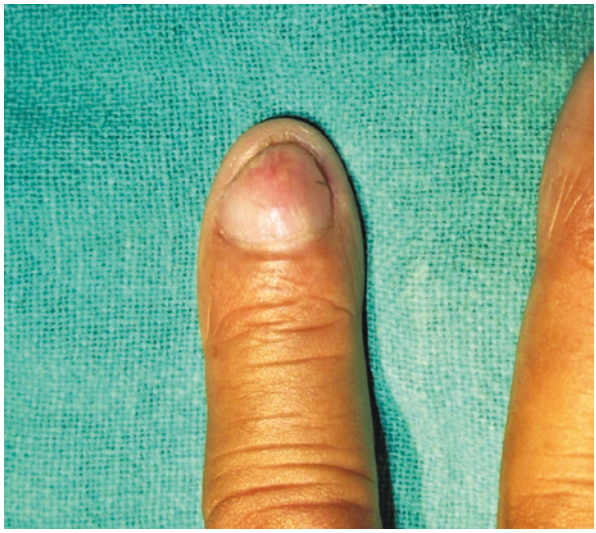

Fig. 15.15 Glomus tumor in 45-year-old lady involving the right index finger

Clinically, the lesions present as a painful nail accompanied with cold hypersensitivity, severe paroxysmal pain, and pin point pain confined to the affected nail site. The tumor is mostly subcentimetric in size, which may occasionally appear as a bluish or reddish subungual lesion (Fig. 15.15). There may be no visible changes in many cases, but the pain is characteristic. Other reported changes include longitudinal erythronychia, true or apparent leukonychia, distal splitting, fissuring, or elevation of nail plate [92]. Useful clinical tests for diagnosis include Love's pin test (pressure induced intense pin-point pain) and Hildreth's test (relief in pain because of transient ischemia induced by a blood pressure cuff). Cold test shows exacerbation of pain on placing an ice cube on nail. Onychoscopy can help in better delineation of the tumor location [92].

Diagnosis is often clinical but imaging techniques like plain X-ray (only larger lesions), ultrasound examination (nonspecific solid hypervascular hypoechoic mass) and high-resolution MRI (modality of choice) are helpful in preoperative diagnosis and planning surgical removal. Histopathology of the lesion is confirmatory showing branching vascular channels of varying sizes, surrounded and separated by nests and aggregates of glomus cells, which are monomorphic round cells with regular, round nuclei, and eosinophilic cytoplasm.

Surgical excision is the treatment of choice for these painful lesions, and can be done either translingually or through a lateral (lateroungual or laterodigital Keyser–Littler) approach. Nail deformity and recurrences are major concerns after surgery, which can be minimized by through preoperative evaluation and careful intraoperative removal while avoiding damage to the nail matrix and nail bed.

15.5 Conclusion

Nail health in women is important for their efficient daily functioning as well as their external appearance, emotional well-being, and cosmesis. The normal aging process as well as state of nutrition in women leads to nail changes that may impair the appearance as well as function of nails, if not promptly addressed. Maintaining healthy nails is based on the use of efficient and safe grooming practices. The plethora of nail cosmetics used is very attractive for women worldwide, but has the potential to compromise nail health. It is important for women and their health-care providers to be aware of such potential complications so that they can be avoided or at least diagnosed early and treated. In collaboration with her health-care provider, a woman should be able to maintain healthy, functional nails throughout her life.

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