



Retronychia of the toenails: a review with emphasis on pathogenesis, new diagnostic and management trends

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Abstract

Retronychia is a condition, first described in 1999, characterized by the embedding of the proximal nail plate into the proximal nail fold and the stacking of a multiple generations of nail plates beneath the proximal nail fold. The disease affects frequently the toenails and is associated with stress-relevant situations including repetitive trauma, ischemic etiologies, postpartum, and compartment syndrome. Predisposing factors including static disorder of the feet may be underestimated. The paucity of data regarding the predisposing factors is because existing studies are limited to small case reports, case series, and retrospective studies. The diagnosis is clinical, which could be challenging because retronychia can easily mimic other nail disorders with chronic paronychia. Since the first description, significant advances have been made regarding diagnostic criteria including ultrasonography. We performed a systematic review of the literature on retronychia from inception to April 2018 with an emphasis on the pathogenesis and new diagnostic and management trends.

Keywords Retronychia · Toenails · Surgery · Beau's lines · Onychomadesis · Ingrown nail · Onychocryptosis

Introduction

The term retronychia was introduced in 1999 by De Berker and Rendall [1]. It is characterized by the embedding of the proximal nail plate into the proximal nail fold and the stacking of multiple generations of nail plates beneath the proximal nail fold.

Retronychia commonly affects the toenails, most frequently involving the great toe. Frequent trauma to these digits is one explanation for this finding.

Since the first description, significant advances have been made. Predisposing factors are better understood, and new diagnostic approaches include ultrasonography (US) with newly proposed diagnostic criteria. In the following review,

we hope to present a comprehensive examination of the available literature.

Methods

We searched PubMed and Google Scholar to identify all published data on retronychia of the toenails in the English literature, from inception to April 2018. We used the following keywords: retronychia, paronychia, Beau's lines, onychomadesis and nail avulsion. Only published articles reporting retronychia occurring on the toenails (with or without fingernail involvement) were included. Randomized controlled trials, original research articles, short reports and case reports were eligible for inclusion. We checked the reference lists of all the articles identified by the above methods. Those references which appeared to meet the inclusion criteria were retrieved in full and further assessed independently by the authors. Three additional articles in French language were included through checking reference lists. The results are explained in the following sections.

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Pathophysiology

Retronychia is related to the association of three factors: the cessation of the nail plate production, the loss of alignment between the nail matrix and the nail plate, and an altered adhesion of the nail plate to the nail bed.

The nail plate is produced by the nail matrix and grows outward over the nail bed. An acute insult to the nail matrix often associated with repeated trauma leads to slowing or cessation of the nail plate production. This manifests clinically as Beau's lines, onychomadesis or retronychia (Table 1). These three conditions share the same pathophysiological mechanism with critical differences [2]. Beau's lines are due to a slowing of nail plate production at the more proximal matrix. Onychomadesis is associated with the cessation of nail plate growth from the matrix. In the case of Beau's lines or onychomadesis the old nail plate remains in the horizontal axis so that the new nail can push it outward until completely replaced.

In contrast to onychomadesis and Beau's lines, retronychia is associated with the loss of alignment of the nail matrix and the nail plate. The growth of a new nail pushes the old one upwards and backwards leading to its embedding into the ventral aspect of the proximal nail fold. The embedding of the proximal nail plate into the proximal nail fold causes inflammation and excess of granulation tissue formation in the periungual skin. A repetitive disruption of nail matrix growth may produce a stacking of nail plates. De Berker et al. [3] and Dahdah et al. [4] also suggested that the old plate remained attached to the distal nail bed so that it could not be pushed out by the new nail [3, 4].

Recent publications also highlight the importance of onycholysis in the pathogenesis of retronychia. Onycholysis facilitates back-and-forth and tilting movements, injuring the overlying proximal nail fold and preventing spontaneous

healing. The repetitive injury also prevents adherence of the newly formed plate worsening the disease. Moreover, Ventura et al. [5] recently reported that onycholysis causes the development of a distal nail fold which is, in turn, leads to the development of a thick, yellow, and dystrophic nail.

Precipitating factors

All published data on retronychia of the toenails are summarized in Table 2. Of the 117 published cases, retronychia affects the great toe in 98% of the cases. Trauma is the most frequent precipitating factor. Repetitive trauma of the big toenails probably explains this location [6]. Many behavioral factors associated with retronychia are reported in the literature, including inappropriate or tight-fitting footwear and increased heel height [7], some activities including running, hiking, mountaineering [1, 3, 4, 8–10], dancing [6], rhythmic gym [5], and martial arts [11].

Though less frequent, ischemic etiologies leading to deformity of the nails may also be associated with retronychia. These etiologies include thrombophlebitis [3] and compartment syndrome [7]. It is hypothesized that extrinsic compression of distal arteries, ischemia and secondarily associated distal edema result in the disruption of nail matrix growth rate [7].

Static disorders of the foot associated with toenail retronychia

Some static disorders of the foot could predispose big toenail to retronychia. They are rarely reported [5, 7, 12]. Nakouri et al. described a case of retronychia in a 34-year-old woman, with a medical history of congenital misalignment of the toenails [12]. Onychomadesis and Beau's lines were seen on the right toenail while retronychia was diagnosed on the left toenail. Gerard et al. [7] also described congenital malalignment of the great toenail as a predisposing factor in one patient among a series of 16 cases. Congenital malalignment of the big toenail is an underreported condition, defined by a congenital lateral deviation of the nail plate [13]. Its pathogenesis remains unclear, but the lateral deviation is hypothesized to be related to increased traction of the hypertrophic extensor tendon of the hallux [13, 14]. An underlining genetic factor is favored, due to twin concordance rates and reported familial cases [13, 15, 16]. Lateral deviation of the nail plate could also be associated with a deviation of the distal phalanx axis [13, 17] but should be distinguished from hallux valgus [13]. Congenital malalignment of the big toenail may result in chromonychia, thickening and triangular deformation of the nail plate, onycholysis and onychomadesis [13, 17].

Table 1 Definitions

Retronychia	A form of ingrowing nail characterized by the embedding of the proximal nail plate into the proximal nail fold and the stacking of a multiple generations of nail plates beneath the proximal nail fold
Beau's lines	Transverse depression of the nails plate that appear at the base of the lunula weeks after a stressful event has temporarily interrupted nail formation
Onychomadesis	Full-thickness transverse groove of the nail plate
Onycholysis	Painless separation of the nail plate from the nail bed
Paronychia	Inflammation localized to the area around the nail root
Chromonychia	Nail plate discoloration
Xanthonychia	Yellow discoloration of the nail plate

Table 2 Retronychia of the toenails: precipitating factors and associated static disorders of the feet (published data from inception to April 2018)

Author	Year	Retronychia of the toenails (n)	Retronychia of the big toe	Retronychia of the fingernails (n)	Precipitating factors	Associated static disorders of the feet
de Berker et al. [3]	2008	16	16/16	3	Thrombophlebitis, running (kept nail long); arthritis, trauma, hiking, poor footwear, high heels	–
Dahdah et al. [4]	2008	2	2/2	–	Trauma, steel-toed boots	–
Chiheb et al. [23]	2010	1	1/1	–	Micro-trauma, tight shoes	–
Baumgartner et al. [6]	2010	5	5/5	–	Repeated trauma from dancing, cerebral tumor and disturbance of motor coordination, 2/5	–
Zaraa et al. [24]	2012	1	1/1	–	Tight shoes	–
Ustuner [25]	2012	1	1/1	–	Renal transplant recipient	–
Fouilloux [9]	2014	6	6/6	–	Hiking (1/6)	–
Piraccini et al. [8]	2014	15	–	–	Trauma, jogging or dancing, uncomfortable shoes (7/15)	–
Reigneau et al. [26]	2015	4	4/4	–	Foot trauma, sport shoes, tight military shoes (2/4)	–
Kimet al. [27]	2015	2	2/2	–	Trauma, high-heeled shoes (2/2)	–
Cabete et al. [28]	2015	2	2/2	–	Shoe trauma 2/2	–
Gatica-Torreset al. [29]	2015	2	1/2	1/2	Surgery of an ingrowing toenail	–
Alonso-Pacheco et al. [10]	2016	1	1/1	–	Mountaineering, tight boots.	–
Gerard et al. [7]	2016	17	16/18	1	Cat scratching, tight footwear, injury, compartment syndrome, intensive sport, postpartum period	Congenital malalignment of the great toenail (1 case)
Ventura et al. [5]	2016	20	20/20	–	Rhythmic gym, trauma, high heels, sports, dance, tennis, hiking	Reflex hyperextension of halluces (9/20)
Campos et al. [21]	2017	1	1/1	–	Micro-trauma	–
Fernández et al. [30]	2017	29	29/29	14	–	–
Robledo et al. [31]	2017	1	1/1	–	–	–
Pizarro et al. [11]	2017	1	1/1	–	Martial arts	–
Yale et al. [32]	2017	1	1/1	–	–	–
Poveda-Montoyo et al. [20]	2018	2	2/2	–	–	–
Nakouri et al. [12]	2018	1	1/1	–	–	Congenital malalignment of the great toenail

Reflex compensatory hyperextension of the halluces is another static disorder of the foot associated to retronychia. Reflex compensatory hyperextension of the halluces is related to claw toes (2nd–5th) [5]. The association of reflex hyperextension of hallux and retronychia may also be underreported. In a series of 20 cases of retronychia of the great toenails, reflex hyperextension of hallux was individualized in nine patients [5]. This condition predisposes to trauma of

the big toenail and may result in Beau's lines, onychomadesis and retronychia [5].

In our experience, podiatric predisposing factors of retronychia (congenital malalignment of the great toenail, reflex hyperextension of the hallux, Egyptian foot type—characterized by a long hallux and shorter second toe) seem to be more frequent than reported. These conditions increase stress on the big toe. Therefore, management of retronychia should also take into consideration the associated static disorders of the feet, to prevent recurrences.

Clinical presentations

Retronychia is mainly reported in adults. Pregnancy represents a risk factor [7]. Children, adolescents and young adults are not commonly affected [8].

Retronychia progresses in two stages, early and late stages:

- *The early stage* is usually underrecognized and is characterized by interrupted nail growth and xanthonychia associated with mild paronychia (Fig. 1).
- *The late-stage* comprises almost all symptoms, particularly intense paronychia and proximal nail plate elevation (Fig. 2). Other signs include distal onycholysis, subungual hyperkeratosis, superficial leuconychia, subungual hemorrhage, and Beau's lines.

Clinical diagnosis is based on a characteristic triad [12]:

- an interruption of the nail growth;
- a subacute proximal paronychia, with an elevation of the proximal portion of the nail plate over the level of the proximal nail fold;
- a xanthonychia.

In the early stages, the clinical diagnosis of retronychia may be difficult to establish. Imaging, particularly ultrasound examination, is useful in doubtful cases.

Ultrasound examination

The diagnosis of retronychia is based on clinical findings. Nevertheless, ultrasonography (US), a noninvasive imaging method, has been introduced for the diagnosis of this condition since 2010 [18].

Since this first report and subsequent studies [10, 19], US diagnostic criteria have been proposed. It included

- the existence of 2 or more overlapping nail plates;

Fig. 1 Early stage of the disease showing paronychia. **a** Interruption of the nail growth and distal xanthonychia, and **b** the proximal portion of the nail plate is slightly elevated

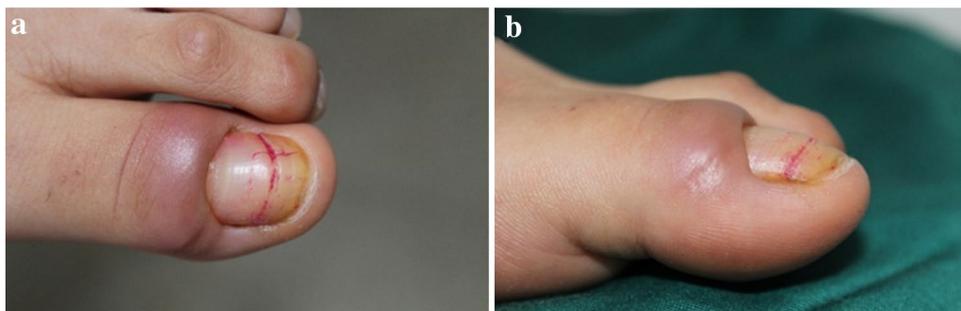


Fig. 2 A case of bilateral retronychia with marked elevation of the proximal portion of the nail plate over the level of the proximal nail fold, onycholysis, xanthonychia, paronychia and purulent discharge from the proximal nail fold of the right toenail

- limited distance between the proximal portion of the nail plate and the base of the distal phalanx;
- reduced echogenicity of the tissue of the proximal nail fold and nail bed related to inflammation;
- the absence of signal deeper under the nail plate, which can be explained by posterior acoustic shadowing.

An increased blood flow in the dermis of the posterior nail fold and nail bed using color Doppler US, related to inflammation, is also reported [18, 20].

These criteria are assessed in comparison to the contralateral side and, therefore, are helpful when the contralateral nail is healthy. However, these criteria may be difficult to apply in cases of bilateral retronychia as comparison of these features with the contralateral nail may not be contributory. In addition, anatomic differences in the sizes of the digits (fingernails and toenails) require more precise measurements [21].

More specific US diagnostic criteria considering the anatomic differences and bilateral retronychia were recently proposed [21]:

- hypoechoic halo surrounding the origin of the nail plate;
- distance between the origin of the nail plate and the base of the distal phalanx of 5.1 mm or less in big toes and thumbs and/or a difference of 0.5 mm of this distance or greater between the affected nail and the contralateral healthy nail;
- proximal nail fold thickness of 2.2 mm or greater for male patients or 1.9 mm or greater for female patients and/or a proximal nail fold 0.3 mm thicker or greater in comparison with the contralateral healthy nail.

According to Fernandez et al. [21], the presence of three major US diagnostic criteria is necessary for diagnosing unilateral retronychia. However, the diagnosis of bilateral retronychia requires the presence of at least two criteria, one of them being the presence of a hypoechoic halo surrounding the origin of the nail plate.

Differential diagnosis

The differential diagnosis includes virtually all causes of chronic paronychia of the proximal nail fold, several subungual tumors and cysts (Table 3).

Management

Some mild forms of retronychia may evolve spontaneously. They could be treated by topical application of potent corticosteroids on the proximal nail fold, but recurrences are frequent [4, 7].

In advanced cases with chronic paronychia and granulation tissues, surgery is recommended. The surgical technique consists of avulsion of superimposed nail plates and excision of granulation tissue. Dahdeh et al. advocated no need to remove all superimposed nail plates, especially when the underlying nail appears whitish and has a healthy shine [4]. However, this attitude could be followed by the recurrence of retronychia, and patients could not experience pain relief [4].

Thus, it is now accepted that all superimposed nail plates should be removed [12].

Avulsion techniques are variable. Some authors advocate that only partial proximal avulsion is sufficient to treat retronychia [3, 22]. The distal part of the preexisting nail plate may be left to support the forward growth of the newly formed nail (Fig. 3). This technique proves helpful except when major onycholysis is observed. In these cases, the preexisting nail plate and nail bed would not support the forward growth of the newly formed nail plate [6] and complete nail plate avulsion is preferred (Fig. 4) [8, 12].

Recurrences are rare [8, 9]. Patients should be informed of the risk of post-operative permanent nail dystrophy. The frequency of post-surgical nail dystrophy is variable, ranging from 13 to 33% [7, 8]. This includes retraction of the nail bed with pincer nail and micronychia [7], impaired nail regrowth with hypertrophy of periungual soft tissues [8].

Treatment of retronychia must also include the management of associated predisposing factors including adequate footwear and correction of static disorders of the foot [7].

Summary

Retronychia is a form of ingrown nail. Predisposing factors including hereditary and static disorders of the feet may be underestimated. The diagnosis is essentially clinical. Two signs are compulsory for the diagnosis: interruption of the nail growth and subacute proximal paronychia. Retronychia can mimic other nail disorders with chronic paronychia such as infections, psoriasis and tumors. Therefore, US could be very useful in doubtful cases. Precise US diagnostic criteria have recently been established. Mild forms of retronychia could be treated by topical corticosteroids. In advanced cases, surgery is saltatory. Treatment must also include management of the predisposing factors including adequate footwear and correction of static disorders of the foot. Knowledge of these aspects will help prevent recurrences and permanent dystrophy.

Table 3 Differential diagnosis of retronychia

Differential diagnosis	Characteristics	Differentiating factors
<i>Inflammatory diseases</i>		
Psoriasis	Psoriasis is a common inflammatory disease of the skin. Fingernails are more frequently affected than toenails. All parts of the nail unit could be affected. Variable degrees of paronychia could be seen. As in retronychia, onycholysis and xanthonychia are reported. “Oil drop” or “salmon patch” is a characteristic feature of psoriasis	Unlike retronychia, nail regrowth is accelerated. Pyogenic granuloma is very unlikely encountered in psoriasis. Other cutaneous features and nail features of psoriasis help making the correct diagnosis
Atopic dermatitis/eczema	Atopic dermatitis is a relapsing, inflammatory disease. Nail changes are more frequently encountered during atopic dermatitis than in other forms of dermatitis. Fingernails are more frequently affected Dermatitis involving the nail folds could be associated with variable degrees of paronychia, dystrophy and pitting of the nails	Nail regrowth is not altered. Cutaneous signs of dermatitis of the proximal nail folds and on other parts of the body enable making the correct diagnosis
Lichen planus	Nail changes in lichen planus include violaceous papules in the proximal nail fold and nail bed, leukonychia, longitudinal ridging, thinning of the entire nail plate, and pterygium formation [33]	Cutaneous lichen planus on other parts of the body could be associated. Unlike retronychia, the nail plate tends to become thinner. Scarring (pterygium) could eventually occur
Pemphigus	Pemphigus is an autoimmune blistering disease. The most frequent nail features are paronychia and periungual blisters. Beau’s lines and onychomadesis could be associated	Bullae affecting the skin and oral mucosa Positive DJF is confirmatory
<i>Infectious disease</i>		
Onychomycosis	Onychomycosis is a chronic fungal infection of the nails caused by dermatophytes, yeasts or molds. It could be classified into four types. Variable degrees of paronychia, onycholysis, and chromonychia could be observed depending on the fungal species and on the root of nail invasion	Nail regrowth is not altered in early disease. Pyogenic granuloma is very unlikely encountered. Laboratory examinations demonstrating the organism (direct microscopy, fungal culture, PAS stain...) are confirmatory
<i>Iatrogenic chronic paronychia</i>		
Retinoids	Several drugs are responsible for paronychia and pyogenic granulomas of the fingernails or toenails	Positive history of culprit drug intake is characteristic. Drug-induced Beau’s lines and onychomadesis have been reported. To date, no case of drug-induced retronychia has been reported
Targeted therapies: anti-EGFR, mTOR inhibitors, anti-MEK		
<i>Tumors</i>		
Myxoid cyst	Myxoid cysts, is usually associated with distal interphalangeal osteoarthritis, and affects more often the fingernails than the toenails. Swelling of the proximal nail fold could be confused with chronic paronychia	Opalescent nodule of the proximal nail fold producing a characteristic irregular groove of the nail plate
Onychomatricoma	Onychomatricoma is a benign, slow-growing tumor derived from the nail matrix. Onycholysis, discoloration and bulging of the nail plate is associated	Honeycomb-like spaces on the free-margin of the nail plate (better seen using dermoscopy) are characteristic features of onychomatricoma
Squamous cell carcinoma/Bowen’s disease	It commonly affects a single nail (most frequently fingernails) and appears as a warty change of nail fold, erythronychia and ooze from edge of nail	The tumor is asymptomatic at the beginning. Destruction of the nail apparatus and underlying tissue/bone can be demonstrated both clinically and using standard X-ray in late disease
Melanoma	Melanoma is a skin cancer resulting from the malignant transformation of melanocytes	Black discoloration of the nail plate extending onto nail fold should raise suspicion of melanoma. Histopathological examination makes the diagnosis

Fig. 3 Surgical treatment of retronychia. Proximal partial avulsion of superimposed nail plates (a). The distal part of the nail plate is not removed to prevent dystrophy and micro-nychia (b, c). Dramatic decrease of swelling and pain was noted after 10 days (d)

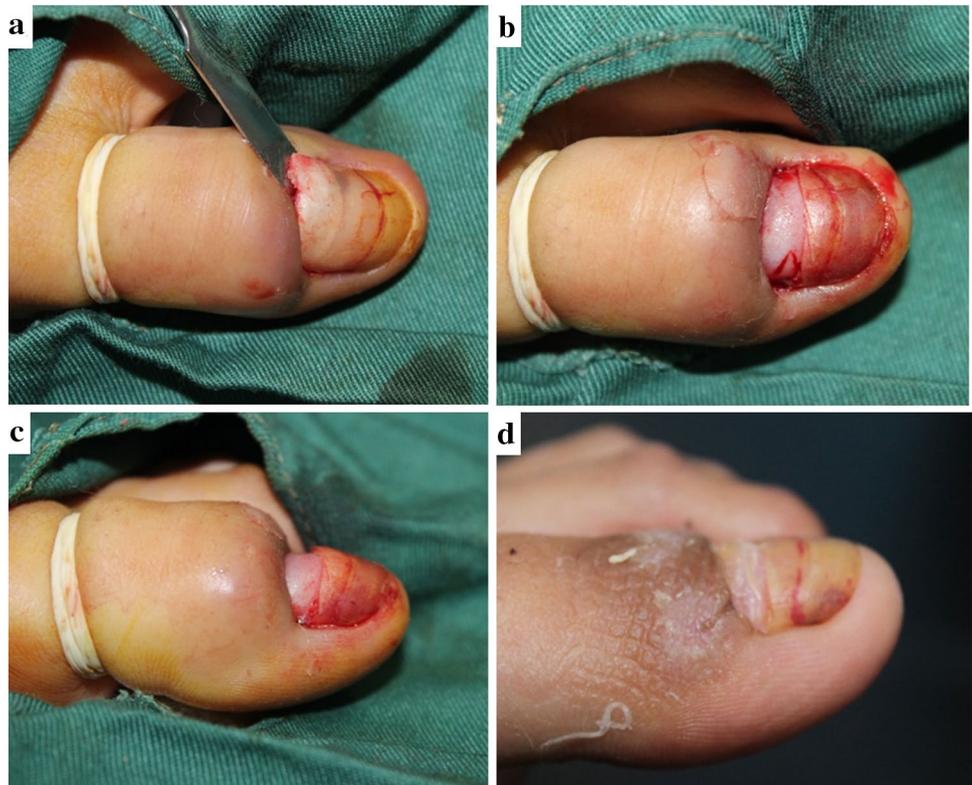
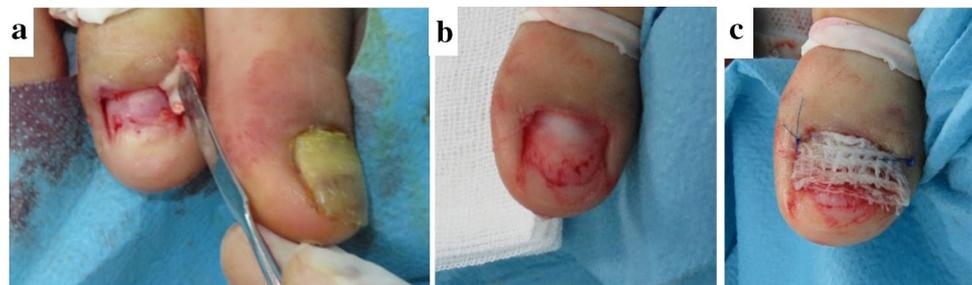


Fig. 4 Surgical treatment of bilateral retronychia. Proximal avulsion of the embedded nail plate of the right big toe (a). Appearance of the nail bed after avulsion (b). A gauze is sutured between the matrix and the proximal nail fold to prevent scarring (c)



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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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