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| <b>Review Article</b>                | <b>Pak-Euro Journal of Medical and Life Sciences</b>         |
| DOI: 10.31580/pjmls.v6i2.2403        | Copyright © All rights are reserved by Corresponding Author  |
| Vol. 6 No. 2, 2023: pp. 145-154      |  |
| www.readersinsight.net/pjmls         | <b>Revised: June 13, 2023</b> <b>Accepted: June 29, 2023</b> |
| <b>Submission: December 29, 2022</b> | <b>Published Online: June 30, 2023</b>                       |

## MANAGING PARONYCHIA: RISK FACTORS, SYMPTOMS AND TREATMENT APPROACHES

Bilal Javed<sup>1</sup>, Muhammad Kamran Taj<sup>1\*</sup>, Saadullah Jan<sup>1</sup>, Imran Taj<sup>1</sup>, Masroora Ali Khan<sup>1,2</sup>, Aroosa Akram<sup>1</sup>, Bibi Sazain<sup>1</sup>, Saima Azam<sup>1</sup>, Sabir Khan Panezai<sup>3</sup>, Sakina Khan<sup>1</sup>

<sup>1</sup>Center for Advanced Studies in Vaccinology and Biotechnology (CASVAB), University of Balochistan, Quetta, Pakistan

<sup>2</sup>Department of Microbiology, Sardar Bahadur Khan Women's University (SBKWU), Quetta, Pakistan.

<sup>3</sup>Education Department, Quetta, Balochistan, Pakistan

\*Corresponding Author: Muhammad Kamran Taj. E. mail: [kamrancasvab@yahoo.com](mailto:kamrancasvab@yahoo.com)



### Abstract

Paronychia, a prevalent nail infection, is characterized by erythema and edema in the lateral nail fold, exhibiting acute or prolonged manifestations with infectious or noninfectious origins. Various causal agents, including *Staphylococcus aureus* and *Candida albicans*, have been identified through bacterial investigations. Immunocompromised individuals, diabetics, and those regularly exposed to chemicals and moisture are at an elevated risk for paronychia. Additionally, certain medications, such as epidermal growth factor receptor inhibitors, can induce paronychia. Occupations involving frequent mechanical trauma, like cooks and housekeepers, are particularly susceptible.

The condition is influenced by several risk factors, including age and participation in manicures. *Staphylococcus aureus* is the primary pathogen in bacterial paronychia, although fungal infections, irritants, nail-biting, and certain medications can also contribute. Complications may lead to the development of felons, and differential diagnoses encompass sclerotic cell cancer, onychomycosis, and cellulitis. Management options range from antibiotics and drainage to conservative measures, with surgery being reserved for rare and severe cases. Laser therapy presents an innovative therapeutic approach. Timely intervention and an understanding of risk factors are pivotal for the effective treatment of paronychia.

**Keywords:** Common, Infection, Management, Paronychia, Risk factors

## INTRODUCTION

Paronychia, an illness affecting the tissues surrounding the nails, is typically characterized by inflammation in the lateral nail fold, presenting as edema and erythema (1). In neglected cases, abscesses may form in the lateral and proximal nail folds, and paronychia can manifest as either an infectious or noninfectious condition, displaying acute or chronic characteristics (2).

Bacterial research has identified several causative agents of paronychia, including *Pseudomonas aeruginosa*, *Candida albicans*, *Staphylococcus aureus*, *Streptococcus faecalis*, coliform organisms, and *Proteus* species (3-5). Common occurrences are observed, especially in children who habitually lick their fingers or individuals with inadequate skin hygiene.

Chronic paronychia, distinguished by inflammation lasting at least six weeks, is characterized by the degeneration of the eponychium and the nail vest barrier (6-8). Factors contributing to this condition include recurrent exposure to external allergens and bacterial or fungal colonization. Those frequently exposed to dampness and chemical irritants are particularly susceptible (9-10). The prevalence of paronychia is elevated in individuals with immunosuppressive and diabetic disorders. Certain medications, such as epidermal growth factor receptor inhibitors, can also induce paronychia.

Occupations involving frequent water contact, such as housewives, maids, and nurses, increase the likelihood of developing paronychia (11). This condition is relatively common among young individuals, causing significant discomfort, especially in those with peripheral vascular disease, diabetes, or



immunological deficits. Paronychia holds a 3:1 female-to-male ratio and is the most prevalent nail infection in the US, with women being more susceptible. Certain professions, such as housekeepers, cooks, and maids, entail a higher risk. The American Academy of Dermatology estimates that 99% of individuals will encounter nail problems at some point in their lives. Women in their late forties and early fifties are particularly vulnerable to this illness (12).

## TYPES OF PARONYCHIA

Paronychia, a common nail infection, is categorized into acute and chronic forms based on duration, with acute paronychia lasting approximately six weeks (13). It is often triggered by factors such as hanging nails, rough nail care, nail biting, trauma, and occasionally foreign objects (13, 14). Notably, chronic paronychia is more prevalent in fingernails and can persist beyond six weeks, commonly affecting the right fingers, especially the thumb and right middle finger, with mechanical trauma identified as a significant risk factor (15).

## TYPICAL SIGNS AND SYMPTOMS OF PARONYCHIA

Symptoms of paronychia manifest rapidly, within hours or days, affecting the sides of the nail, the nail fold, and cuticle areas (16). Pain, edema, and sensitivity characterize paronychia, with reddening and warmth in the surrounding skin. Pus-filled abscesses may form, requiring drainage and antibiotic treatment (16). If untreated, nails may grow irregularly, exhibit ridges or waves, turn yellow or green, and become dry and brittle.

## COMMON RISK FACTORS FOR INFECTION WITH PARONYCHIA

Various risk factors contribute to paronychia, including nail-related habits, compromised immunity, and the potential for mimicking other diseases like squamous cell carcinoma and metastatic cancer (17, 18). Microorganisms, predominantly *Staphylococcus aureus*, play a crucial role in bacterial paronychia infections, with aerobic and anaerobic bacteria, as well as nonbacterial agents like *Candida albicans* and herpes simplex virus, implicated (20).

Paronychia is linked to a number of risk factors, such as nail biting, manicures, artificial nail use, and the existence of hangnails, which can weaken the natural infection barrier in the nail fold. Hand infections are more common in people with compromised immune systems, such as those with diabetes or immunosuppression (17). In addition, paronychia can mimic other diseases such as squamous cell carcinoma, subungual melanoma, and metastatic cancer. Rarely, reports of metastatic breast cancer in the great toe's lateral nail fold have surfaced (1, 18). Therefore, it is crucial to rule out both benign and malignant neoplasms when chronic paronychia is suspected. Paronychia has been associated with a number of variables, including atopic illnesses, long-term medical conditions, psoriasis, fungal skin infections, sports activity, and ageing. Additionally, there might be a hereditary component. When treating individuals with paronychia, healthcare providers must be aware of these risk factors (19).

## SIGNIFICANCE OF MICROORGANISMS IN PARONYCHIA INFECTION

An important factor in paronychia infections is microorganisms. For the most part, most occurrences of bacterial paronychia infections in humans are caused by the common pathogen *Staphylococcus aureus* (20). Every year, *S. aureus* infections in the soft tissues and nails of Americans result in around 500,000 hospitalisations and 10 million outpatient visits. Acute paronychia can also be caused by other aerobic pathogens such as *Klebsiella pneumoniae*, *Eikenella corrodens*, group A hemolytic streptococcus, and gamma-hemolytic streptococci. Anaerobic bacteria are also frequently linked to paronychia in addition to aerobic bacteria. Fusobacteria species, Bacteroides species, and Gram-positive anaerobic cocci are a few types of these anaerobic bacteria. *Enterococcus faecalis*, Proteus species, and *Pseudomonas aeruginosa* are a few less frequent infections that cause paronychia. Moreover, certain cases have been linked to nonbacterial agents, including yeast (*Candida albicans*) and viruses (like herpes simplex) (2).

## **INFLUENCE OF IRRITANTS AND CHEMICALS ON PARONYCHIA INFECTION**

Chemicals and irritants may also contribute to paronychia development. This disorder is more likely to develop in those who are exposed to irritants, such as detergents and other chemicals that irritate the skin. Those who regularly handle chemicals without wearing protective gloves are especially in danger (21).

## **THE IMPACT OF BITING AND PICKING ON PARONYCHIA INFECTION**

The habit of picking at or biting nails is another factor that contributes to paronychia. Minor skin abrasions or cracks surrounding the nails may result from nail biting or cuticle picking. These tiny cuts give germs a way to penetrate the epidermis and perhaps cause paronychia (22).

## **THE INFLUENCE OF MEDICATIONS ON PARONYCHIA INFECTION**

There is evidence that several drugs, especially those that cause inflammation around the nails, may be paronychia triggers. These drugs consist of retinoids, some cancer therapies, HIV prescriptions, and certain antibiotics (23). Drugs can cause drug-induced toxicity that results in paronychia when taken in conjunction with retinoids, inhibitors of the epidermal growth factor receptor (such as cetuximab), and tyrosine kinase inhibitors (such as neratinib and afatinib) (23). Remarkably, persistent paronychia in HIV patients is frequently caused by the antiviral drug indinavir, which is identical to retinoids (24, 25).

## **IMPACT OF INGROWN TOENAILS ON PARONYCHIA INFECTION**

About 20% of foot diseases addressed by family physicians are ingrown toenails, also known as onychocryptosis or unguis incarnatus. They arise as a result of traumatising the periungual skin of the lateral nail fold by the adjacent nail plate, which sets off an inflammatory foreign body reaction (27). Along with enlargement of the afflicted nail fold, this frequently results in the development of a painful, seeping, and foul-smelling lesion (28). There is an ingrown toenail as a result of the nail plate penetrating the lateral nail fold, which is often accompanied by considerable inflammation of the nail fold (29).

## **INFLUENCE OF MANICURES ON PARONYCHIA INFECTION**

Many methods and instruments are used during manicures, some of which are known to be dangerous. Among the known risks associated with manicure procedures are bacterial, fungal, mycobacterial, and viral infections (such as herpes simplex and human papillomavirus) (30). Insufficiently sterilized instruments, such as clippers, blades, abrasive files, electric drills, and footbaths, can harbor bacteria and stimulate their growth. Cuticle cleaning, filing, and cutting can cause micro- and macro-traumas, which makes it easier for microorganisms to infiltrate. Moreover, when unintentionally applied to periungual skin, some ingredients in nail polish and enhancers might function as contact sensitizers. Paronychial infections may be brought on by substances such as acrylates, formaldehyde, and toluene sulphonamide-formaldehyde resin (31).

## **IMPACT OF FOOTWEAR ON PARONYCHIA INFECTIONS**

Running shoes that fit too tight, physical damage, and extended exposure to damp conditions inside the footwear can all lead to paronychia, a condition that many runners experience (32). Both acute and chronic manifestations of this illness are possible. Acute paronychia can result from a single traumatic incident (e.g., running into a rock) or from a buildup of repetitive microtrauma (e.g., persistent pressure from the nail plate against the front of the shoe during long-distance races). These situations can result in excruciating and perhaps incapacitating nail infections and inflammation; thus, in order to prevent paronychia, runners must choose footwear that fits properly, practice good foot care, and pay close attention to avoiding injuries (33).

## **PARONYCHIA RISK FOR HAIRDRESSERS**

Because hairdressers are constantly exposed to a variety of contributing factors, they are at a significant risk of acquiring paronychial illnesses. These causes include physical irritation from hair strands,

repeated exposure to chemical irritants found in hair products, continual immersion in water and detergents, wearing gloves for extended periods of time to guard against these irritants, and possible exposure to allergens from hair dyes and bleaches. When a hair shaft penetrates the nail fold and causes chronic paronychia, a female hairdresser may be more vulnerable. Preventing this condition requires maintaining good personal hygiene habits, like wearing clean gloves and carefully removing any hairs that pierce the epidermal barrier. Hairdressers can greatly lower their risk of acquiring paronychia disorders, which could negatively impact their overall health and nail health, by taking these preventative measures and staying informed about the unique dangers related to their line of work (34).

## **AGE-RELATED PATTERNS IN PARONYCHIA INFECTION**

Age is a major determinant in paronychia infection incidence, and different age groups have varied risk factors. The most common cause of paronychia in children of all ages is finger sucking. These infections may thrive in an environment that is conducive to their development because of the ongoing wetness and the introduction of oral bacteria. However, women who are in their late forties and early fifties also have a notable risk of developing paronychia. This age group is more susceptible to infections and inflammation around the nails, which may be related to ageing-related changes in skin suppleness, circulation, and immunological response (5).

## **ASSOCIATIONS WITH COEXISTING MEDICAL CONDITIONS**

It's critical to understand that not all occurrences of inflammation of the paronychia are restricted to certain nail conditions. The symptoms of paronychia can be closely mimicked by certain dermatological disorders, such as pemphigus vulgaris and Reiter's disease, which complicates diagnosis and therapy. In addition, persistent paronychia could be a sign of systemic diseases such as squamous cell carcinoma, diabetes, immunosuppression, metastatic malignancy, and subungual melanoma. Interestingly, there is evidence that breast cancer can spread to the great toe's lateral nail fold, which emphasizes the importance of being cautious while managing paronychia's that are resistant to conventional therapy. The necessity of a multidisciplinary approach to address the entire range of probable causes and guarantee prompt and suitable care is highlighted by the necessity of a thorough study in such instances in order to rule out both benign and malignant neoplasms (1, 5, 9, 19, 37). Elderly and long-term diabetic patients experience a large increase in the development of foot lesions as a result of diabetic neuropathy. Research indicates that subclinical neuropathy and modest neuromotor dysfunction are already present in young people with type 1 diabetes. This implies that in ordinary clinical practice, it is crucial to use basic methods to identify both clinical and subclinical neuropathy in order to manage nerve dysfunction, as measured by nerve conduction velocity (38). It is interesting to note that adolescents with type 1 diabetes have a substantial prevalence of nail-bed infections; however, no research has looked into the possibility of a link between diabetes or diabetic neuropathy and the emergence of nail-bed infections in adolescents (39).

## **PARONYCHIA AND PSEUDO PYOGENIC GRANULOMA IN CANCER PATIENTS**

When using capecitabine and epidermal growth factor receptor inhibitors, paronychia and pseudo pyogenic granuloma (Pseudo-PG) are frequent and difficult side effects to deal with. Advanced solid malignant tumors are being treated with these inhibitors more and more. Pseudo-PG and paronychia occur in 10% to 30% of patients; their incidence is dose-dependent and usually necessitates up to 8 weeks of continuous treatment (40).

## **ETIOPATHOGENESIS OF PSEUDO-PG AND PARONYCHIA**

It is yet unknown what specifically causes these disorders. According to some experts, the periungual epidermis's first shedding and weakening is caused by these antineoplastic drugs. This may lead to onychocryptosis and periungual inflammation, which further encourage the growth of granulomatous tissue (40, 41). The severe discomfort associated with paronychia can interfere with daily activities and self-care, greatly lowering the quality of life for those affected. Since a number of treatments, such as surgery,

topical antiseptics, antibiotics, and corticosteroids, frequently have a low success rate, managing this condition can be difficult. In certain instances, it could be essential to lower the dosage or stop taking anti-cancer drugs (40, 42).

## DIFFERENTIAL PARONYCHIA DIAGNOSIS

**Felon:** an infection within the compartments of the fingertip pulp. It can be the direct consequence of paronychia.

**Cellulitis:** an infection of the skin that causes swelling and erythema in the affected area.

A fungal nail infection that results in whitish-yellow discoloration is called onychomycosis.

A rare kind of persistent paronychia called squamous cell carcinoma may be misinterpreted as a malignant subungual tumour.

Psoriasis of the nails influences both fingernails and toenails, resulting in a variety of deformities.

**Herpetic Whitlow:** A distal finger viral infection caused by HSV that manifests as vesicles and vesicopustules (16, 43).

## PARONYCHIA'S PATHOGENESIS

Clinically, chronic paronychia manifests as nail fold enlargement, frequently with cuticle rupture present. When paronychia is present, the skin around the nail unit and the nail unit itself may become sensitive. Bacteria can enter the nail unit when the seal is broken, starting an inflammatory cycle that can be difficult to stop. With pre-existing chronic paronychia, there may eventually be acute exacerbations of acute paronychia. Parallel ridges, or Beau's lines, are the most prevalent anomalies of the nail plate and are caused by the pressure of inflammation on the matrix (3).

## DIAGNOSIS OF PARONYCHIA

### EVALUATING PARONYCHIA

The first step in the diagnostic process is to compile an extensive and pertinent history. Examine each of the 20 nails carefully, keeping in mind that local processes and drug interactions could also be contributing factors to paronychia. This is in addition to the usual causes (11). Based on the patient's medical history and physical examination, acute paronychia can be diagnosed. Examining risk factors linked to uncommon pathogenic organisms is essential for these illnesses (45). The main signs of chronic paronychia, which are frequently less severe than those of acute paronychia, are erythema, swelling, and discomfort (4). The proximal nail fold frequently separates from the base nail. Chronic paronychia can also cause changes to the nails, such as ridging, grooves, discoloration, or rounding of the nail plate.

## DIAGNOSIS AND MANAGEMENT OF PARONYCHIA INFECTION

### DIGITAL PRESSURE TEST FOR PARONYCHIAL ABSCESSSES

The digital pressure test is used to determine whether paronychial abscesses are present and how severe they are. This examination involves applying light pressure to the affected digit's distal volar aspect and looking for blanching in the paronychia region, which could be a sign of an abscess. For the diagnosis of paronychia, radiographs and laboratory tests are usually not indicated. Gramme staining and culture are employed to identify the bacterial aetiology of fluctuant paronychia (23).

### HISTOPATHOLOGY IN PARONYCHIA

A few lymphocytes and a thick infiltration of plasma cells are seen in the upper dermis of paronychia. In the middle and lower dermis, this dermal infiltration is mainly perivascular. There is some acanthosis in the epidermis, beginning at the outer nail fold. Similar features, such as edema in the epidermis and thick infiltration throughout the entire dermis, are seen in the biopsy sample in the event of an acute aggravation of chronic paronychia (5).

### DETERMINING THE APPROPRIATE MANAGEMENT



The selection of treatment for paronychia is contingent upon various criteria, including the etiology, course, degree of involvement, and any associated risk factors. In most cases, an opening in the barrier that separates the nail from the nail fold causes infectious paronychia. The gap between the nail and nail fold becomes open to the entry of bacterial or fungal organisms as a result (48).

## **TREATMENT OF PARONYCHIA INFECTION**

### **CONSERVATIVE THERAPY**

Early on, conservative therapy is frequently successful if an abscess has not yet formed. This involves soaking in warm water three or four times a day. Warm soaks, an oral anti-staphylococcal drug, and splint protection are advised in situations where the illness is persistent (1).

### **DRAINAGE THERAPY**

Before beginning antimicrobial therapy for severe paronychial infections, some experts advise getting both aerobic and anaerobic cultures (7). It can be necessary to promote natural drainage or perform surgical drainage if there is an abscess or fluctuation. When paronychia is neglected, pus under the nail fold may move to the other side and result in a "run-around abscess." Pus may build up under the nail in more serious situations, necessitating nail removal for adequate drainage. It is possible to remove pus using an intra-sulcal procedure without the requirement for local anesthesia. In order to do this, a blunt object must be inserted into the groove created by the nail plate and lateral nail fold. The pus is expelled, and the nail fold is gradually peeled away from the nail. To guarantee that drainage occurs throughout the fold, a little strip of mesh gauze can be inserted. It is advised to take warm saline baths until redness and irritation go away (49).

### **ANTIBIOTIC THERAPY**

Antibiotic therapy may be necessary to stop anaerobes in people who bite their nails and kids who sucking their fingers. Ampicillin and penicillin both works well against oral bacteria. But *S. aureus* and *Bacteroides* can become resistant to antibiotics. The majority of the bacteria that cause these illnesses are effectively inhibited by the antibiotics clindamycin (Cleocin) and amoxicillin-clavulanate potassium combination (Augmentin) (7). Resistance in some anaerobic bacteria, such as *Escherichia coli*, makes first-generation cephalosporins less effective (2).

### **ANTIBACTERIAL SOLUTIONS OR OINTMENT THERAPY**

Topical antibiotics may be used, perhaps in conjunction with a corticosteroid. Fusidic acid plus betamethasone was found to be more effective in treating acute paronychia than gentamycin ointment. Both therapies were effective, resulting in a 50% decrease in discomfort and no negative side effects. Treatments such as acetic acid soaks or oral antibiotics may be necessary in the event of recurrent bacterial infections. When all other forms of medical care fail, surgery is advised. Excellent results have been obtained with procedures including eponychial marsupialization, total nail removal, and antifungal steroid ointment applied to the nail bed (1, 18, 32, 50).

### **Nd:YAG LASER THERAPY FOR PARONYCHIA**

#### **Nd:YAG LASER TREATMENT**

Paronychia may benefit from neodymium-doped yttrium aluminium garnet (Nd:YAG) laser therapy. Heat is produced during this treatment, which causes inflammation and raises vascular permeability, improving vascular microcirculation. This procedure is essential for repairing anomalies in the nail system. Furthermore, it has been discovered that Nd:YAG laser therapy exhibits antibacterial properties against a variety of bacteria and fungi, including species of *Candida* (51, 52).

### **ANTI-INFLAMMATORY EFFECTS**

With its ability to heat the dermis by photothermolysis and disrupt the inflammatory infiltrate, Nd:YAG laser treatment can help reduce inflammation (53). Also, as a secondary minor chromophore, water

is the main target of the laser. Nd:YAG laser therapy may also have anti-inflammatory effects since it can increase TGF- $\beta$  and IL-8 levels, two factors that are known to have anti-inflammatory properties. This is according to studies conducted by Jung et al. (2009). It is capable of regulating skin tissue perfusion and vascular permeability (21).

### **DIRECT FUNGICIDAL EFFECTS**

In addition to its anti-inflammatory qualities, Nd:YAG laser therapy might be useful in eliminating bacteria due to its direct fungicidal effects. This implies that, when used in the treatment of paronychia, the laser may act as an antimicrobial (3).

## **CONCLUSION**

Paronychia, a prevalent and discomforting condition impacting the perinail tissues, is marked by inflammation of the lateral nail fold, often leading to erythema and edema. It can manifest as either an acute or chronic ailment, with infectious and non-infectious origins. Untreated cases may progress to abscess formation in the proximal and lateral nail folds, introducing potential complications. The etiology of paronychia involves a spectrum of agents, encompassing bacterial, fungal, and viral infections. Notably, *Staphylococcus aureus* is a frequently identified bacterial culprit. Individuals with suboptimal hand hygiene or prolonged exposure of fingers to moisture, such as finger-sucking children, face an elevated risk of developing paronychia. Additional risk factors include the use of artificial nails, engagement in manicures, nail biting, and the presence of hanging nails. Age plays a significant role in susceptibility, with older adults and children being more prone. Occupations involving frequent water exposure, compromised immune systems, and roles like hairdressing also heighten vulnerability. Furthermore, specific medications, including antibiotics and cancer therapies, have been associated with paronychia development. Given its potential resemblance to other dermatological conditions and its connection to systemic illnesses, an accurate diagnosis is pivotal for effective and timely treatment. Management approaches for paronychia encompass conservative methods, drainage therapy, antibiotic administration, and the application of antibacterial solutions or ointments. In severe cases, surgical interventions like eponychia marsupialization or total nail amputation may be warranted. Notably, neodymium-doped yttrium aluminum garnet (Nd:YAG) laser therapy, with its anti-inflammatory and potentially antibacterial properties, emerges as a promising alternative for paronychia treatment, demonstrating efficacy in reducing inflammation and enhancing vascular permeability.

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