

Toenails: Where Orthopedics and Onychology Meet

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Onychomycoses are generally held to be the most frequent nail disorders. This was recently disputed when orthopedic abnormalities were recognized as being the cause of nail changes, in particular onycholysis. The authors had found that gait irregularities lead to nail changes and called this the “asymmetric gait nail unit syndrome (AGNUS)” [1, 2]. An analysis of toenail alterations in six different nail clinics in five countries confirmed that orthopedic problems associated with nail changes are at least as frequent as toenail mycoses although very often mistaken for fungal nail infections and other dermatoses (Figs. 8.1 and 8.2). Even in children, foot deformities can often be detected in association with nail alterations (Unpublished) [3].

The big toenail is the most common victim of orthopedic foot and toe abnormalities (Table 8.1). Although varying to an extreme extent even within the same individual, nail changes may look similar to other nail conditions, particularly onychomycoses and toenail psoriasis. Their pre-

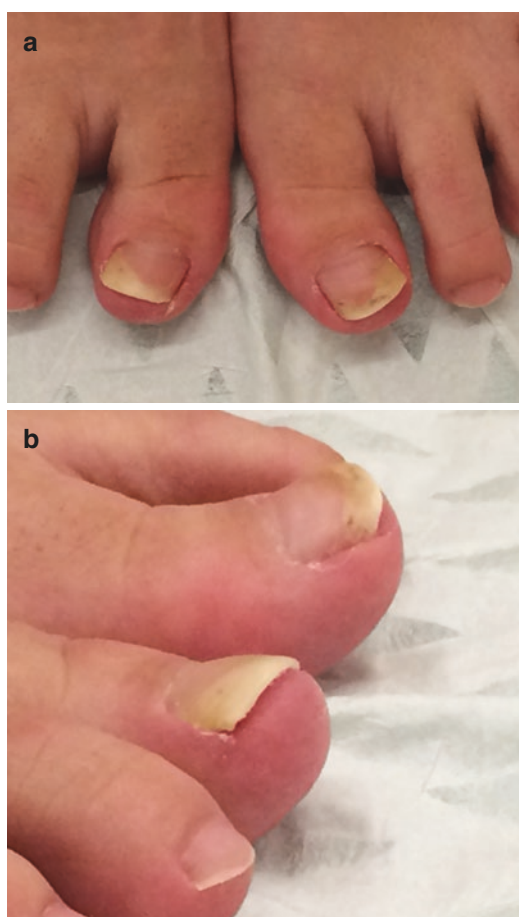


Fig. 8.1 Asymmetric gait nail unit syndrome in a 56-year-old patient with mild hallux valgus, hallux valgus interphalangeus, hallux erectus, and inward rotation of the big toe exhibiting distal onycholysis and nail bed hyperkeratosis. (a) Dorsal view. (b) Lateral view

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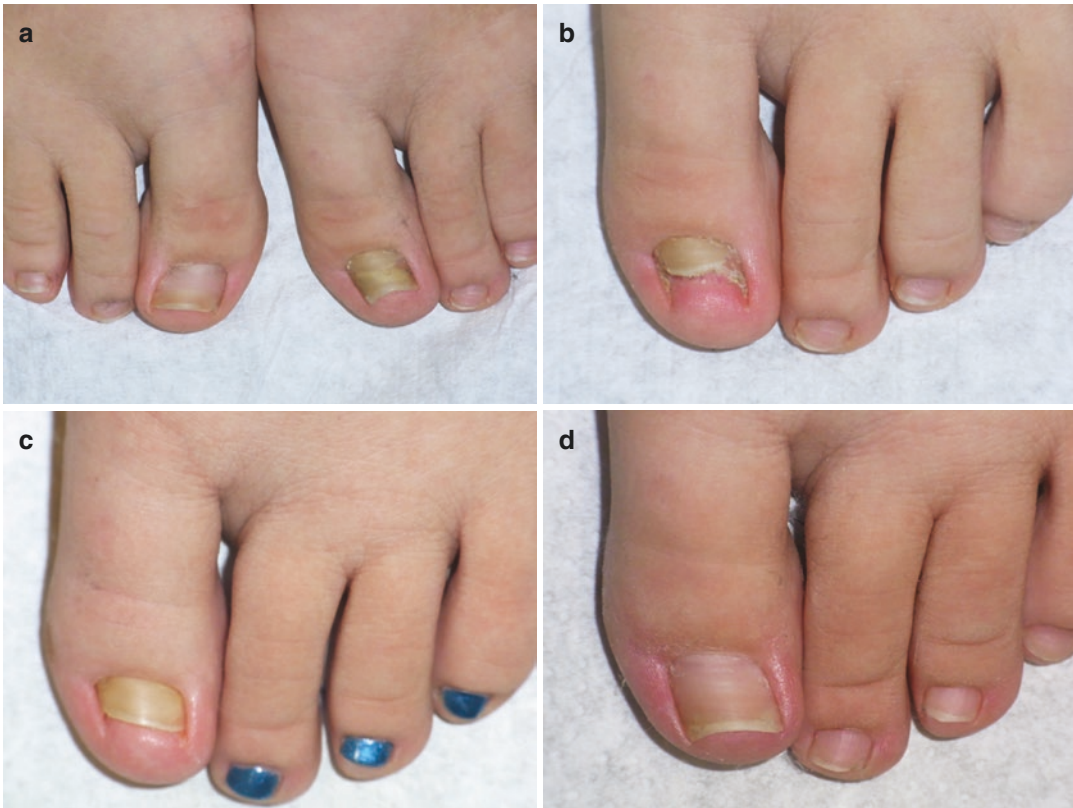


Fig. 8.2 Asymmetric gait nail unit syndrome in a 16-year-old girl. **(a)** Marked distal medial onycholysis associated with hallux valgus and hallux valgus interphalangeus. **(b)** Cutting the onycholytic nail away demon-

strates a distal bulge in the front of the remaining nail. **(c)** After 5 months of consistent taping, nail growth is visibly improved. **(d)** One year later, a near-normal nail has regrown

Table 8.1 Minor and major orthopedic problems causing toenail abnormalities

Orthopedic problem	Big toenail	Lesser toenails
Hallux valgus	Onycholysis Subungual hyperkeratosis Subungual corn (heloma) Inward toe rotation Lateral deviation of big toe and toenails Retronychchia Compression nails Pincer nails	Overriding toe Medial deviation of lesser toes and toenails Retronychchia
Hallux erectus	Onycholysis Subungual hyperkeratosis Subungual corn	Often associated with hammertoe of the second toe
Hallux rigidus	Onycholysis	
Flat foot	Onycholysis	
Splayfoot	Onycholysis Inward rotation of big toe	Outward rotation of the little toe
Double little toenail [19]		Broad little toenail often mistaken for corn. Tends to catch stockings when pronounced
Short distal phalanx	Upward growing of big toenail	Increased longitudinal curvature of lesser toenails => parrot nails
Age-related foot deformation	Onycholysis, malposition, thickening, onychogryphosis	Onycholysis, malposition, thickening, onychogryphosis
Wide base of the distal toe phalanx [20, 21]	Pincer nails, usually associated with lateral deviation of the distal phalanx and the nail	Pincer nails, usually associated with medial deviation of the distal phalanx and the nail

cise differential diagnosis is of paramount importance to institute a correct treatment and to avoid lengthy, expensive, and potentially risky therapies [4].

Hallux Valgus

Bunion deformity is an extremely common disorder affecting a high percentage of the population with female predominance. It is an autosomal dominant condition with a positive family history in 90% of the cases [5]. The genetic component is said to be stronger when the hallux valgus occurs in younger persons [6]. In a community-based study of 600 elderly Bostoners, 52% of women and 25% of men had hallux valgus, which was defined as an angular deviation $>15^\circ$ of the big toe in relation to the first metatarsal bone toward the lesser toes. Theories as to its etiology abound: Several factors of hallux valgus development have been reported to be associated with structural factors, sex, age, BMI, foot pain, pes planus, and footwear. Among the structural factors are also metatarsal length, metatarsal head shape, first ray hypermobility, and hind-foot pronation. Clinically, hallux valgus is more frequently observed in women and more prevalent in the elderly. An association with increased BMI, foot pain, and pes planus was also seen. The prevalence of hallux valgus is much higher in persons wearing shoes than those with unshod feet, and shoe types may be important in the development of hallux valgus [7]. However, the claim that high-heeled shoes are the main reason for the female predominance is certainly not true. Hallux valgus is said to be extremely rare in little children [8–10], a statement that we *cannot* confirm. In contrast, systematic X-ray examinations in infants and little children have shown a medial deviation of the first metatarsal bone in relation to the second one associated with an oblique joint line of the first cuneiform-metatarsal joint. This is, curiously, not mentioned in the extensive literature on hallux valgus. It is also evident that hallux valgus gets worse with age as it is a self-aggravating condition since both the flexor and the extensor tendons pull and increase the angle

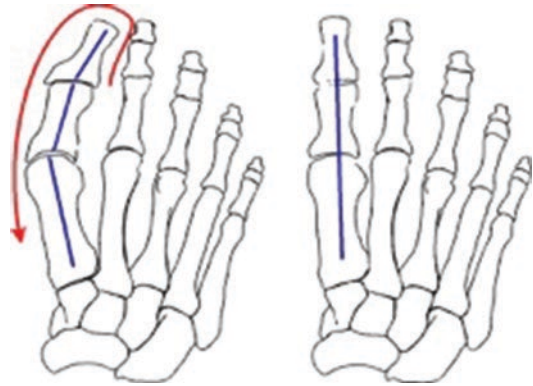


Fig. 8.3 Left: Hallux valgus starts at the joint between os cuneiforme I and os metatarsale I: the joint line is oblique. The blue lines show the arc formation of the first ray. The red line indicates the action of taping. Right: Ideal straight position of metatarsale I – basal and distal phalanx of the big toe

of the arch (Fig. 8.3). Although taping cannot address the oblique os cuneiforme I–os metatarsale I joint space, it is able to correct the metatarsophalangeal and the interphalangeal joints. Long-term pressure leads to bone reduction and long-term tension to bone apposition or growth, respectively, which is the principle of taping in hallux valgus treatment.

The nails in hallux valgus are often thickened, nontransparent, and partially onycholytic, and there is a nail bed hyperkeratosis; this appearance is frequently confused with onychomycosis. An acquired asymmetric lateral nail deviation may develop. In severe cases, an onychogryphosis may occur. This abnormality is also prone to development of chronic retronychia (Fig. 8.4).

Hallux valgus interphalangeus is defined as a lateral deviation of the long axis of the distal phalanx from that of the first phalanx. Together with the common hallux valgus, it forms an arch of the first ray that tends to self-aggravate due to foot activities with pull on the flexor and extensor tendons of the hallux. On X-ray films, an asymmetric distal phalanx is seen with an exaggerated medial condyle in adults and an asymmetric epiphysis of the distal phalanx in children (Fig. 8.5). This is virtually always observed in the hereditary type of pincer nails [20, 21]. Again, conservative treatment is by taping.



Fig. 8.4 Chronic retronychia in a 12-year-old female patient with hallux valgus and mild hallux valgus interphalangeus. (a) Dorsal view. (b) View from proximal. (c) Taping of the toe. (d) After 4 months of taping

Splayfoot

Hallux valgus is almost always associated with a splayfoot. Nail changes may be similar, though not so pronounced. Inward rotation of the big toe and outward rotation of the little toe are associ-

ated. The little toe may be rotated to a degree that it stands vertical, which may cause a parungual callus causing pain while walking. This is even more pronounced in case of a double little toenail (Fig. 8.7).

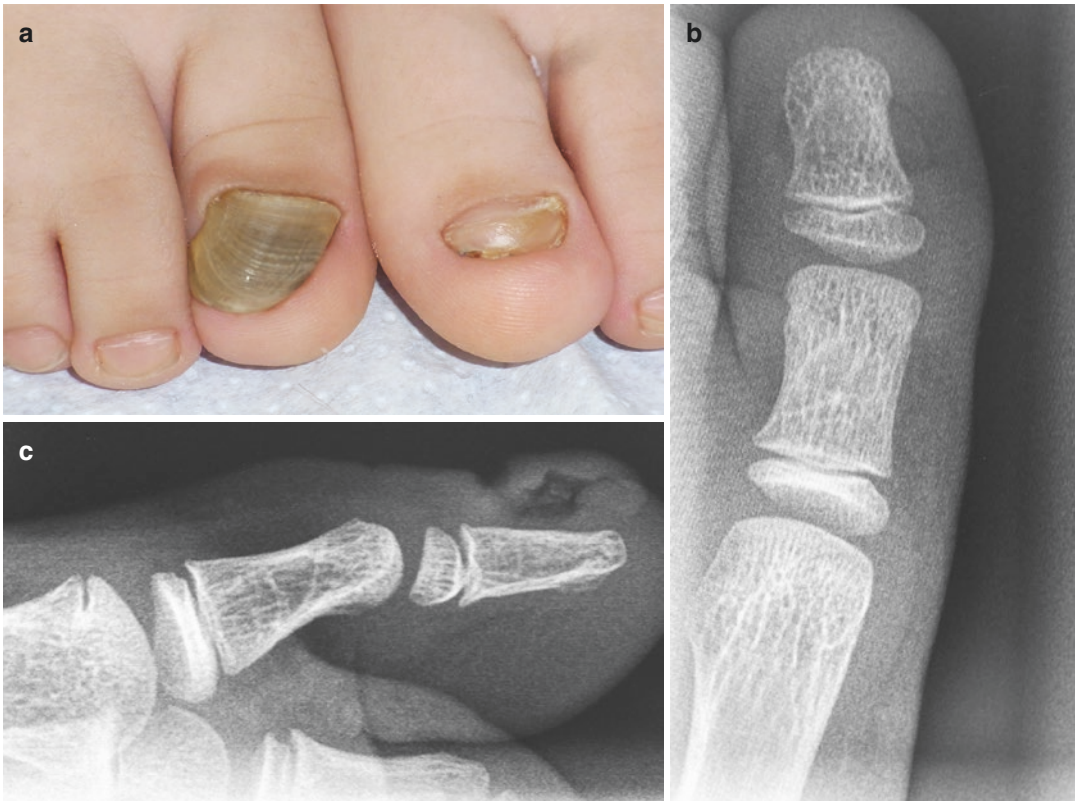


Fig. 8.5 A 5-year-old girl with congenital malalignment and hallux valgus interphalangeus (a). The X-ray film of the right toe shows an asymmetric wedge-shaped epiphysis of the distal phalanx of the great toe (b). Also, the lat-

eral X-ray demonstrates an asymmetric epiphysis explaining the upward direction of the distal phalanx. The nail is bridging a deeply sunk-in nail bed, and there is a distal bulge (c)

Pes Planus

Flat foot is also very common and usually combined with splayfoot. Nail changes are virtually identical.

Hallux Erectus

Hyperextension of the hallux results in a condition called hallux erectus. A statistically significant correlation between hallux interphalangeal

joint hyperextension and first metatarsophalangeal joint pain was found ($r = 0.78$, $p = 0.01$) [8]. The dorsal overextension leads to the friction of the free nail margin at the shoe box and may consequently cause distal subungual hyperkeratosis that is often confounded with distal subungual onycholysis (Fig. 8.6). Clinically, the extensor hallucis tendon stands out as an elevated band. Dermatologic treatment is by taping the hallux down in a slightly overcorrected position: A tape of 2 cm width is fixed on the nail and led around the tip of the toe to its pulp and with some tension



Fig. 8.6 Hallux erectus with distal onycholysis

over the plantar surface of the basal phalanx to the ball of the foot. To keep the tape in place, another tape is lightly fixed around approximately 270° of the basal phalanx like a holster. With time, the patients learn not to pull the big toe upward.

Hallux Rigidus

Hallux rigidus is degenerative arthritis of the first metatarsophalangeal joint. With 2.5% of all persons over 50 years suffering from hallux rigidus, it is said to be the most frequent arthritic condition of the foot [9]. Its progression is associated with pain and limited motion. Depending on its severity, nail changes vary from mild onycholysis, to subungual hyperkeratosis, to onychogryphosis.

Double Little Toenail

This tiny abnormality of the fifth toenail is quite common, though very often overlooked [10, 19]. It is seen in all races and is apparently autosomal dominant [10, 19]. The nail may be obviously doubled or be just wider with a longitudinal split

or only an indentation (Fig. 8.7). The reason is a small bone spike at the disto-lateral side of the distal phalanx that gives rise to an accessory nail anlage. This can be seen in good radiographs although they are difficult to obtain. The double nail of the little toe may become symptomatic in patients with splayfoot and pes planus when the fifth toe rotates outward and stands vertical. This is felt like a clavus with which it is very often confounded. Treatment is by surgical resection of the accessory nail segment or by chemocautery of the accessory matrix portion [10, 19].



Fig. 8.7 Double little toenail. The right fifth nail exhibits just a shallow longitudinal depression (a), whereas the left one shows a longitudinal split running till the cuticle and clearly delineating the accessory nail (b)

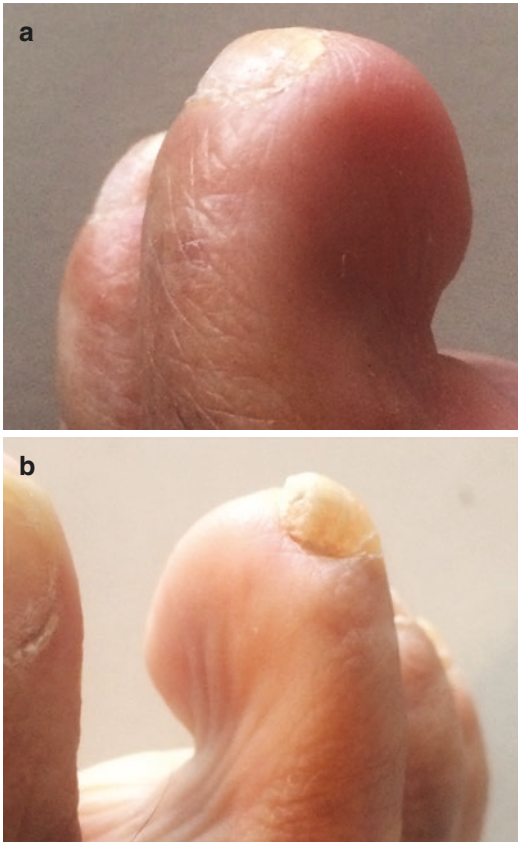


Fig. 8.8 Short distal phalanx of the second toes with longitudinal overcurvature of the nail. (a) Left third toe. (b) Right third toe

Short Distal Phalanx

The distal phalanx of the toes may be abnormally short although the nail bed is of normal length. This leads to the lack of support of the distal nail bed which is pulled plantarly and causes a pronounced longitudinal curvature of the nail in the sense of a parrot beak nail (Fig. 8.8). The nail may press into the pulp and cause a callus similar to what is seen in a hammertoe. Sometimes, there may be a central split in the distal nail plate. An abnormally short distal phalanx of the big toe in little children may lead to upward distortion of the nail as the pulp of the toe is dislodged dorsally during gait (Fig. 8.9).



Fig. 8.9 Upward distortion of the big toenail in an abnormally short distal phalanx. (a) Dorsal view. (b) Lateral view

Age-Related Foot Deformation

More than 40% of the population has foot problems and the prevalence increases with age. They are usually painful and impede walking and many sports activities. All types of nail changes described above may develop.

Wide Base of the Distal Toe Phalanx

According to our investigations, a wide base of the distal phalanx of the big toes is always seen in the symmetrical form of pincer nails [5, 6].

Fig. 8.10 Moderate overcurvature of the big toenails in a 17-year-old male patient with mild hallux valgus and hallux valgus interphalangeus. (a) Dorsal view of both sides. (b) Left toenail with painful ingrowing of the lateral nail edges. (c) Immediate pain relief by insertion of a wisp of cotton under the lateral nail edges



The terminal phalanx is asymmetrical and shows laterally, whereas affected lesser toes are medially deviated (Figure). The basal condyli are increased with a bigger one on the medial side, which is easily felt with sliding palpation. With time, this develops into a hooklike shape possibly representing the insertion of the medial interosseous ligament. The matrix horns are located here, which results in a widening of the natural curvature of the hallux nail proximally that now compensatorily curves in more distally [20, 21]. The result is the typical nail overcurvature that is sometimes more than 360° at the free nail margin. In the beginning, when the lateral nail margins are vertical, they may press into the lateral nail sulcus which causes pain and may induce an ingrowing nail in younger persons (Fig. 8.10) and in older persons a hyperkeratosis in the nail sulcus called onychophosis (Fig. 8.11). In addition to the pronounced condyli at the base of the

distal phalanx, a small osteophyte is often seen on lateral-view radiographs; they develop from traction by the elevated distal nail bed.

Treatment of pincer nails depends on the severity and symptoms. In mild cases, orthonyx therapy with elastic steel braces, shape memory alloy nail clips, plastic strips, and taping may alleviate pincer nails [11]; however, as they do not attack the underlying bone alterations, recurrences are very frequent and appear quick. As the medial and lateral condyli cannot be removed without risking to damage the lateral ligaments and destabilize the joint, the lateral matrix horns on which they act have to be removed. This is best done by avulsing a medial strip of the nail plate and selectively remove the matrix horn, either by scalpel dissection or chemocautery with phenol, trichloroacetic acid 85%, or sodium hydroxide 10%. In case of severe nail bed deformation, a nail bed plasty is recommended [20, 21].



Fig. 8.11 Pincer nails in a 55-year-old female patient with marked lateral deviation of the distal big toe phalanges and medial deviation of the distal phalanges of the affected lesser toes. (a) Dorsal view. (b) Frontal view

Inborn Nail Abnormalities in Children with Bone Changes

Congenital dystrophy of the great toenail was described in 1978 [12] and renamed congenital malalignment of the great toenail in 1979 as it was recognized to be associated with a lateral deviation of the nail's long axis [13]. The condition is characterized by a thickened, discolored, malformed triangular nail with a lateral deviation of its long axis. Its surface is oyster shell-like with Beau's lines that are the result of horizontal splits in the matrix from compression in the longitudinal axis, a mechanism exactly identical to that of retronychia. The transverse ridges are usually closer to each other on the lateral nail plate indicating a curvature in the long axis of the nail,



Fig. 8.12 Congenital malalignment in a 5-year-old boy. There is a mild interphalangeal valgus position of the fourth toe with mild medial nail deviation



Fig. 8.13 Untreated congenital malalignment of the big toenails of a 12-year-old girl

which might be due to the higher proliferation of the medial in relation to the lateral matrix horn (Figs. 8.12 and 8.13). The nail margins press into the soft tissue leaving pressure marks. We have found severe onycholysis in all fully developed cases (Fig. 8.14), which is apparently the most important prognostic factor. Onycholysis is also the reason for the extreme shortening of the nail bed and heaped-up tissue in front of the nail, which is the cause of the worsening by minor trauma [14]. X-ray examinations have shown a mild to moderate hallux valgus formation, mostly as a hallux valgus interphalangeus (Fig. 8.15) [15]. Another group postulated that a hypertrophy of the latero-posterior ligament inserting at the matrix horn would pull the matrix proxi-



Fig. 8.14 A 5-year-old girl with congenital malalignment of the hallux nails; the right nail is onycholytic and demonstrates all features of the disease, whereas the left nail is not onycholytic and only shows a trapezoid nail

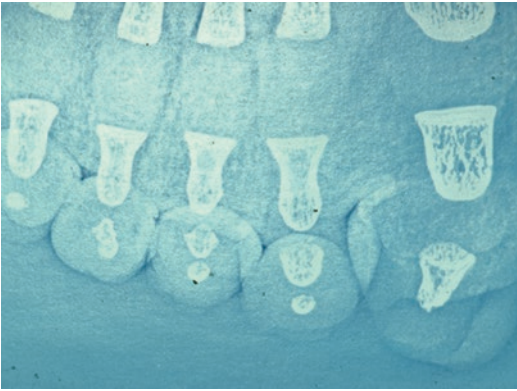


Fig. 8.15 Radiograph of the forefoot of a 1-year-old girl with congenital malalignment of the big toenail

mally resulting in an oblique direction of the nail growth [16]. This would also explain the bulge over the lateral matrix horn.

Whereas some authors have seen spontaneous resolution in almost half of their cases [17], our experience is much less favorable. The surgical correction of the long axis of the entire nail unit devised in 1983 requires dissection of the entire nail unit beyond the proximal matrix and is usually successful if done before the age of 2 years; the later the surgery, the less the results are satisfying [3]. Due to the modest results of surgery, we have performed taping in infants and children to correct the hallux valgus and hallux valgus interphalangeus to correct the bone position. A tape is fixed at the lateral side of the big toe and carried around its tip along the toe's medial side to the midfoot with tension. This immediately



Fig. 8.16 Congenital overcurvature of the right hallux nail in a 4-year-old boy with a mild hallux valgus (a). Taping of the right big toe leads to a better toe position as seen at the interdigital space between toes 1 and 2 (b)

shows a better toe axis. The tape is applied to correct the direction of the phalanges (Fig. 8.16), and another tape is applied on the maldirected nail plate to pull it medially. Further, as there is no counterpressure for the toe pulp during gait by the onycholytic nail, a distal bulge develops, and the nail bed shrinks. The success rate is better than surgery provided the taping is done correctly and consistently. The treatment duration in infants is usually 1 year and increases with the age of the patient. When the feet are sweaty, particularly in summer, the skin may be painted with an alcoholic extract of the resin of the mastic tree (Mastisol®), which renders the skin much stickier. Untreated congenital malalignment – if not resolving spontaneously – leads to very unsightly



Fig. 8.17 Hallux valgus interphalangeus with severe onycholysis as evidenced by the yellow nail discoloration and multiple transverse lines. (a) Before taping. (b) With

taping. (c,d) X-ray films show the hallux valgus interphalangeus and the wedge shape of the distal phalanx epiphysis



Fig. 8.18 Congenital malalignment of the big toenails in a 26-year-old man with hallux valgus and hallux valgus interphalangeus

nails, and many teenagers and young adults are then embarrassed by their ugly nails (Figs. 8.17 and 8.18).

Congenital malalignment is also seen as a late-onset condition [18]. This is not uncommon and, in our experience, virtually always associated with a pronounced hallux valgus interphalangeus. We postulate that due to the bone malposition, there is an unphysiological strain and stress on the nail leading to onycholysis that progresses and is followed by disappearance of the nail bed, which gives support to the nail plate. The lack of nail plate support allows movements with shearing forces that result in horizontal splits between the nail and matrix. A trauma is usually remembered as the precipitating event. Finally, a clinical pattern develops that is indistinguishable from the congenital form. Treatment of adults with neglected congenital malalignment is usually unsuccessful. Total matrix phenolization is then cosmetically and functionally superior to the thick discolored nail that is often painful and impedes normal gait and sports activities (Figs. 8.19 and 8.20).

Fig. 8.19 Congenital malalignment of the big toenails in a 35-year-old female patient. **(a)** Dorsal view; note the bulge of the lateral matrix horn of the right toe. **(b)** Frontal view showing a mild hyperextension of the right hallux. Probing shows that there is virtually no nail bed left



Other big toenail alterations in newborns and infants are represented by upward nail growth and nail overcurvature. All these toenail dystrophies have an asymmetric epiphysis in common that does not exhibit the ideal lenticular shape but more a wedge shape. The base of this wedge is medial in case of lateral deviation and plantar in upward growing nails (Fig. 8.21).

Medial deviation of a lesser toenail is occasionally seen. It presents as a thick, curved discolored onycholytic nail mimicking onychogryphosis.

Overcurvature of the hallux nail is sometimes seen in infants and preschool children. It is very often associated with lateral nail deviation (Figs. 8.22 and 8.23).

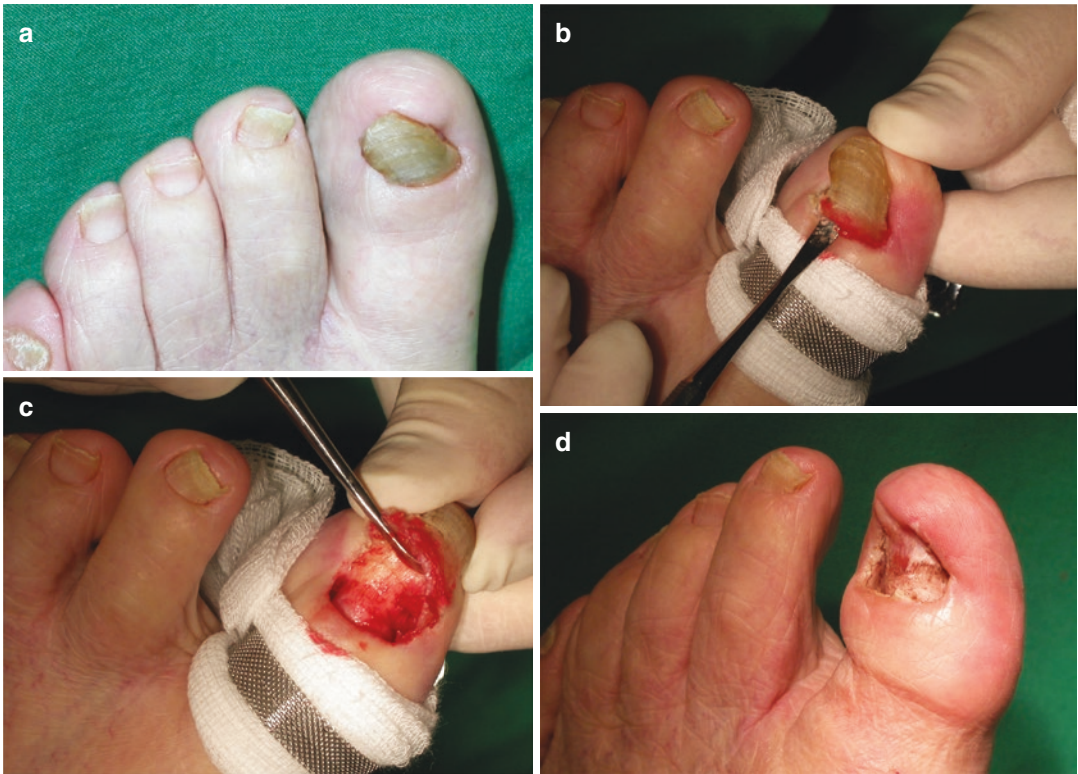


Fig. 8.20 Neglected congenital malalignment of the left big toenail in a 62-year-old woman causing pain. There is a lateral deviation of the hallux and a medial deviation of the second toenail pointing at a complex condition. (a) Almost complete onycholytic discolored nail. (b)

Proximal nail avulsion. (c) The nail plate is elevated from proximal showing a normal matrix length. (d) Immediately after phenolization of the entire matrix, an extremely short nail bed is seen with a very big distal hump due to lack of counterpressure during gait



Fig. 8.21 Overcurvature of the right hallux nail and upward growth of the left nail (Courtesy Dr. Patricia Chang, Guatemala)



Fig. 8.22 Congenital nail dystrophy with lateral deviation and overcurvature due to hallux valgus interphalangeus



Fig. 8.23 An 8-year-old boy with congenital unilateral upward growing and overcurved big toenail. (a) Dorsal view. (b) Frontal view. (c) Lateral-view X-ray demonstrating the slightly asymmetric distal epiphysis and the

upward direction of the distal phalanx. (d) X-ray dorso-plantar view showing the asymmetric epiphysis of the distal phalanx. (e) Same patient at age 11 after 2 years of taping

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