

Introduction

Dermoscopy refers to the examination of the skin using skin surface microscopy, and is also sometimes called ‘epiluminoscopy’ and ‘epiluminescent microscopy’. Dermoscopy is mainly used to evaluate pigmented lesions in order to distinguish malignant from benign skin lesions but recently its uses have been extended to diagnose inflammatory and infectious nail diseases (*Rudnicka et al., 2012*).

It is a non-invasive diagnostic imaging technique which allows the visualization of subtle clinical features of the skin surface and underlying structures not visible to the naked eye. Dermoscopy requirements include a high quality lens for 10 to 14x magnification and a lighting system. This enables visualization of subsurface structures and patterns. Hand-held devices are usually lightweight and battery-powered. The nail unit is an important part of cosmetic appearance of an individual (*El-Domyati et al., 2014*).

Pigmented and non-pigmented nail alterations are a frequent challenge for dermatologists. A profound knowledge of clinical and dermatoscopic features of nail disorders is crucial because a range of differential diagnoses and even potentially life-threatening diseases are possible underlying causes. Important and common differential diagnosis of the nail diseases are subungual hemorrhage, onychomycosis, foreign bodies, bacterial infections, traumatic injuries or artificial

discolorations of the nail unit may less frequently cause a non-continuous nail alteration. Also nail diseases include pigmentary and non-pigmentary lesions. Pigmentary lesions include: longitudinal melanonychia, nevus or melanoma. Many systemic diseases that may also show involvement of the nails are: psoriasis, atopic dermatitis, lichen planus & alopecia areata, tend to induce alteration in numerous if not all nails of the hands and feet. Benign or malignant neoplasms that may also affect the nail unit include: Glomus tumor, Bowen's disease, squamous cell carcinoma (SCC), and rare collision tumors (*Haenssle et al., 2014*).

Nail disorders are defined according to their appearance and the part of the nail affected: the nail plate, the tissues that support or hold the nailplate in place, or the lunula. The consequences of most nail disorders are purely cosmetic. Other disorders, such as ingrown nails, inflammation, erythema, abscesses or tumours, cause functional impairment or pain. The appearance of the lesions is rarely indicative of their cause. Possible causes include physiological changes, local disorders or trauma, systemic conditions, toxic substances and drugs (*Prescrire, 2014*).

Onychomycosis (OM) is a common disease, accounting for up to 50% of all ungual pathologies (*De Moraes et al., 2013*). The most common clinical form of onychomycosis shows a distolateral pattern that often involves the nails of the first and/or fifth toe. Dermoscopic examination typically reveals: A whitish

discoloration of the nail, superimposed longitudinal parallel striation, and/or jagged proximal edges with spikes. Moreover, small splinter hemorrhages and/or various nail discolorations (chromonychia/aurora borealis) with green, yellow or brown colors may occur. Of note, an intense green color of the nail plate severely affected by a mycotic infection often indicates a secondary infection with *Pseudomonas* species (spp). After a clinical and dermoscopic examination the causative dermatophytes (mostly *Trichophyton* (*T*) *rubrum*, *Epidermophyton* (*E*) or *Microsporum* (*M*) species) may be differentiated by cultural techniques (**Haenssle et al., 2014**).

Initially utilized for the study of the nail pigmentation, dermoscopy is now widely used for evaluation of all nail diseases and should be utilized routinely, as it provides important information. In some nail diseases, dermoscopic examination provides the diagnosis, even though in the majority of cases, it only permits a better visualization of features already visible with the naked eye. As any other examination, nail dermoscopy requires a good knowledge of nail anatomy & physiology and the pathogenesis of the nail diseases: we have to know which part of the nail we have to look at (**Piraccini et al., 2012**).

Dermoscopic observation of the nail can be performed with a handheld dermoscope, which allows visualization of all the nail at once, or with a videodermoscope, which allows magnifications up to 200x. The main technical problem comes

from nail plate convexity and hardness, which makes it difficult to obtain complete apposition of the lens to the surface; a gel should be used as interface medium. We commonly use ultrasound gel or antiseptic gel for hands. The study of the nail plate surface should be done with dry dermoscopy, since the gel covers surface abnormalities, while observation of color abnormalities requires it (*Ribeiro et al., 2012*).

Aim of the Study

The aim is to study the dermoscopic characteristics of onychomycosis and correlate dermoscopic picture with the causative organism, aiming to assist clinicians in correctly evaluating & diagnosing onychomycosis with the help of dermoscopy.

Chapter 1**Nail Apparatus**

The nail is considered to be a specialized modification of the skin- an ‘epidermal appendage’ that plays an important role in human’s everyday life. It grows at a rate of 0.1 mm per day and is fast in younger people. It is faster in the fingers than in the toes (*Bajantri and Bharathi, 2011*).

Nails are keratinous horny plates that form protective coverings on the dorsal surface superior to the distal phalanges of the fingers and toes (*Daniel, 2004*). The nail is the permanent product of the nail matrix. Its normal appearance and growth depend on the integrity of several components such as the surrounding tissues and the bony phalanx that are contributing to the nail apparatus (*De-Berker et al., 2007*).

The human nail can be considered to have many mechanical and social functions. The most prominent functions are fine manipulation, scratching, physical protection of the extremity, tactile sensation and a vehicle for cosmetics and aesthetic manipulation. For many of these functions there is therefore an optimal nail length, although there can be conflict between aesthetic and functional norms (*De-Berker et al., 2007*).

The nail helps to increase the sensory perception in the pulp and helps in picking up small objects. Nail loss or deformity is not only unaesthetic in appearance but can be functionally incapacitating. A proper knowledge and understanding of nail

anatomy is very much essential for proper treatment of various conditions affecting it (*Bajantri and Bharathi, 2011*).

A. Overview of the nail physiology:

The nail is a window to the nail bed. It is held in place by the nail folds and ends at a free edge distally. At its proximal margin it lies adjacent to the distal interphalangeal joint. The insertion of the extensor tendon of this joint lies 1.2 mm from the matrix which has a common biological and surgical processes that affect these two structures (*De-Berker et al., 2007*).

The growth rate of nails is highly variable among individuals, with average values of 3mm per month for fingernails and 1mm per month for toenails. A normal fingernail grows out completely in about 6 months, whereas it takes a toenail about 10 – 12 months (*Gupchup et al., 1999*).

The nail forms at approximately 10 weeks of intrauterine life from sole plate appearing on dorsum of each finger. At birth, a well-grown nail indicates maturity of the foetus. The perionychium refers to the nail and surrounding structures including the hyponychium, nail bed and nail fold (Figure (Fig.) 1). Eponychium refers to the soft tissue proximally on the dorsum of nail continuing to the dorsal skin and contributes to the nail shine (*Zook et al., 2002*).

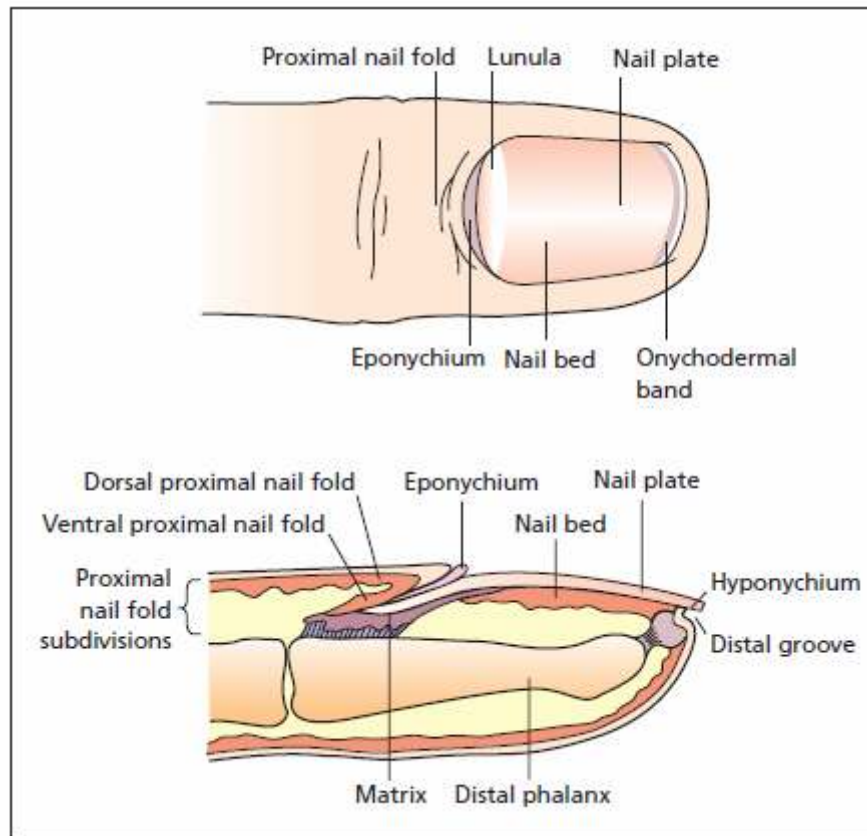


Fig. (1): Structure of a fingernail (*Achten and parent, 1983*).

The fine filamentous material attaching nail to eponychial fold is the nail vest. Underneath the nail plate there lies the nail bed. The white arc on the nail just distal to eponychium is the lunula. The nail bed distal to this is the sterile matrix and proximal to that is the germinal matrix (Fig. 2). The nail fold consists of the germinal matrix and eponychium (*Bajantri et al., 2011*).

Below the distal attachment of the nail with the pulp skin is the plug of keratinous mass called hyponychium which is

rich in polymorphs and lymphocytes which act as a barrier to infection. The term paronychia refers to the fold on each lateral aspect of the nail (Fig.2). Distal to the lunula, the nail becomes translucent and the underlying nail bed appears pink (*Bajantri and Bharathi, 2011*).

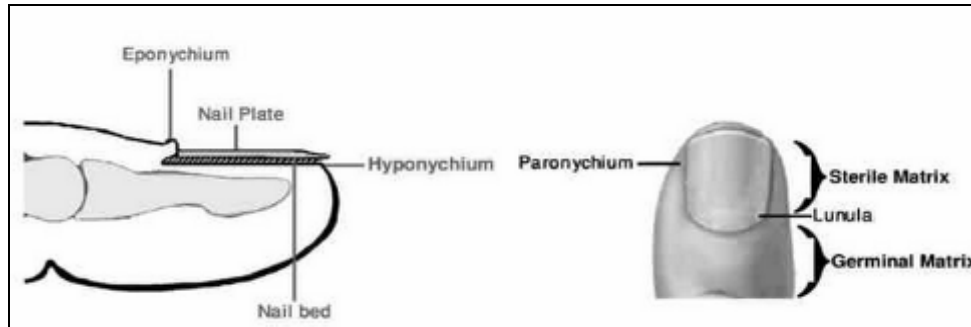


Fig. (2): Anatomy of the nail (*Bajantri and Bharathi, 2011*)

B. Anatomy of the nail:

Human fingernail gross anatomy consists of 3 structures. Starting from the outer structure, they are the nail plate, the nail bed, and the nail matrix (Fig.3). The nail is formed by the keratinous mass pressed between the nail bed and the eponychial fold and grows distally (*Bajantri and Bharathi, 2011*).

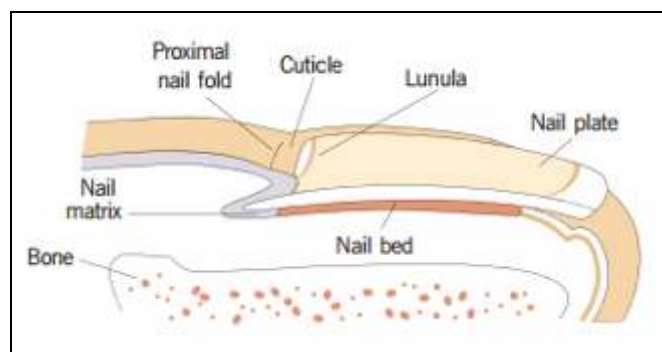


Fig. (3): Nail Architecture (*Gupchup et al., 1999*)

Anatomic structures of the nail include (from distal to proximal): Hyponychium, onychodermal band (ODB), nail bed, nail plate, lateral nail folds (LNF) (perionychium), lunula (distal part of the matrix), cuticle, nail matrix, proximal nail fold (PNF) (eponychium) (Fig. 4) (*Rich, 2005; Ximena and Gregor, 2006*).

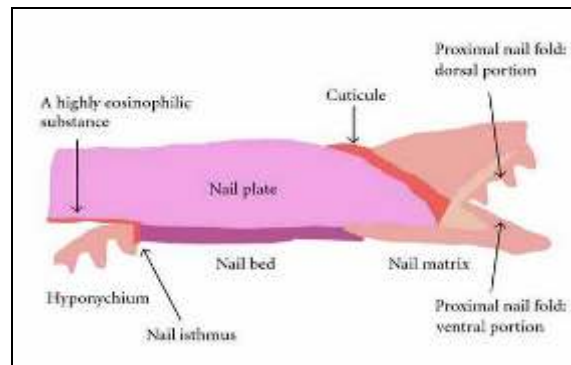


Fig. (4): The nail apparatus (*Naoki Oiso et al., 2012*)

1. Hyponychium:

The hyponychium is the cutaneous margin underlying free nail bordered distally by the distal groove. Distal groove (limiting furrow) is a cutaneous ridge demarcating the border between subungual structures and the finger pulp (*De-Berker et al., 2007*).

It is the portion of the nail unit that is distal to the nail bed and under the free edge of the nail plate. It is continuous with the volar skin of the digit. The hyponychium extends proximally to the distal groove and ODB (*Rich, 2005*). It represents the junction of the terminal nail bed with skin of the fingertip. The nail plate becomes non-adherent at this point and

extends from a variable distance over the tip of the finger (Fig. 6) (*Ximena and Gregor, 2006*).

It protects against the penetration of foreign bodies, dirt and the invasion of pathogens that cannot digest keratin. (*Ximena and Gregor, 2006; Haneke, 2006*).

2. Onychodermal band:

The ODB is the distal region of the nail unit, approximately 1-1.5 mm in width which marks the transition of the nail bed to the hyponychium. The nail isthmus, which clinically corresponds to the ODB, is responsible for the strong adherence between the nail plate and the nail bed and is the site of primary damage in onycholysis (*Tosti et al., 1996*).

For several authors, the ODB is described as 2 sub-bands of tonal values which are slightly milky and pink from proximal to distal. The 2 sub-bands show individual variation and are often scarcely visible. It has been stated that the proximal sub-band (the white band of Pinkus) corresponds histologically to the attachment of the compact orthokeratotic layer of the hyponychium to the nail plate (*Perrin, 2008*).

The white appearance of the central band represents the transmission of light from the digit tip through the stratum corneum and up through the nail. If the digit is placed against a black surface, the band appears dark (Fig. 5) (*De-Berker et al., 2007*).

The integrity of the ODB is important for the health of the nail bed (*Haneke, 2006*). It represents the first barrier to

penetration of materials to beneath the nail plate. Disruption of this barrier by disease or trauma precipitates a range of further events affecting the nail bed (*De-Berker et al., 2007*).

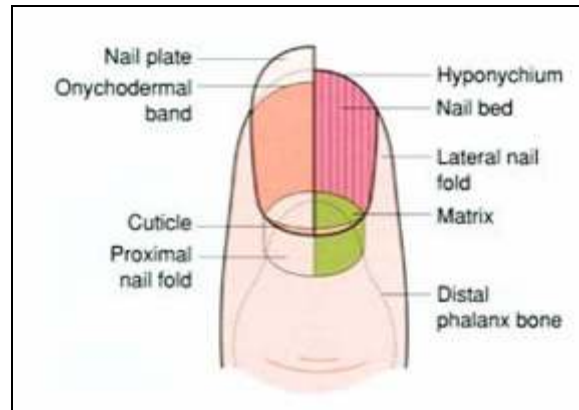


Fig. (5): Nail structure showing hyponychium and ODB (*Rich, 2005*).

3. Nail bed:

The nail bed (sterile matrix) is the vascular bed upon which the nail rests extending from the lunula to the hyponychium. This is the major territory seen through the nail plate (*Tosti et al., 1996*).

The nail bed dermis lies beneath the nail plate and derives its pink color from its rich vascular supply (*Rich, 2005*). Avulsion of the nail plate reveals a pattern of longitudinal epidermal ridges (Fig.6-a & 6-b) stretching to the lanula (*Baran, 1996*).



Fig. (6-a): Nail avulsion showing longitudinal ridges in nail bed
(*Baran and Dawber, 2012*).

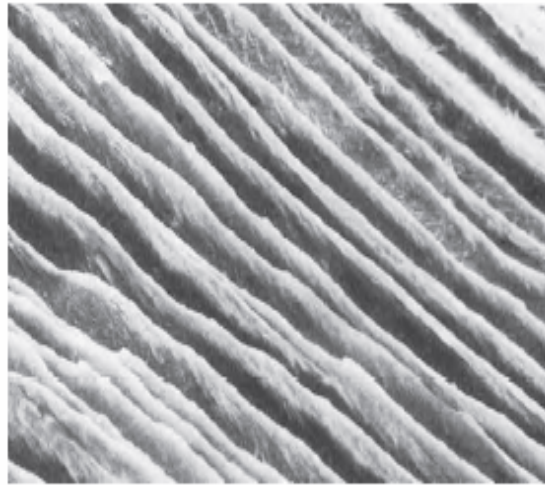


Fig. (6-b): Electron micrograph of the nail bed demonstrating longitudinal ridges
(*Baran and Dawber, 2012*).

On the underside of the nail plate is a complementary set of ridges, which has led to the description of the nail being led up on the nail bed as if on rails (Fig.7). The free edge of a nail loses the ridges, suggesting that they are softer than the main nail plate structure (*De-Berker et al., 2007*).



Fig. (7): Undersurface of the nail plate showing longitudinal ridges
(*Baran and Dawber, 2012*).

The function of the nail bed is to allow the nail plate to grow longitudinally keeping it strongly attached to it (*Tosti et al., 1996*).

4. Nail plate:

It is the largest durable keratinized structure which continues growing throughout life (*De-Berker et al., 2007*). The nail plate, commonly called “the nail”, is a mechanically and chemically resistant sheet of compacted keratinized cells. It is semi-transparent and has a smooth, shiny surface (Fig.8). The surface becomes ridged and less shiny with age (*Haneke, 2006*).



Fig. (8): Normal fingernail plate (*Piraccini, 2014*)

The nail plate is a thin (0.25 - 0.6 mm) for fingernails and up to 1.3mm for toenails), hard, yet slightly elastic, translucent, convex structure. It is made up of approximately 25 layers of dead

keratinized, flattened cells. They are tightly bound to one another via numerous intercellular links, membrane-coating granules and desmosomes, randomly arranged on the lateral sides of plasma membranes (*Zatz et al., 1999*).

The proximal matrix is responsible for the nail shine. Surgical or traumatic damage to it, may result in a dull-rough surface and/or nail dystrophy (*Haneke, 2006*). Nail hardness is due to the calcium it contains (0.1%) and disulfide bonds found in the keratin in the nail plate (*Rich, 2005*).

The nail plate is “pushed” out by two factors: (1) the matrix which makes a new plate; (2) the nail bed which moves slowly, parallel to the direction of the nail growth, toward the tiny grooves and ridges of the inferior border of the nail plate (*Perrin, 2008*).

The dorsal and ventral aspects of the nail plate are viewed as bilaminar, hyperechoic (white), parallel bands with a virtual hypo-echoic (dark grey) space between them called the interpolate space (*Ximena and Gregor, 2006*).

The dorsal part, 0.08–0.1 mm thick, consisting of tight, flattened cells, whose keratin filaments are oriented parallel and perpendicular to the growth axis (*Piraccini, 2014*).