

Nail unit ultrasound: a complete guide of the nail diseases

Felipe Aluja Jaramillo¹ · Diana Carolina Quiasúa Mejía^{2,3} ·
Hector Mauricio Martínez Ordúz⁴ · Cesar González Ardila⁵

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Abstract

Introduction The nails have a functional and esthetic importance for patients. Almost always, the nail disorders are diagnosed on the basis of clinical findings, but imaging methods may be required for a better assessment. These imaging methods, such as ultrasound and magnetic resonance, may help to establish an accurate diagnosis. Magnetic resonance imaging is not widely available and sometimes may be very expensive; that is why, ultrasound is an excellent imaging modality. Our objective is to expose the nail unit anatomy, the nail unit anatomy in ultrasound, and some of the frequent pathologies found in our daily practice.

Methods A review of the literature was done to review the anatomy, technical aspects, and different findings in normal and abnormal nail unit ultrasound.

Results Ultrasound offers an appropriate alternative for the evaluation of the nail unit, allows a real-time evaluation of each one of the components of the nail unit with an optimal visualization of these structures, and allows the evaluation of the thickness of the components, the vascularity, and blood flow by Doppler application. In addition, the nail unit disorder, such as infectious diseases, inflammatory and rheumatologic conditions, nail tumors, among others, may be assessed, not only in the diagnosis but also in the follow-up. Pre-surgical evaluation, surgical follow-up, and some procedures, such as biopsies, may be done by this technique.

Conclusions Ultrasound is an excellent technique for evaluation of normal anatomy, diagnosis, and follow-up of patients with nail unit diseases. This is an alternative for other imaging methods and may be used for an accurate diagnosis approach.

✉ Felipe Aluja Jaramillo
macario171@gmail.com

Diana Carolina Quiasúa Mejía
dquiasuam@hotmail.es

Hector Mauricio Martínez Ordúz
hmauriciomartinez@hotmail.com

Cesar González Ardila
drcesargonzalez@yahoo.com.ar

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Sommario

Oggetto Le unghie hanno un'importanza funzionale e estetica per i pazienti. Quasi tutti i disturbi delle unghie sono diagnosticati sulla base di reperti clinici ma le metodiche di Imaging sono richieste per una migliore valutazione. Queste metodiche di Imaging, come l'ecografia e la RM, possono aiutare nell'ottenere una diagnosi più accurata. La RM è una metodica di Imaging non facilmente disponibile e rappresenta un costo aggiuntivo, per questo motivo l'ecografia è una metodica eccellente in questo campo. Il nostro obiettivo è mostrare l'anatomia

¹ Radiology Department, Country Scan LTDA, Carrera 16 # 84a- 09 Cons. 323, Bogotá, Colombia

² Dermatology Department, Instituto de Pós-graduação Médica Carlos Chagas-Policlínica Geral do Rio de Janeiro, Rio De Janeiro, Brazil

³ Carrera 21 No 122-87, Bogotá, Colombia

⁴ Radiology Department, Clínica Universitaria Colombia, Calle 23b # 66-46, Bogotá, Colombia

⁵ Dermatology Department, Clínica Universitaria Colombia, Calle 23b # 66-46, Bogotá, Colombia

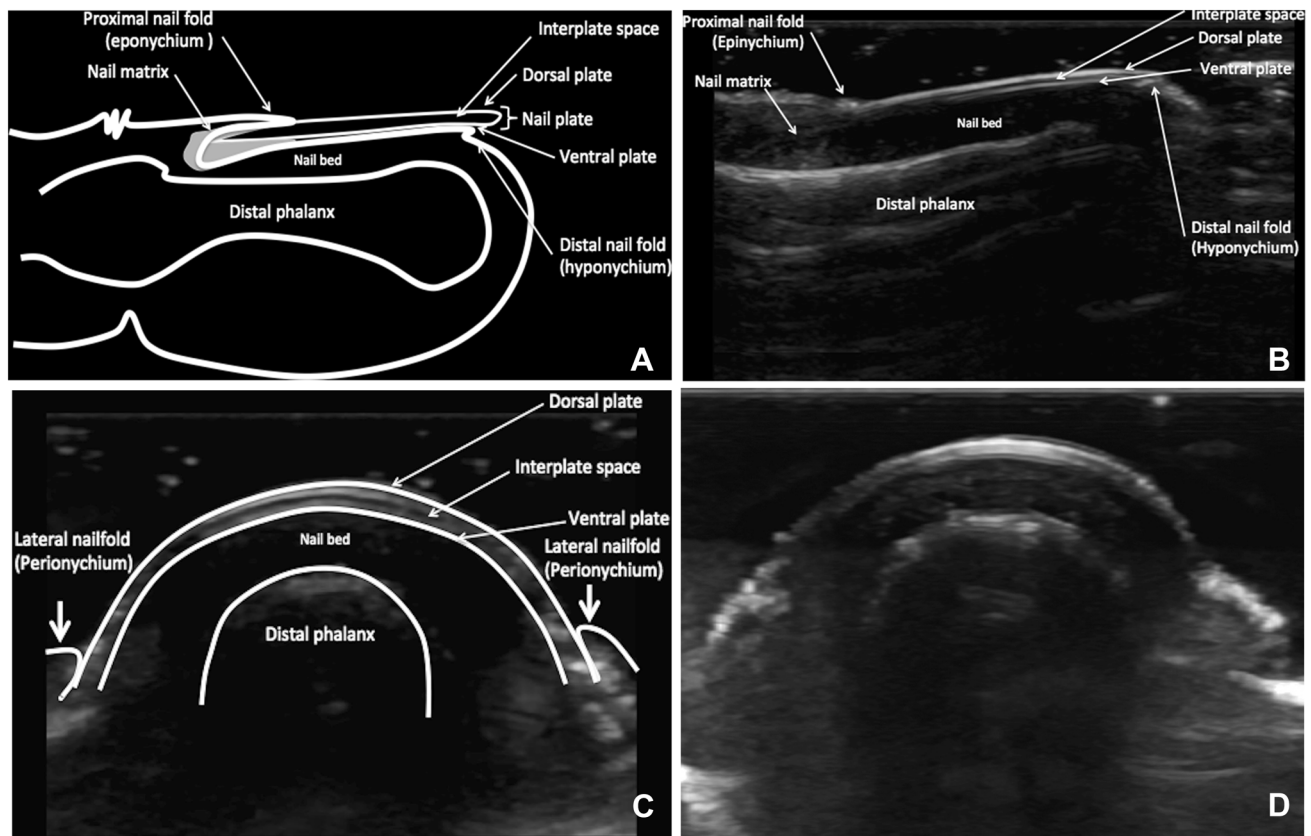


Fig. 1 **a** Anatomic scheme of a longitudinal view of the nail. **b** Ultrasound, longitudinal view. Anatomic components of the nail unit and periungual zone are pointed out. **c** Anatomic scheme of a

transverse view of the nail. **d** Ultrasound, transverse view. Anatomic components of the nail unit and periungual zone are pointed out

normale, l'anatomia ecografica delle unghie e anche alcune delle patologie più frequenti nella pratica clinica quotidiana.

Metodi E' stata effettuata una review della Letteratura riguardo l'anatomia, gli aspetti tecnici e i reperti ecografici delle unghie normali e patologiche.

Risultati L'ecografia offre un'alternativa valida nella valutazione delle unghie, permettendo una valutazione in tempo reale dello spessore dei componenti, della vascolarizzazione al color Doppler. Inoltre, la diagnosi e il follow-up dei disordini delle unghie, sia infettivi, infiammatori, reumatologici, tumorali, possono essere effettuati. Infatti, La valutazione pre-chirurgica, il follow-up e alcune procedure come le biopsie possono essere effettuate mediante questa metodica.

Conclusioni L'ecografia è una tecnica eccellente per la valutazione dell'anatomia normale, la diagnosi e il follow-up delle malattie delle unghie. Essa è un'alternativa che sembra valida rispetto ad altre metodiche di Imaging per una diagnosi accurata.

Abbreviations

US Ultrasound

Introduction

Nails have a functional and esthetic importance for patients [1, 2]. Almost every day, nail disorders are diagnosed based on clinical findings, but sometimes, imaging methods are required [1]. These imaging methods are based on ultrasound and magnetic resonance imaging. However, magnetic resonance is not a widely available method, which may be very expensive and not fully useful. Consequently, ultrasound is becoming an excellent imaging modality [1].

Ultrasound (US) offers an appropriate alternative for the evaluation of the nail unit. This method allows for a real-time evaluation of each one of the nail unit components, an evaluation of thickness and individual characteristics with gray scale, and evaluation of vascularity with Doppler ultrasound [1, 3, 4]. Nail unit disorders, such as psoriasis, onychomycosis and nail tumors, among others [5–8], can be assessed in the diagnosis and follow-up [9]. Pre-surgical evaluation, surgical follow-up, and ultrasound-guided procedures can be done [10, 11]. A well-performed nail US can guide the clinician in the diagnosis and may offer the advantage of reducing the number of nail biopsies and complications [11].

Worthy of note, US is an operator-dependent method. Therefore, it is essential that sonography operators receive appropriate training in performing nail unit ultrasound [7]. Our objective is to review the nail unit ultrasound anatomy and technique and the frequent pathologies found in our daily practice.

Nail unit ultrasound anatomy and characteristics

It is important to note that nail unit structures have different densities that enable their differentiation through ultrasound [1, 4, 11–13].

The nail is formed by the nail unit and the periungual zone [14–16]. The nail plates, the nail matrix, and the nail bed form the nail unit and the periungual zone is composed of the periungual tissues or periungual folds [16–20].

The nail plate is a bi-laminar structure that originates at the middle third of the phalanx. It is composed of two parallel hyperechoic bands, one ventral and one dorsal, formerly named ventral plate and dorsal plate, separated by a virtual space denominated the interplate space that has a hypoechoic appearance (Fig. 1) [1, 11, 15, 21, 22]. The thickness of the plates varies between 0.3 and 0.65 mm [11]. This thickness varies between fingers, with the thicker nail present on the first finger of the right hand, and the thinner the fifth finger in the left hand [9], as well as across gender, being thicker in males [9, 12].

The nail matrix is a hyperechoic structure, located in the proximal aspect of the nail bed [1, 15], noting that the ventral aspect may appear as a hypoechoic area in normal individuals [11], and its length varies between 1 and 5.3 mm with a mean of 3.4 mm [11].

The nail bed is a hypoechoic structure located immediately inferior to the nail plates extending to the periosteum of the distal phalanx (Fig. 1) [1, 11, 22]. It is an extremely vascularized structure receiving branches from the principal arteries in hand and foot. The average thickness is 1.5 mm (0.7–6 mm), which must be measured in the middle third of the phalanx [11, 21–24].

The periungual tissues are divided depending on their location as proximal fold (eponychium), lateral folds (perionychium), or distal fold (hyponychium) (Fig. 1) [1]. The phalanx is the deepest structure, appearing as a hyperechoic band, located immediately inferior to the nail bed (Fig. 1) [1, 11, 15].

As previously mentioned, in Doppler US, the nail unit is a highly vascularized structure especially in the nail bed [1]. It has multiple arteriovenous anastomoses [11], the vessel diameter is 1–2 mm [1], and has a characteristic low resistance and low flow velocities [21]. Abnormal findings in Doppler imaging can guide the radiologist to a diagnosis.

Nail unit ultrasound technique

US requires a high-resolution compact linear transducer of 15 MHz or higher [15, 21] that allows for a better definition of the structures [25] with a cross section of at least 5 mm in depth and 10 mm wide [2]. Usually, the compact linear probe (namely hockey stick type) is the one that adapts better to the nail surface [25].

For adequate imaging, an extensive gel cap should be placed over the nail surface to allow for an optimal interface [1]. It is not necessary to use a pad and any element

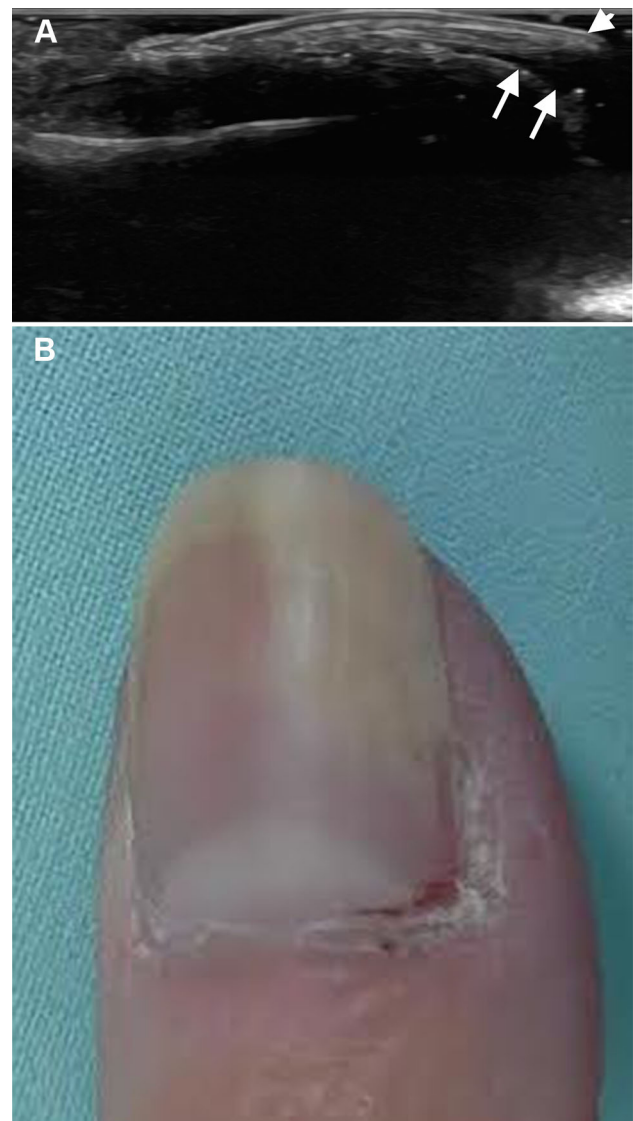


Fig. 2 Onycholysis on patient with onychomycosis caused by *Candida*. **a** Ultrasound, longitudinal view. Separation of the distal edge of the nail bed affecting the medial aspect of the nail (arrows), with thickening of the nail plates (arrowhead). **b** Separation of the distal edge of the nail bed affecting the medial aspect of the nail (arrows)

Fig. 3 Onychomycosis. Ultrasound **a** longitudinal and **b** transverse views. Increase in the thickness of the nail bed with posterior acoustic shadow (arrows). There is a diffuse irregularity and thickening of the nail plates (arrowhead). **c** Patient with onychomycosis with onycholysis, chromonychia, and paronychia

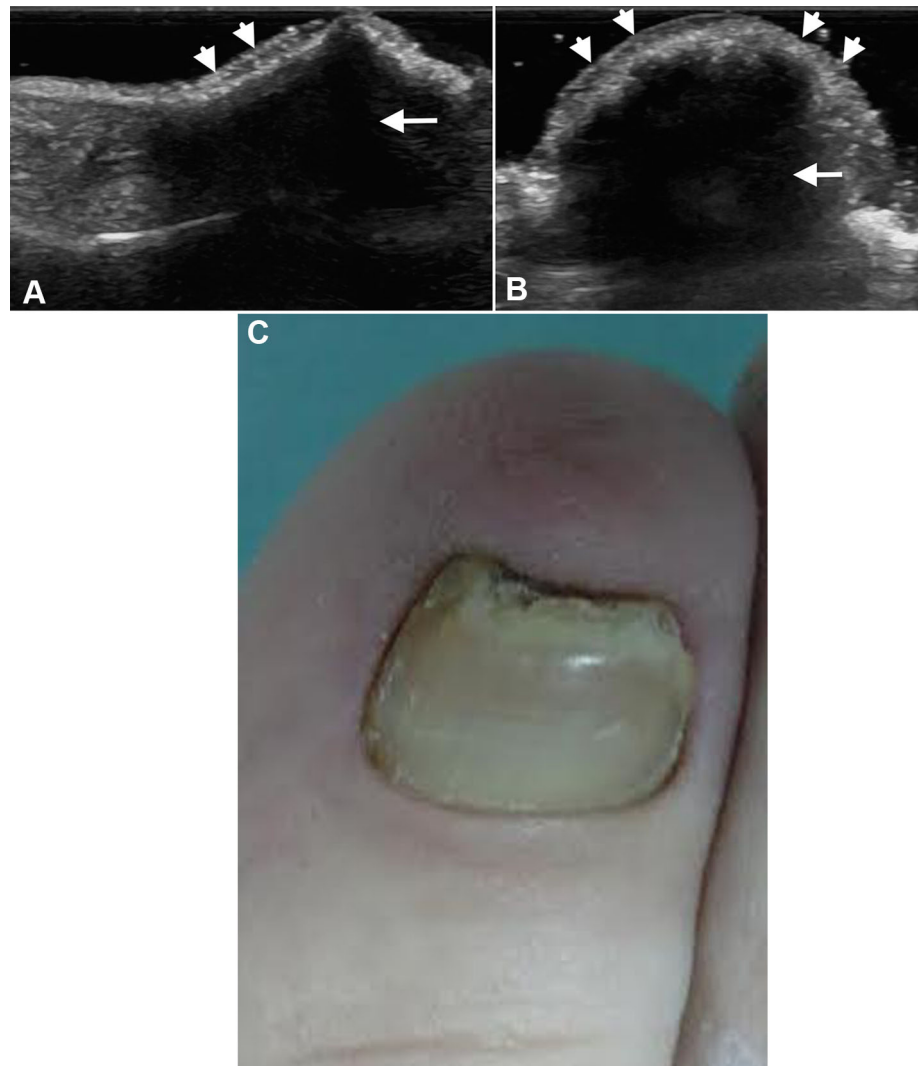
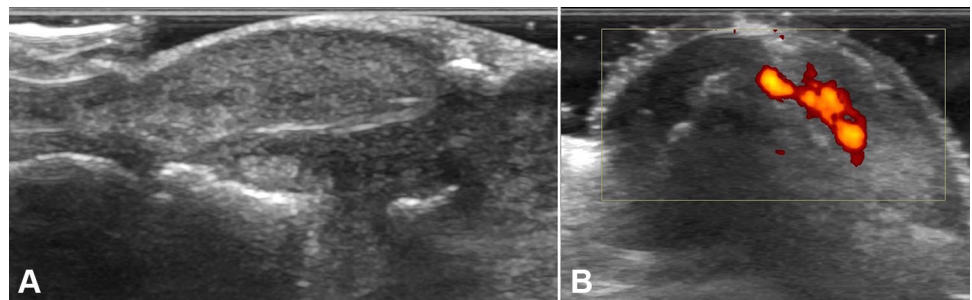


Fig. 4 Paronychia. Ultrasound **a** longitudinal and **b** transverse views. Areas of increased echogenicity interposed with hypoechoic areas and increased vascularization during power and color Doppler analysis



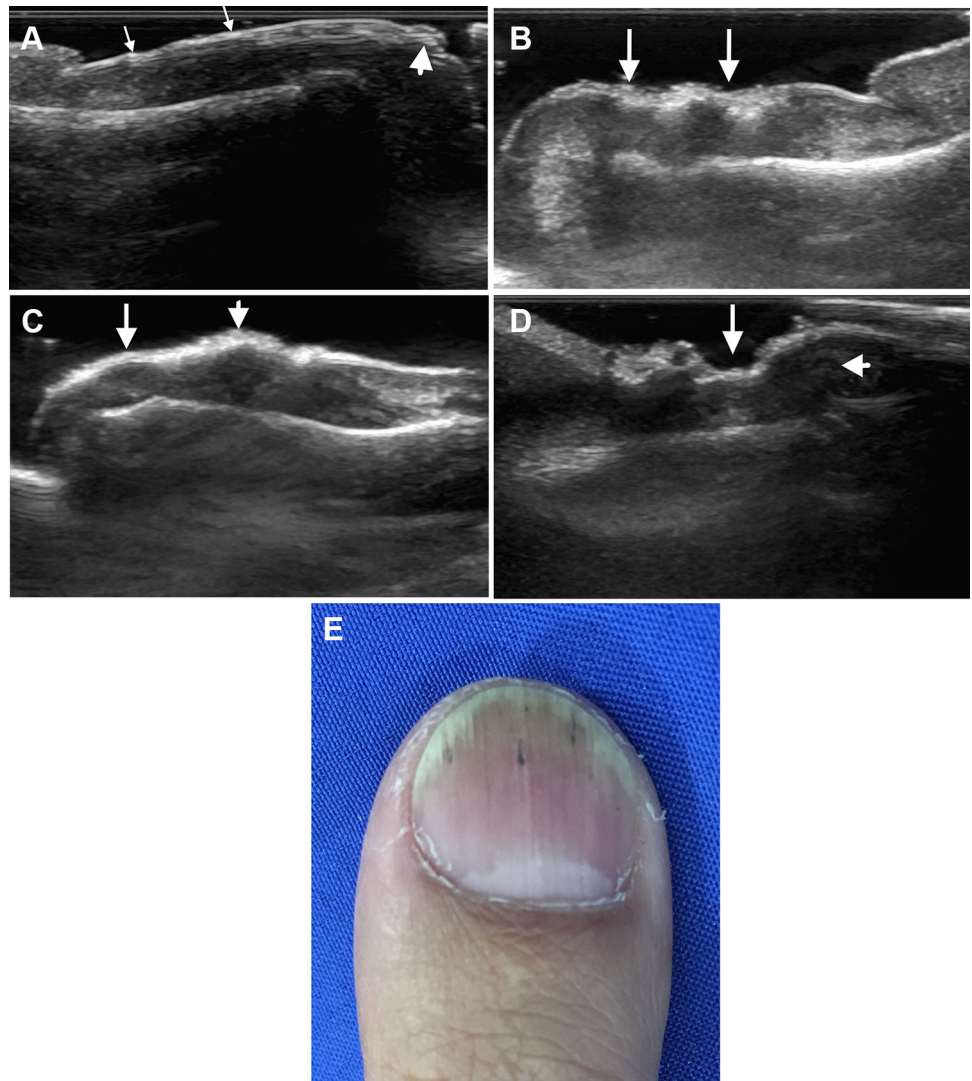
that produces compression over the vessels should be avoided [25].

Usual 2D gray scale followed by power, color, and spectral Doppler in two perpendicular axes is used [1, 15, 25]. In addition, 3D reconstructions with 5–8 s sweeps may be performed [1, 15, 25]. Compound imaging enhancers and panoramic field of view are recommended settings [1, 5].

The exploration must include the unguis unit and the periungual regions in every patient [15]. Each one of the structures can be assessed and the echogenicity, size, localization, involvement of surrounding structures, and blood flow characteristics must be reported [15].

This is a non-painful technique, and usually, sedation is not required. Patients must assist with unpolished nails.

Fig. 5 Psoriasis. Ultrasound in longitudinal view. **a** Focal hyperechoic involvement of the ventral plate (arrows) with fusion and irregularity of the middle and proximal third of the nail plates. There is also loosening of the definition of the ventral plate edges (arrowheads). **b** Wavy appearance with thickening and fusion of the nail plates (arrows). **c** There is involvement of the ventral and dorsal plates with loosening of the definition of the nail plates (arrow) and thickening and fusion of the nail plates specially in the middle third (arrowhead). **d** There is fusion, irregularity, and thickening of the nail plates with hyperechoic involvement of the ventral plates. Onychomadesis is seen between the middle third and distal third of the nail plates (arrow). Mild thickening of the distal nail bed is seen (arrowhead). **e** Patient with psoriasis, there is onycholysis with wavy appearance of the nail and some splinter hemorrhages



Signs in nail disease

Onycholysis

It is defined as the separation of the nail plate from the bed unit, starting in the distal edge of the nail plate and moving backward to the proximal edge [26].

This condition is considered a pathological finding non-pathognomonic of a disease [26]. It may be related to repetitive microtrauma and is considered as an early sign of onychomycosis caused by *Candida* [26, 27]. It can be seen in systemic diseases, such as psoriasis, systemic lupus erythematosus, pemphigus, lichen planus, amyloidosis, and the use of Bleomycin [26].

On US, the separation of the distal edge of the nail bed is seen as an anechoic gap between the nail plate and the nail bed. Other findings, such as thickening of the nail plates and thickening of the nail bed, could be found depending

on the cause (e.g., onychomycosis) (Fig. 2a, b). US can contribute to the differential diagnosis in cases, where there are no clear findings in the physical assessment.

Onychomadesis

It is defined as the separation of the proximal edge of the nail plate from the nail matrix and the nail bed [14]. A new nail plate begins to form pushing the distal nail [14]. It can compromise the cuticle with destruction of the matrix [14]. This clinical sign has been associated with acute trauma, epidermolysis bullosa, scarlet fever, thrombosis, exfoliative dermatitis, and some others [14]. Usually, it develops 4–8 weeks after a severe systemic illness or trauma [28]. Retronychia (growing of the nail plate backward to the nail matrix) may be seen as a rare complication [29].

On US, the main finding is the separation of the nail plate in two portions with thickening of the nail bed and

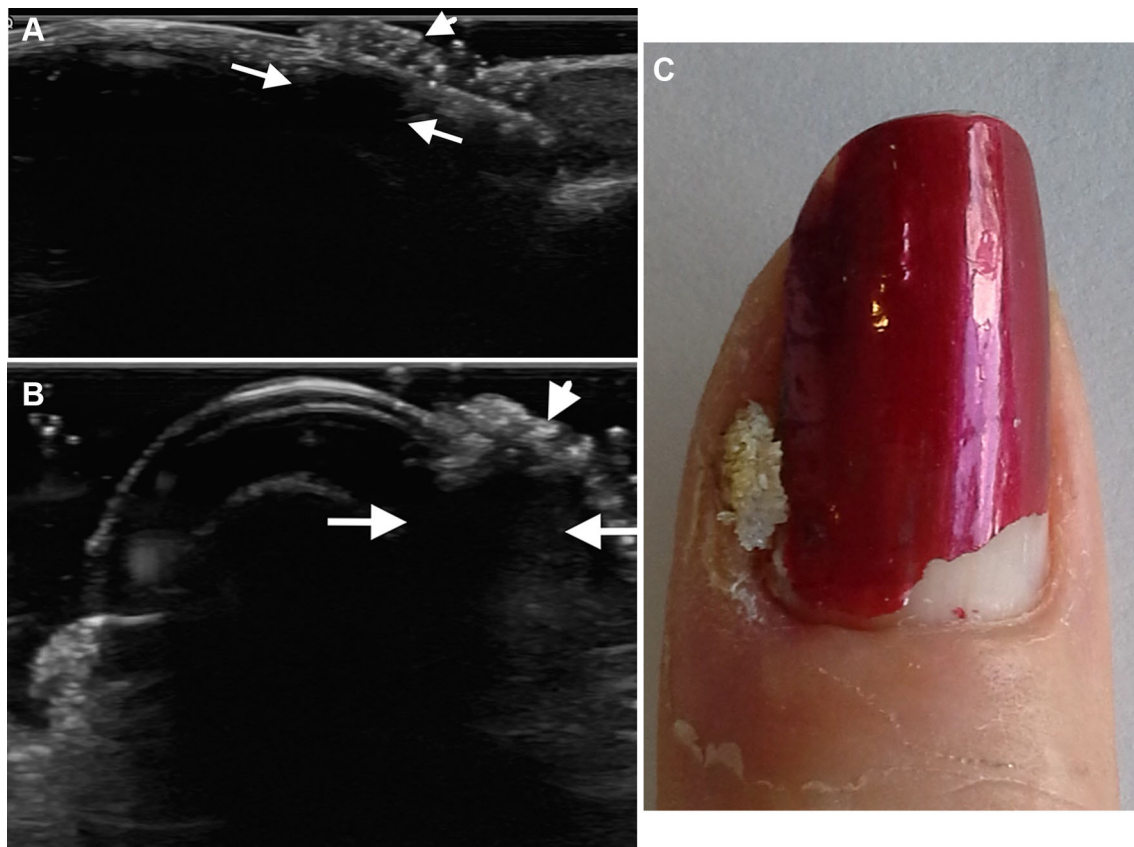


Fig. 6 Subungual warts. Ultrasound **a** longitudinal and **b** transverse views. Hypoechoic fusiform eccentric lesion (*arrows*), also hypovascular, with an exophytic hyperechoic component located in the lateral

fold (*arrowhead*). This lesion is associated with thickening of the nail plates. **c** Patient with subungual wart with a lobulated mass in the lateral nail fold that protrudes to the surface

decreased echogenicity [28]. An anechoic disruption of the ventral plate especially near the proximal edge is another finding that may be related to onychomadesis [28].

Infectious and inflammatory conditions

Onychomycosis

It is the fungal infection of the nail unit which is usually caused by dermatophytes (*Trichophyton rubrum* or *Trichophyton mentagrophytes*), non-dermatophyte, and fungi (*Candida* species) [30–32].

The infection starts in the hyponychium producing subungual hyperkeratosis and onycholysis [30].

US shows an increase in the thickness of the nail bed, more important than the one seen in psoriasis [28]. There is also diffuse thickening and irregularity of the nail plates, fusion of the nail plates, and posterior acoustic shadow in the nail bed.

US follow-up after treatment may reveal a normal nail unit with an adequate nail bed thickness with appropriate

distinction of the dorsal and ventral plates (Fig. 3). US can be helpful in the differential diagnosis between onychomycosis, psoriasis, and some other, such as subungual exostosis, based on the US characteristics.

Paronychia

It is the inflammation and/or infection of the soft tissues surrounding the hand and toe nails, known as the periungual tissues [27].

Infection in the acute setting is caused primarily by *Staphylococcus aureus* [33]. Chronic cases may be related to irritant substances or allergic reactions and has been related to psoriasis, systemic lupus erythematosus, and use of drugs like retinoids [27]. Secondary colonization by bacteria and fungal infection (*Candida*) is not uncommon [33].

On US, a diffuse thickening of the periungual fold is noticed, with areas of increased echogenicity interposed with hypoechoic areas, and increased vascularization during power and color Doppler analysis related to the inflammatory process around the periungual tissues (Fig. 4).

Inflammatory and autoimmune systemic conditions

Psoriasis

It is a frequent inflammatory autoimmune-mediated multi-organ disease [30]. It affects the skin, the joints, and nail unit among others [14, 30, 34]. Fifty-five percent of psoriatic patients can have manifestations on the nail unit, such as onycholysis, “Oily spots”, pits (punctuate depressions of the nail plate), splinter hemorrhages, or subungual hyperkeratosis [14, 35]. It is known that 53–86% of patients with psoriatic arthritis may have nail involvement [28].

The morphologic changes described in US are (1) focal hyperechoic involvement of the ventral plate (Fig. 5a), (2) loosening of the definition of the ventral plate edges (Fig. 5b), (3) wavy nail plates (Fig. 5c), and (4) involvement of the ventral and dorsal plates with loosening of the definition (Fig. 5d) [28]. The initial finding may be thickening of the nail plate, which is less than the one seen in onychomycosis [28]. Increased blood flow using Doppler color may be another finding that can also be used for the follow-up of these patients [28, 36]. The increase in the vascularity is usually noted in the active phases of disease, starting in the proximal nail bed and extending forward to the distal edge [28]. US is especially helpful for the evaluation of the nail involvement and is very useful for the treatment follow-up; as the disease is controlled, the nail findings tend to become normal. Patients with controlled psoriasis have no nail ultrasound abnormalities.

Scleroderma and systemic lupus erythematosus

Scleroderma is a connective tissue disorder involving the small vasculature that can affect the nail unit [28]. It is an autoimmune disease centered in small- and medium-sized arteries and arterioles of the skin, gastrointestinal tract, lungs, heart, and kidneys [30, 37]. The digital ischemia of the nails can be seen as increasing of the curvature of the nail plate, loss of the nail plate, and the distal nail fold [30, 37].

As seen in other connective tissue disorders, lupus erythematosus affects the microvasculature [28]. This connective tissue disorder has a predilection for small digital arteries causing thromboembolic phenomena in the distal arteries which lead to hypovascular changes of the nail bed seen in Doppler analysis [1, 5, 28, 38].

The US changes may be secondary to the small vasculature affection [28]. There is decreased echogenicity of the nail bed secondary to edema, thickening, and thinning of the nail plates and variable amounts of decreased

vascularity in the nail bed sometimes with irregularity and discontinuity of the nail plate, as an indirect sign of nail matrix affection [28].

Rheumatoid arthritis

It is an autoimmune disorder characterized by symmetric inflammatory arthritis and systemic symptoms [28]. The affection is mostly localized in the periungual tissues, the tendons (tearing or atrophy), bone (erosions), and joint space (narrowing) [28, 39]. Particularly in the nail, there may be thickening, hypoechogenicity, and increased vascularity of the nail bed [1, 5, 28]. Thickening of the proximal nail fold can be a common finding [28].

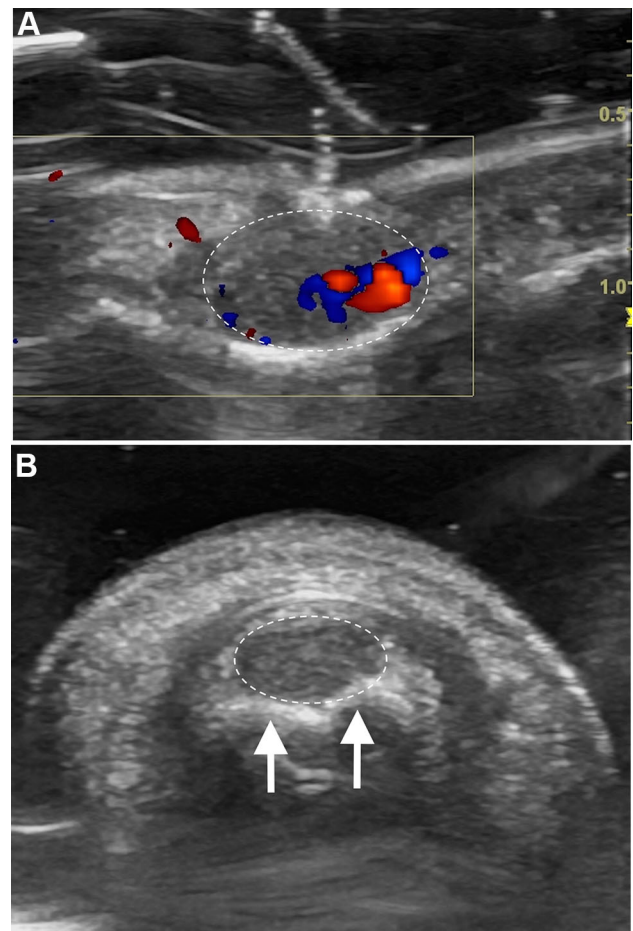


Fig. 7 Glomus. Ultrasound **a** longitudinal and **b** transverse views. A hypoechoic, hypervascular lesion (*pointed line*), located in the proximal third of the nail bed. There is also signs of chronicity with mild erosion of the proximal third of the phalanx (*arrow*)

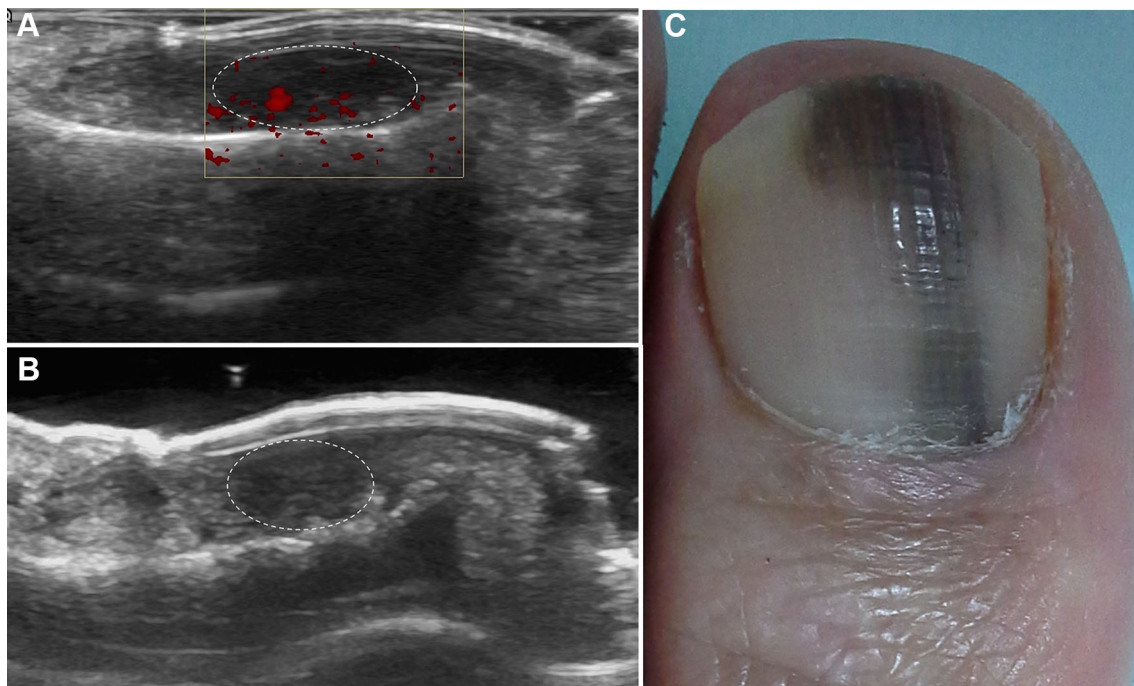


Fig. 8 Melanoma. Ultrasound **a** longitudinal and **b** transverse views. Hypoechoic, ill-defined, hypervascular mass in the middle third of the nail bed (*pointed line*), corresponding to melanoma in a patient with melanonychia. **c** Patient with melanonychia corresponding to melanoma

Tumors and tumor-like conditions

Subungual warts

It is a benign epithelial proliferation that develops in response to infection caused by the human papilloma virus commonly seen as hyperkeratosis [28, 40]. Usually seen as slow growing lesions that affect the distal fold (hyponychium) or the lateral folds (perionychium) and less frequently growing into the nail bed [28, 40]. Erosion of the adjacent phalanx cortical bone may be present [40]. If the nail matrix is affected displacement and dystrophy of the nail plates can be seen [28].

In US, subungual warts appear as a hypoechoic fusiform eccentric lesion, characteristically hypovascular, which may have an exophytic component [28]. These lesions can be associated with thickening of the nail plates and the interplate space especially in those cases, where the nail matrix is compromised (Fig. 6) [28]. US may be helpful in the differential diagnosis based on the US characteristics, and can provide information about the extension and involved structures.

Glomus tumor

It is a non-frequent benign tumor (hamartoma) originated from the neuromyoarterial glomus body (arteriovenous anastomosis) responsible for thermoregulation [23].

Although glomus bodies are present in the dermis throughout the body, 75% of these glomus tumors occur in hands, which represent 1–4.5% of all hand tumors [23]. The age of presentation varies from 30 to 50 years [23].

In US, the appearance consists of a solid, hypoechoic mass, located in the nail bed, with increased vascularization at color Doppler imaging (Fig. 7) [23, 28]. Chronic lesions may remodel the cortical bone of the distal phalanx [23, 28]. These characteristics allow for an appropriate diagnosis in US.

Hemangioma

It is a benign non-reactive process with increase in the number of vessels [7, 23]. Those hemangiomas located in the finger are not uncommon [23]. On US, the hemangiomas are hypoechoic and partially defined lesions, with increased vascularization [41]. Sometimes, hyperechoic dots with posterior acoustic shadow, corresponding to phleboliths, may be seen in the center of the lesion [41].

Mucoid cyst

These mucoid cysts originate from the mucoid degeneration of connective tissue [23]. They may be classified in: distal to the interphalangeal joint, no connection to the interphalangeal joint, or sub-matrical [4, 23]. The first of

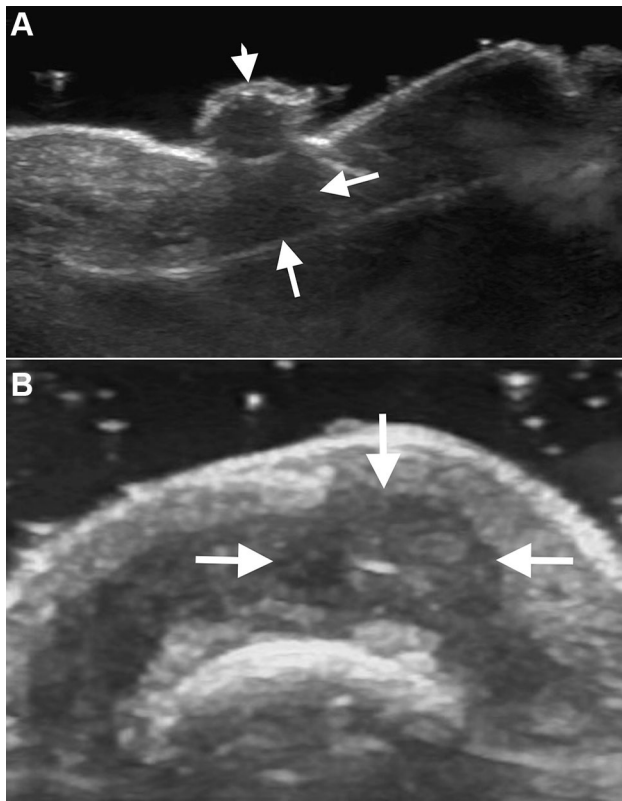


Fig. 9 Fibrokeratoma or Koeneńs fibroma. Ultrasound **a** longitudinal and **b** transverse views. There is a hypoechoic, hypovascular, round, eccentric, lesion located in the proximal third of the nail bed with extension to the nail matrix (*arrows*). An exophytic component is seen as a polypoid, hypoechoic and hypovascular lesion involving the proximal nail fold (*arrowhead*)

these three is the most common type accounting for 80% of cases, and the last one or sub-matrixial is rare [4, 23].

These cysts appear in middle age or older individuals, with a predilection for women [23, 42]. Clinically, they appear as subungual masses between the proximal nail fold and the distal interphalangeal joint [23].

In US, their appearance is of round or oval, sometimes lobulated, anechoic, or hypoechoic structures [23, 28]. They may have internal echoes corresponding to viscous or gelatinous debris [28]. There may be unguinal plate abnormalities if it affects the unguinal matrix [28]. US allows an appropriate identification of the characteristic of this lesion that is almost diagnostic with exclusion of other possible differential diagnosis.

Onychomatricoma

These are benign tumors that develop in the nail matrix in hand and feet [28, 30].

On US, they are ill-defined heterogeneous, predominant hyperechoic and hypervascular lesions compromising the interplate space and nail matrix, with hyperechoic dots in

the center that may extend through projections to the interplate space or the matrix region [28, 41]. As a characteristic, onychomatricomas are eccentric in location and may have remodeling and sometimes erosion of the distal phalanx [41]. Thickening of the proximal nail fold is not an uncommon finding [28, 41].

Keratoacanthoma

It is a benign neoplasm that consists of squamous epithelium with a central crater filled with keratin [23]. This tumor usually develops in the fifth decade and has a male predilection [23]. It may have a malignant transformation to squamous cell carcinoma [23, 43]. Their clinical appearance is a rapidly growing and painful mass under the nail plates that may involute and leave a small-pitted scar [23].

On US, the appearance of the keratoacanthoma consists of a well-circumscribed lesion, hypoechoic with some anechoic areas related to its solid and cystic nature, with posterior acoustic shadow and also remodeling cortical margin and erosion of the cortical margin [8, 28, 41].

Malignant melanoma

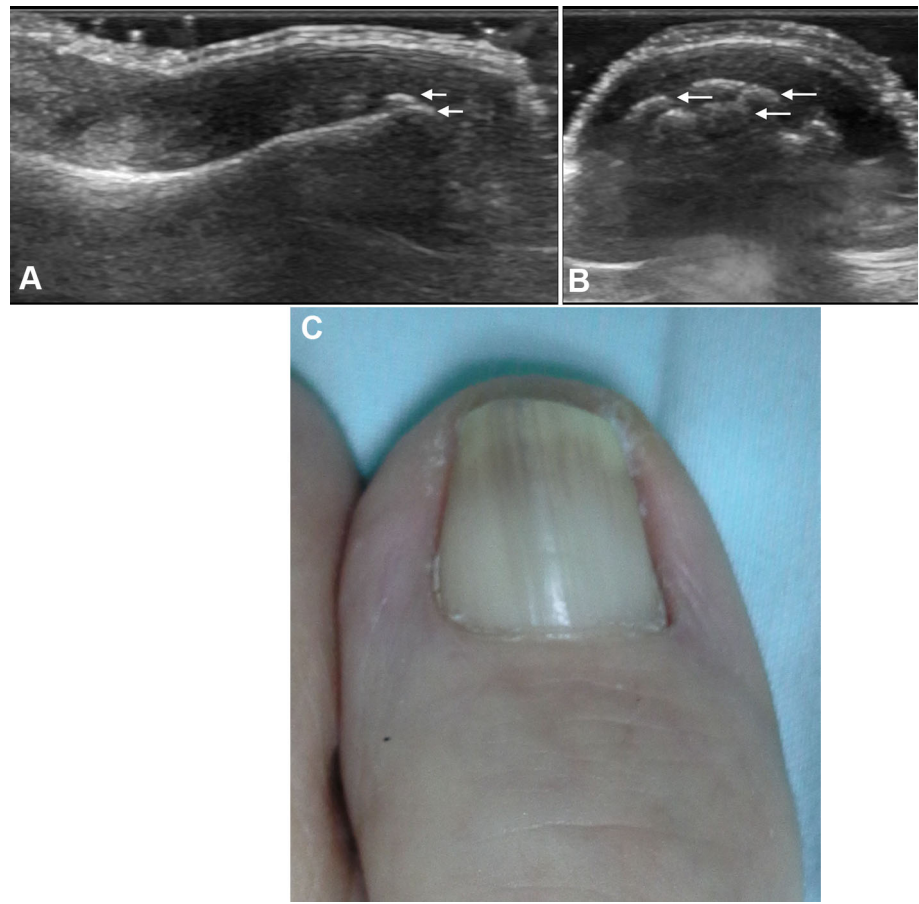
Subungual melanoma is considered an uncommon presentation of melanoma [23, 44–46]. The histologic subtype affecting the nail unit is often the acral lentiginous melanoma, which is located primary in the first toe and index finger [23]. The incidence varies between 0.3 and 2% [45, 46]. The age of presentation ranges between the sixth and seventh decade and has no predilection for gender [23, 45]. Longitudinal melanonychia (pigmented strip) on the unguinal plate is a common clinical finding [46]. It has been established that repetitive trauma is a risk factor for melanoma [46].

In US, melanoma is a solid, homogeneous, hypoechoic, ill-defined, hypervascular mass [23, 28]. Ill-defined hypoechoic areas may present in the periphery related to peritumoral growth or infiltration [23]. It must be pointed out that in the early stages of the disease, there may be no ultrasonographic findings (Fig. 8) [28]. US is useful in the evaluation of the extent of the lesion and in the determination of the involvement of adjacent structures.

Fibrokeratoma or Koeneńs fibroma

It is a heterogeneous group of tumors with a several distinct subtypes and forms of presentation [28]. The lesions may be congenital, such as Koeneńs fibromas related to tuberous sclerosis, and other acquired lesions as, for example, garlic clove-shaped fibromas [28, 47, 48]. Almost 50% of patients with tuberous sclerosis have Koeneńs fibromas [28].

Fig. 10 Subungual exostosis. Ultrasound **a** longitudinal and **b** transverse views. Band-like heterogeneous hyperechoic structures with irregularity of the cortical bone (*arrows*) and posterior acoustic shadow related to subungual exostosis. There is also some hypoechoic cap surrounding the hyperechoic structures related to cartilaginous tissue. **c** Patient with subungual exostosis presenting with pseudoleukonychia, mild melanonychia in a *gray* background *color*



On US, these tumors appear as hypoechoic lesions, round, oval, fusiform or polypoid, hypovascular, and eccentric located in the nail bed [28]. In addition, these tumors can affect the periungual region or involve the matrix [28]. The bony margin may be remodeled in large-sized lesions [28]. Doppler color US can reveal hypovascularity in these types of tumors except in the angiofibromas that have increased vascularity (Fig. 9) [28].

Subungual exostosis

It is also known as Dupuytren exostosis [23, 30]. It is a benign overgrowth of bone from the distal phalanx, which expands through the nail bed and periungual region beneath the nail plates [23, 49]. It can cause deformation of the dorsal portion of the nail unit [30]. Although it can occur at any age which is often found in adolescents and young adults with predilection for the female gender [23]. The causes of the subungual exostosis are unknown, but trauma or chronic infection may be related [23]. As a characteristic, subungual exostosis lacks cortical and marrow continuity to the subjacent bone [23, 50]. The differential diagnosis includes onychomycosis or any subungual tumor [30].

The US appearance is consistent with band-like hyperechoic heterogeneous structures with posterior acoustic shadow, well-defined margins, calcifications, and a hypoechoic cap corresponding to cartilaginous tissue that may surround it [23, 28]. Hypovascularity or a mild vascularity may be seen with Doppler color US (Fig. 10) [51]. US can be helpful in the differential diagnosis, especially with onychomycosis that may have similar clinical characteristics.

Miscellaneous conditions

Onychocryptosis

It is defined as the abnormal growing of the nail into the lateral nail fold, also known as ingrowing toenail [28]. In this case, the nail plates are covered by the lateral nail fold [28]. It is caused by curved nail plates, hypertrophied lateral folds, congenital misalignment, improper nail cut, or poor hygiene [28, 52]; in addition, genetic predisposition has been described [28, 52]. The treatment is almost always surgical, although it has a high recurrence rate after surgery [28].

US reveals ingrowing of the toenail into the lateral fold with diffuse thickening, increases in the echogenicity, and increases Doppler color of the lateral nail fold related to inflammatory changes [28].

Trauma

The nail unit is continuously exposed to repetitive trauma that may be caused by feet deformities, inadequate footwear, and some others [30]. These traumas can affect not only the nail unit but also the surrounding tissues, developing hematomas among others [1]. The changes described in the nail unit due to trauma are onycholysis, hematoma, and leukonychia [1, 30].

On US, hematomas may be hypoechoic, hyperechoic, or anechoic ill-defined lesions that may have septa in the interior, depending on the stage of blood products.

Not only the soft tissues may be affected, also fractures of the distal phalanx may be seen with disruption of the hyperechoic band corresponding to the cortical bone of the phalanx.

Conclusions

Ultrasound can be an excellent imaging modality for the evaluation of the nail unit, from anatomy to nail unit diseases. As a non-invasive technique, it provides an excellent alternative for imaging the nail unit for diagnosis and follow-up. It allows the characterization of the lesions and can detect tumors, infections, and systemic diseases that may affect the nail. It is essential for the radiologist to familiarize himself/herself with this technique, and with knowledge of anatomy and the common diseases for an accurate diagnosis.

Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest regarding the publication of this article.

Ethical statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Written informed consent was obtained from the patient for the publication of this paper and accompanying images.

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