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Review Article

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Refining Nail Surgery: Clinical Pearls and Best Practices

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ABSTRACT

The nail is not only aesthetically significant but also functionally essential, as it protects the distal digits and serves as a counterpart for pressure-bearing areas. Nail surgery presents unique challenges since, even after successful treatment of pathological conditions, scarring may lead to cosmetic deformities, and partial or complete nail loss can result in functional impairment. Fortunately, recent advancements in nail surgery have improved treatment success rates while minimizing complications. This review focuses on the surgical management of 6 key nail disorders: ingrowing nails, pincer nails, onychogryphosis, glomus tumors, digital mucous cysts (DMCs), and nail unit melanoma (NUM). For recalcitrant ingrowing nails, soft tissue excision rather than direct nail intervention yields better outcomes. Pincer nails require surgical correction of the protruding nail bed to prevent recurrence. Onychogryphosis is effectively managed with repeated nail grinding to reduce thickness and maintain nail shape. Glomus tumors can be effectively diagnosed using ultrasound, with surgical excision reserved for cases with clear imaging findings. DMCs may be treated with surgical deroofing followed by chemical peeling agents to reduce recurrence. In NUM, a conservative surgical approach can be considered for cases of in situ or minimally invasive, avoiding unnecessary amputation. This review synthesizes key clinical pearls and best practices to optimize patient outcomes in nail surgery. By integrating the latest evidence and surgical innovations, we provide a comprehensive guide for dermatologic and surgical practitioners seeking to refine their approach to nail procedures.

Keywords: Glomus tumor; Melanoma; Nails; Nails, ingrown; Surgery

INTRODUCTION

The refinement of nail surgery begins with anesthesia. Methods to minimize pain during anesthesia include pre-application of topical anesthetic cream, applying an ice cube for at least six minutes before injection, and using vibrating massagers[1]. Since lidocaine is acidic, dilution with bicarbonate can help reduce pain[2]; however, excessive bicarbonate may increase the risk of necrosis[3]. To reduce bleeding and enhance anesthetic efficacy, lidocaine with epinephrine can be used, and studies have shown that it does not increase the risk of fingertip necrosis[4]. Historically, issues arose when epinephrine was mixed manually, so it is recommended to use commercially prepared lidocaine with epinephrine[5]. However, epinephrine is contraindicated in patients with severe hypertension or Raynaud's phenomenon. For pregnant patients, while lidocaine with epinephrine is classified as Food and Drug Administration category B and can be used, epinephrine itself is category C, making lidocaine without epinephrine the preferred choice[6].

To minimize bleeding during nail surgery, a digital tourniquet is commonly used. However, continuous application for more than 20–30 minutes increases the risk of fingertip necrosis, necessitating its release every 20 minutes[4,7]. Postoperative hemostasis methods include the application of brimonidine 0.33% gel[8], a selective alpha-2 adrenergic receptor agonist, as well as various hemostatic materials that can be sprayed or applied to the surgical site[9].

This review will sequentially explore the surgical approaches and management strategies for ingrowing nails, pincer nails, onychogryphosis, glomus tumors, digital mucous cysts (DMCs), and nail unit melanoma (NUM).

INGROWING NAILS

Ingrowing toenail (onychocryptosis) is a common and often painful condition in which the edge of the nail plate penetrates the surrounding soft tissue, leading to a foreign body-like inflammatory reaction[10]. This results in granulation tissue overgrowth, infection, and pain. The etiology is multifactorial, including poorly fitting shoes, improper trimming, chronic trauma, and mechanical pressure[11].

For the treatment of ingrowing nails, there are two fundamentally different approaches[12]. Most dermatologists favor the view that a wide nail plate in relation to a narrow nail bed is the primary cause and therefore propose narrowing the nail plate to prevent it from growing into the surrounding tissue. However, some believe that the soft tissue is primarily at fault and propose removing the excess soft tissue so that there is no substrate for the nail to grow into.

Taping, dental floss placement, protective tubes, and gutter splints are simple and effective conservative measures appropriate for mild cases of ingrowing nails[13]. However, in more advanced cases characterized by chronic inflammation and granulation tissue formation, these approaches are often insufficient, and surgical intervention becomes necessary for definitive management. While various surgical procedures have been proposed over the decades, no universal consensus exists on a single best approach. Instead, recommended treatment options vary depending on the severity of the condition.

Ingrown nails are classified into three stages by severity (Heifetz classification)[14]. Stage 1 involves mild erythema and swelling, managed with conservative care. Stage 2 includes infection and granulation tissue, often requiring partial nail avulsion or chemical matricectomy. Stage 3 presents with severe infection and hypertrophic tissue, necessitating definitive surgical intervention.

Winograd method (wedge resection of the nail plate and nail bed)

First described in 1927, the Winograd method involves partial lateral nail plate excision with wedge resection of the germinal matrix and hypertrophic tissue, followed by suturing[15]. Altun and Peker[16] reported that, following the Winograd procedure, the sutured group experienced less postoperative bleeding and granulation tissue, a shorter return-to-work time, and no difference in recurrence compared to the unsutured group. Kim et al.[17] reported favorable outcomes with a modified technique omitting wedge resection and using curettage with electrocautery, resulting in a low recurrence rate (3.95%) and rapid recovery (mean of 13.26 days).

Partial nail avulsion with matricectomy

First described by Ross[18], this technique involves removal of the lateral nail plate and destruction of the lateral matrix using surgical, chemical (e.g., phenol, trichloroacetic acid [TCA]), or physical methods (e.g., CO_2 laser). Phenolization has been shown to significantly reduce recurrence without increasing the risk of infection, postoperative pain, or delayed healing[19]. Widely adopted by dermatologists, it is effective; however, potential complications include nail plate narrowing, dystrophy, and spicule formation[13]. Given the role of the great toenail in balance and postural stability, such changes may impair foot function[20]. Additionally, in cases with extensive granulation tissue, recurrence rates may be higher[21].

Soft tissue excision (STE, preserving the nail plate)

First described in 1959, STE is based on the idea that hypertrophic soft tissue—not the nail—is the main cause of deformity[22]. The technique preserves the nail plate while excising the lateral nail fold and granulation tissue under local anesthesia. Hemostasis is achieved with 50% TCA, and the wound is either sutured or left to heal by secondary intention.

Jung et al.[23] treated 12 recalcitrant ingrown toenails with STE, preserving the nail plate in all cases (**Fig. 1**). Nine underwent secondary intention healing (SIH) and three were sutured. In the SIH group, 50% TCA was used for hemostasis. Toenail width increased by 52.5%, with no recurrences over a median follow-up of 188.2 days.

Noël[24] described an elliptical excision of hypertrophic soft tissue with primary closure in 23 patients, without matricectomy or nail avulsion. All cases healed without complications or recurrence over 12 months. Similarly, Dąbrowski and Litowińska[25] performed bilateral STE with subungual suturing in 54 nails, reporting only one recurrence, minimal pain, and high patient satisfaction.

STE offers excellent cosmetic and functional results, especially in chronic and recurrent cases. Its main disadvantage is the

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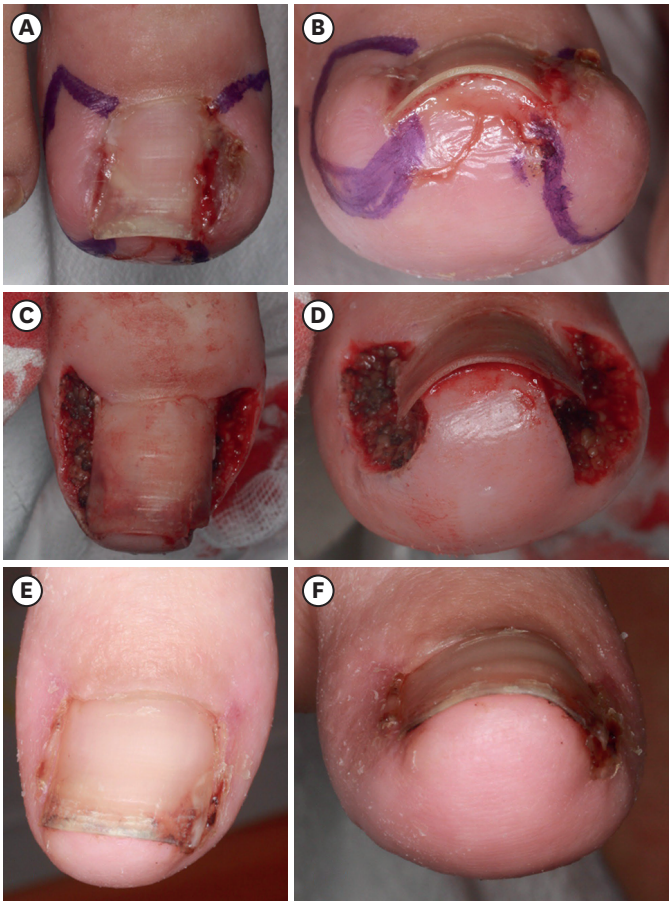

Fig. 1. Treatment of recalcitrant ingrown toenail with soft tissue excision. (A, B) Preoperative views. (C, D) Immediate postoperative views. (E, F) Six weeks postoperatively.

prolonged healing period, necessitating attentive wound care and infection control.

PINCER NAIL

Pincer nail is marked by excessive transverse curvature of the nail plate, most often affecting the great toenail, causing pain or ulceration[26]. Risk factors include tight footwear, systemic diseases, nail tumors, fungal infections, and medications like β-blockers[27].

Early hypotheses suggested that bony overgrowth or distal phalangeal enlargement caused excessive curvature. However, more recent studies indicate that osteophytes may be a consequence, not a cause. Differences in the growth rates of the dorsal and ventral nail plate layers, along with shrinkage of the nail bed, are now considered primary contributing factors[28]. Its high prevalence in bedridden patients highlights the role of mechanical forces—nails naturally curve downward to counter daily upward pressure, and loss of this balance may lead to deformity[29].

Conservative treatments include nail softening with 40% urea or 3% salicylic acid, thinning the nail with a grinder, and applying plastic braces[30]. Sano and Ichioka successfully reduced severe curvature by nail grinding, restoring mechanical balance[31]. Despite various conservative and surgical options, there is no standardized treatment approach.

Originally described by Zadik[32] in 1950, complete matrix removal often led to flap necrosis and poor cosmetic/functional outcomes. Modern surgery now aims to preserve the nail matrix and structure. Standard surgical correction begins with careful nail plate removal while preserving the matrix. A periosteal flap is elevated through incisions along the hyponychium and lateral folds, followed by subperiosteal dissection to reduce curvature. Osteophytes, if present, are removed. The lateral nail walls are de-epithelialized, and the widened nail bed flap is fixed in place. The original nail plate is flattened and reapplied as a biologic dressing to support healing.

Nail bed widening is a key technique to correct pincer nail deformity by increasing the nail bed's surface area and reducing transverse curvature. Methods include zigzag incisions or 5-flap Z-plasty with osteophyte removal allow effective transverse expansion of the nail bed and provide a more stable base[33,34]. Given the risk of ischemia from periosteal flap elevation, vascular status should be carefully assessed.

Shin et al.[35] introduced a matrix-preserving technique that avoids nail plate removal, showing favorable outcomes in 11 patients. A 5-mm oblique incision is made at both proximal nail folds, and the nail plate is bent at its point of maximal curvature to expose the nail bed, which is dissected from the distal phalanx. After excising hypertrophic tissue and osteophytes, the matrix is gently ablated. The nail bed is then flattened and sutured, allowing precise correction with minimal complications while preserving nail integrity (**Fig. 2**). Ozawa et al.[36] used a splint from an aspiration tube post-matrix widening, maintaining shape and reducing recurrence in most patients.

Pincer nail deformity has both structural and mechanical causes. While conservative treatments may help in mild cases, they are often insufficient for severe deformities. Surgical options such as nail bed reconstruction, flap expansion, and splinting aim to correct curvature while preserving nail structure, and should be selected based on individual patient factors.

ONYCHOGRYPHOSIS

Onychogryphosis is marked by thickened, elongated, and deformed nails most commonly affecting the great toenail[37]. The pathogenesis is unclear, but proposed mechanisms include asymmetric nail matrix activity beneath the posterior nail fold and nail

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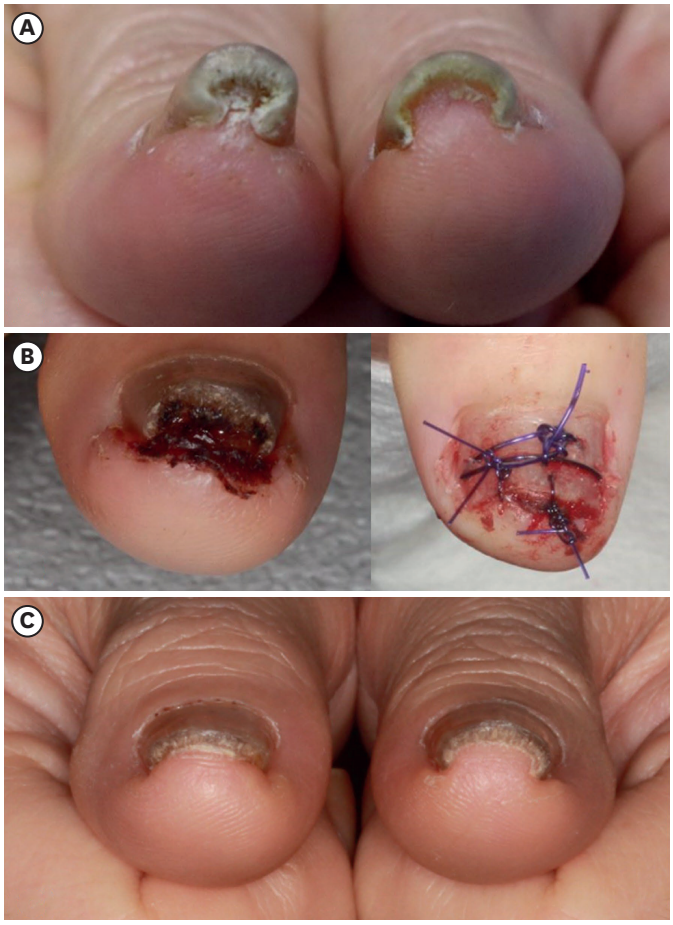

Fig. 2. Treatment of pincer nail using a matrix-preserving surgical technique. (A) Preoperative views. (B) Excision of the protruding nail bed and flattening with fixation of the curved nail plate. (C) Two months postoperatively.

bed hyperplasia with hyperkeratinization[38]. It is linked to poor hygiene, limited self-care, systemic diseases (e.g., psoriasis, syphilis, ichthyosis), and vascular conditions (e.g., varicose vein, stasis dermatitis)[39].

Chronic microtrauma from ill-fitting shoes or foot deformities like hallux valgus is a key factor[37]. To alleviate pressure and reduce nail thickness, conservative treatments such as mechanical trimming or nail avulsion (with or without matricectomy) are commonly employed[40]. When trimming is difficult due to excessive thickness, cryotherapy with liquid nitrogen can dehydrate the nail, making it brittle and easier to cut[41]. Recommended tools include dual-action nail clippers or, in more advanced settings, medical-grade grinding drills (**Fig. 3**).

A recent case report showed that repeated intramatrix dexpanthenol injections after nail avulsion provided sustained improvement for five months, likely due to its anti-inflammatory and healing effects[38]. However, conservative treatments often offer only temporary relief with high recurrence. In severe or recurrent cases, total nail avulsion with matricectomy—via surgical excision, chemical ablation, or electrodessication—is commonly required.

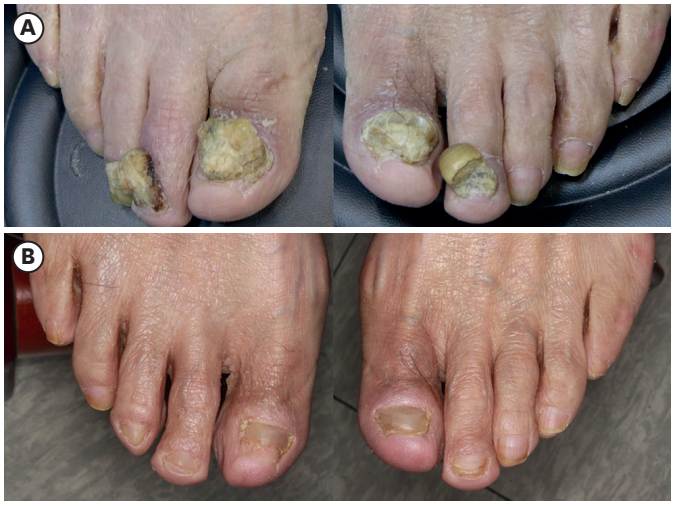

Fig. 3. Treatment of onychogryphosis using the grinding method. (A) Before treatment. (B) After treatment.

Gürbüz et al.[42] treated 14 patients with total matricectomy and V-Y advancement flap, achieving complete resolution without recurrence or complications over a 13.5-month follow-up. Patients returned to normal activities within 4.5 weeks and reported high satisfaction. Chan and Pehr[43] reported a 1 out of 11 recurrence rate using electrodessication matricectomy, involving nail avulsion, curettage, and matrix ablation. They also reviewed 11 studies on electrodessication matricectomy, which showed recurrence rates similar to phenolization, cryotherapy, and curettage, with low infection rates (0%–10.3%).

GLOMUS TUMOR

Glomus tumors are uncommon benign neovascular tumors arising from the thermoregulatory glomus body. They can occur anywhere, but predominantly affect the hand (up to 75% of cases), particularly the subungual region of the distal phalanx[44]. Subungual glomus tumors present with the classic triad of intense paroxysmal pain, point tenderness, and cold sensitivity. Their small size and subungual location often make them clinically difficult to detect. However, characteristic symptoms and subtle nail alterations (e.g. a reddish or bluish spot or ridge deformity) often provide diagnostic clues. In ambiguous cases, imaging studies such as high-resolution ultrasonography or magnetic resonance imaging (MRI) are invaluable for confirming the diagnosis and pinpointing tumor location[45,46].

Complete surgical excision is the only curative treatment. It reliably abolishes pain if the entire tumor is removed, although the anatomy of the nail unit makes surgery challenging. An improper approach risks damaging the germinal matrix or nail

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bed, potentially causing permanent nail deformities, and incomplete excision can result in persistent or recurrent tumor. Thus, the surgical technique must balance aggressive tumor removal with preservation of the delicate structures of the nail apparatus. Over the years, various approaches have been developed or refined to minimize postoperative nail dystrophy and recurrence.

Anatomical considerations in subungual glomus tumor surgery

The anatomy of the nail unit plays a critical role in selecting a surgical approach. The nail plate overlies the nail bed and germinal matrix; damage to these structures can result in permanent nail dystrophy. Tumor location within the subungual space often dictates the ideal route for excision. For example, lesions in the nail matrix (proximal nail bed) are closer to the germinal zone and carry higher risk of nail deformity after surgery. In contrast, tumors confined to the distal nail bed or hyponychium may be accessed more easily with less disruption to nail growth centers. Careful attention to neurovascular structures and the bony dorsal phalanx is also necessary, as subungual glomus tumors reside in a tight anatomical compartment. Overall, an approach tailored to the tumor's location and size—combined with magnification (e.g. surgical microscope)—can maximize tumor visualization and excision while preserving normal nail anatomy.

Transungual approach

The transungual approach is the traditional and most widely practiced technique for subungual glomus tumor removal. It involves removing or lifting the nail plate to directly access the tumor through a dorsal nail bed incision. Typically, a longitudinal or elliptical incision is made in the nail bed directly over the palpable lesion. This direct access offers excellent visualization of centrally located tumors and straightforward excision. Indeed, transungual excision has high success rates when the tumor is completely removed. Lee et al.[47] reported that meticulous excision of glomus tumors via an incision chosen according to tumor location resulted in no recurrences in a series of 22 patients. However, the transungual approach has notable limitations. By definition it disrupts the nail bed (and sometimes the germinal matrix), which can lead to nail dystrophy if not carefully repaired. For instance, one study noted that roughly one-third of patients developed postoperative nail plate abnormalities when the nail matrix was damaged during tumor excision[48]. Additionally, incomplete excision through a limited incision can result in residual tumor and recurrence. Thus, while the transungual approach offers direct tumor access, it requires meticulous technique to minimize complications. Surgeons often employ fine instruments and magnification to carefully lift the nail bed and excise the full lesion, then precisely repair the nail bed to encourage normal nail regrowth.

Nail bed margin approach

The nail bed margin approach is a newer surgical technique, instead of incising through the center of the nail bed, the surgeon makes an incision along the margin of the nail bed. The nail plate is typically partially lifted or removed, and the nail bed is dissected from its margin to expose the subungual space under direct vision. By working from the margin, this technique avoids a full-thickness incision through the central nail bed or matrix, theoretically reducing damage to critical areas that could cause nail deformity. Wang et al.[49] introduced the nail bed margin approach and reported excellent outcomes in a series of 17 patients. All patients underwent tumor excision via a lateral nail bed margin. At a mean follow-up of 31.4 months, none of the patients experienced recurrence of the tumor or symptoms. Importantly, nail cosmetic results were very favorable—the nails regrew with normal shape in all cases, and no postoperative complications were observed. Given its simplicity and efficacy, the nail bed margin approach was proposed as an excellent alternative to traditional techniques.

Minimally invasive transungual approach

A relatively recent advancement in surgical technique is the introduction of the minimally invasive transungual approach. This modified technique for subungual glomus tumor excision offers a limited operative window while enabling precise localization of the lesion (**Fig. 4**). Despite the constrained surgical field, adequate exposure of the tumor was achieved, facilitating efficient resection with reduced operative time compared to conventional methods. Postoperative recovery was characterized by rapid wound healing, minimal pain, and negligible scarring. The recurrence rate was low (2.6%), and all patients reported high levels of satisfaction with both cosmetic outcomes and symptom resolution[50]. The modified approach emphasizes nail preservation and facilitates faster healing. Preservation of the nail plate not only minimizes postoperative pain but also reduces the risk of nail deformity associated with mechanical trauma.

DMCs

DMCs are common benign lesions with mucinous content, typically near the distal interphalangeal joints or proximal nail folds[51]. Though often asymptomatic, they can cause discomfort, restricted joint mobility, or nail abnormalities such as longitudinal grooves. The pathogenesis of DMCs remains uncertain. While trauma is occasionally implicated but often absent. The most widely accepted hypothesis suggests degeneration of the fibrous capsule or synovium, especially when a cyst-joint connection is present. Imaging and intraoperative findings often reveal underlying osteoarthritic changes, especially with Heberden's nodes[52,53].

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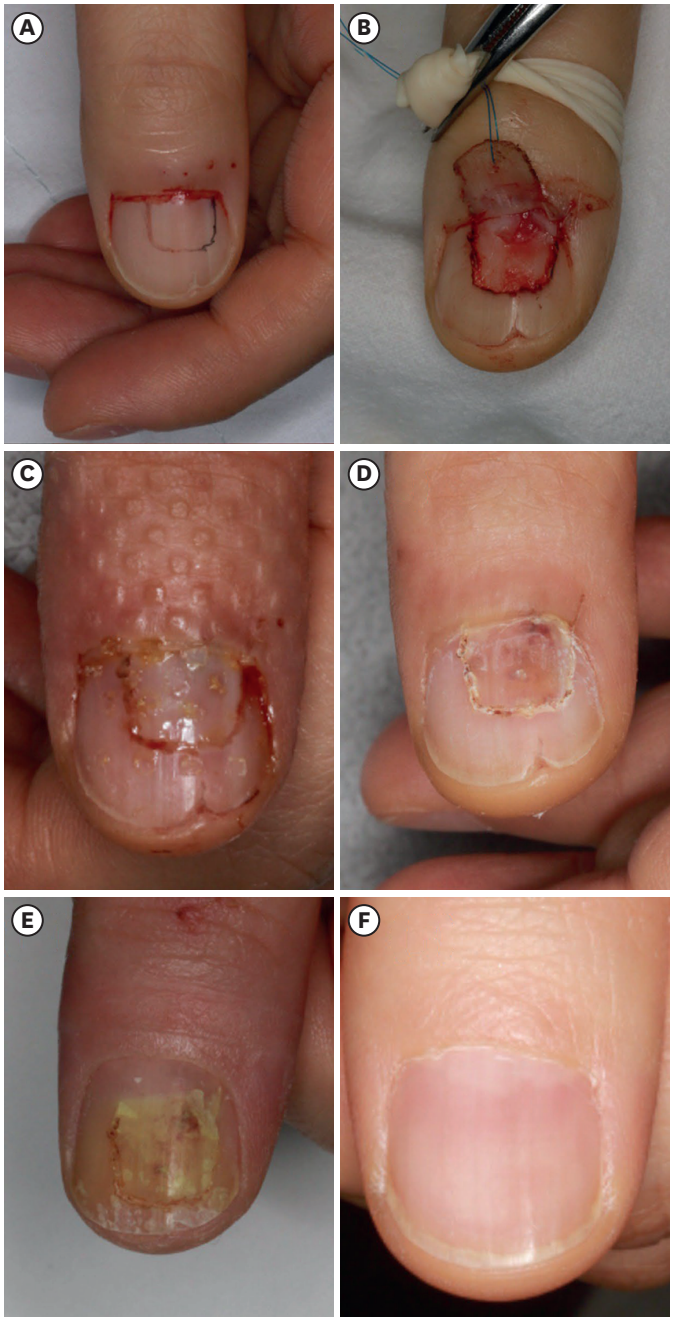

Fig. 4. Treatment of a glomus tumor using a minimally invasive transungual approach. (A) Creation of a window using a carbon dioxide laser. (B) Elevation and fixation of the nail plate. (C) Postoperative day 3. (D) Two weeks postoperatively. (E) Six weeks postoperatively. (F) Six months postoperatively.

Diagnosis can be aided by transillumination, fine-needle aspiration, and methylene blue injection to outline pedicles in ganglion-type cysts. Ultrasonography reveals well-defined, anechoic cysts, while MRI offers excellent sensitivity, especially for small or subungual lesions. Histopathology or electron microscopy may help in select cases.

Treatment options range from conservative to surgical, each with varying effectiveness, recurrence rates, accessibility, and potential complications. Conservative treatments include repeated needling, steroid or sclerosing injections, cryosurgery, CO_2 laser therapy, and infrared coagulation. A summary of both conservative and surgical options is provided in **Table 1** [51,52,54-58]. Surgical options include simple excision (often with rotational flap), osteophytectomy for joint disease, and pedicle ligation for precision. Rotational flaps also improve nail appearance and function.

Recent study reported by Jung et al.[59] introduces a minimally invasive technique combining surgical deroofing with TCA (50%) application for DMCs (**Fig. 5**). It achieved 68% complete remission with no long-term recurrences. This method is safe, repeatable, and effective for both ganglionic and myxomatous types. By inducing fibrosis at the cyst origin, especially in ganglion-type DMCs, it seals joint connections without extensive excision.

NUM

NUM is relatively rare in Caucasian populations, accounting for approximately 2%–3% of all cutaneous melanomas[60]. In contrast, it represents up to 10%–20% of melanoma cases in individuals from darker-skinned populations[61]. Clinically, it often appears as irregular, pigmented longitudinal melanonychia (brown, black or gray) with nail plate dystrophy. Pigmentation extending to the periungual skin, known as Hutchinson's sign, may also be observed. Amelanotic variants may present as erosive nodules with nail plate changes.

Dermoscopic findings include polymorphic vessels and milky-red areas[62]. The thumb, great toe, and second digit are most commonly involved. Clinical resemblance to benign conditions (e.g., onychomycosis, viral warts, subungual hemorrhage, or pyogenic granuloma) often delays diagnosis and worsens prognosis.

NUM displays a unique genetic profile distinct from other acral melanoma subtypes[63]. It has a low frequency of *BRAF* and *NRAS* mutations, indicating a ultraviolet (UV)-independent pathogenesis, likely due to the UV-shielding properties of the nail plate[64]. NUM shows high genetic heterogeneity, with recurrent mutations in *PIK3CA*, *EGFR*, *FGFR3*, *PTPN11*, *STK11*, and *TP53*, as well as frequent copy number gains in CCND1 and CDK4[65].

In cutaneous melanoma, surgical excision margins are typically determined according to the Breslow thickness (BT) of the primary tumor. However, in anatomically and functionally sensitive areas such as the hands, feet, and nail unit, functional preservation must also be considered. For NUM, the choice of surgical approach—ranging from amputation to wide local excision or Mohs micrographic surgery—is influenced by the depth of invasion.

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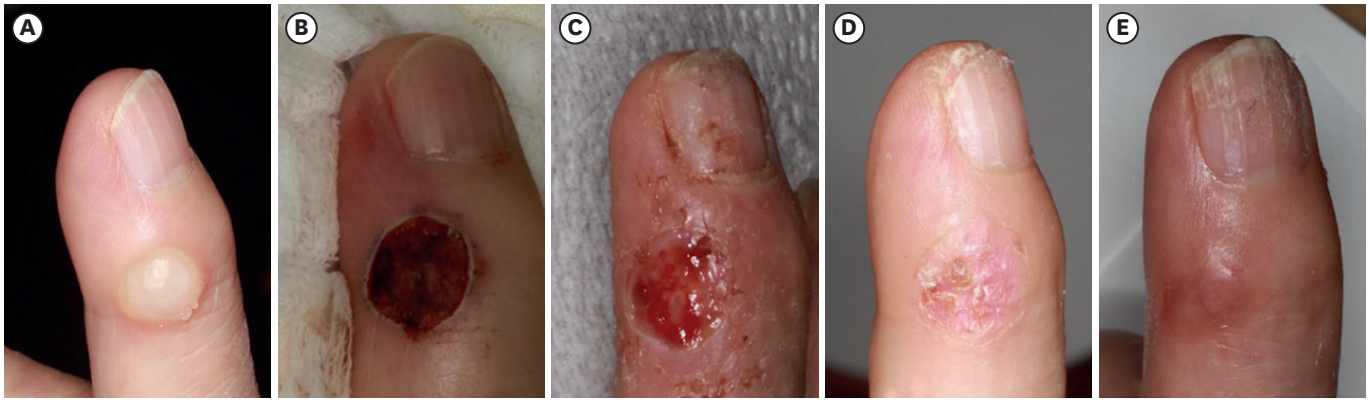

Fig. 5. Treatment of a digital mucous cyst on the finger. (A) Preoperative view. (B) Surgical deroofing with trichloroacetic acid application. (C) Two weeks postoperatively. (D) One month postoperatively. (E) Four months postoperatively, showing scar formation.

Table 1. Summary of treatment options for digital mucous cysts

Method	Cure rates	Key benefits	Potential drawbacks
Conservative treatment			
Repeated needling	~70% (2–5 sessions)[56]	Can induce fibrosis; done at home	Discomfort may reduce compliance
Steroid/sclerosing injections	61%–77%[51]	Reduces cyst volume & vascularity	Skin atrophy, pigmentation changes
Cryosurgery	60%–87%[51,54]	Effective for ganglion-type cysts	Pain, scarring
CO_2 laser therapy	88%[51]	Low infection risk	Limited access and requires expertise
Infrared coagulation	86%[57]	Good cosmetic results	Minor: pain, erythema, blistering
Surgical treatment			
Simple excision	88%–100% success[58]	Definitive removal	Joint stiffness, nail deformity, bleeding, infection[52]
Excision+ osteophytectomy	98%[52]	Ideal for OA-related cysts	More invasive and recurrence rate 3%–31.8%[55]
Surgical deroofing and TCA application	68% complete cure, 32% partial response	Minimizes complications	Repetitive treatment

OA: osteoarthritis, TCA: trichloroacetic acid.

A report from the Mayo Clinic on NUM emphasized that, when histologically negative margins are achieved, the level of resection does not significantly impact clinical outcomes[66]. This supports the feasibility of function-preserving surgical approaches in appropriately selected cases. In fact, recent studies including single center study and meta-analysis, have shown no significant difference in recurrence rates between functional surgery and amputation in cases of in situ or minimally invasive NUM[67,68].

Amputation, particularly of the thumb or great toe—where NUM most commonly arises—can lead to significant functional and psychological consequences, including impaired balance and gait, increased pressure on adjacent toes and plantar surfaces, foot deformities, ankle strain,

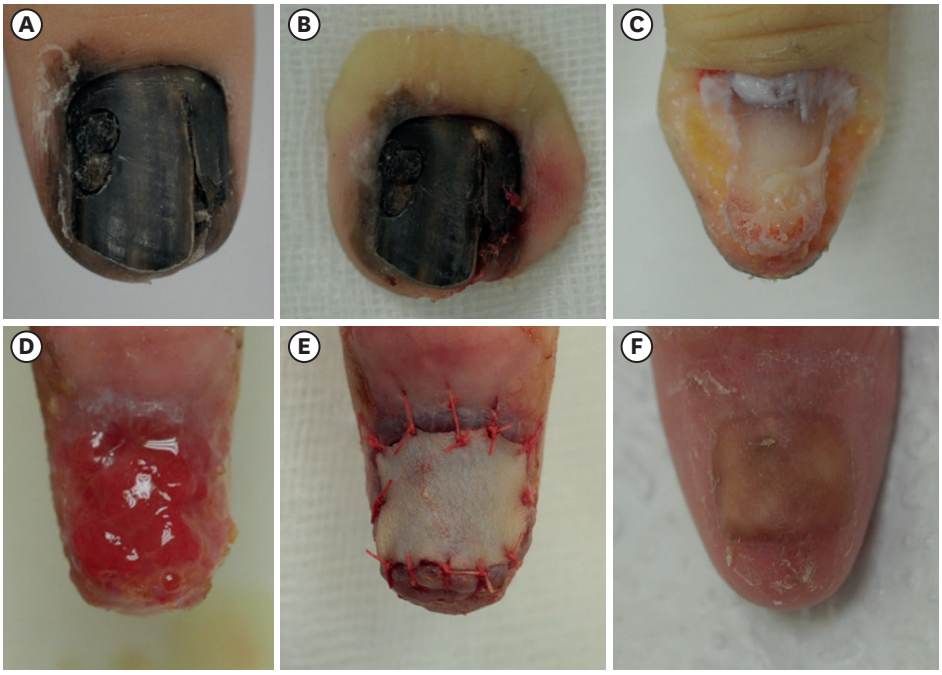

Fig. 6. Functional surgery for nail unit melanoma. (A) Melanoma in situ on initial biopsy. (B) Excision with a 0.5-cm margin. (C) Deep margin reached bone. (D) Granulation tissue after 34 days of secondary healing. (E) Skin graft performed. (F) Complete healing at 16 days post-graft.

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phantom limb pain, and emotional distress. These concerns underscore the importance of function-preserving strategies when complete tumor clearance is achievable. For NUM with a BT <0.8 mm, functional surgery may provide an amputation-sparing option (**Fig. 6**)[69]. However, cases with risk factors for recurrence—such as male sex, greater BT, amelanotic appearance, ulceration, and nodular features—require thorough patient counselling and close follow-up[68].

CONCLUSION

The surgical management of nail disorders requires a nuanced approach tailored to each condition's pathophysiology and clinical presentation. Beyond surgical intervention, postoperative care plays a crucial role in optimizing outcomes and preventing recurrence. Nutritional support, including the intake of carotene-rich foods[70,71], may contribute to maintaining healthy nail regrowth, as carotene exhibits immunomodulatory effects and potential antioxidant properties. Additionally, the use of nail hydrating solutions has been shown to reduce inflammation[72], with a report suggesting improvement in pincer nails following their application[73].

As nail surgery continues to evolve, incorporating evidence-based refinements into surgical techniques and postoperative management will further enhance patient outcomes. Future studies should focus on optimizing treatment strategies, minimizing complications, and exploring adjunctive therapies to support long-term nail health.

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CONFLICTS OF INTEREST

The authors have nothing to disclose.

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