NailKnowledge

THE NAIL UNIT

ESSENTIAL ANATOMY AND PHYSIOLOGY FOR THE BEAUTY INDUSTRY

WRITTEN BY
TRACY ANNE SHELVERTON

Thanks to Doug Schoon especially for Figures 32 & 33 and Vitaly Solomonoff for keeping me on the straight and narrow while writing this book but also for their contribution to my knowledge over the years.

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Introduction

This eBook is designed for both professional nail technicians who are committed to the care and well-being of their client's fingernails and anyone interested in how the nail unit works and functions.

By acquiring a deep understanding of the entire nail unit you can understand how to ensure its health.

In this eBook, we examine the fundamentals of nail anatomy, exploring the structures that make up the nail unit and their functions.

By understanding these components, you will be equipped with the knowledge to maintain and enhance their health.

We will explore the nail plate, nail bed, and surrounding tissues, each one of which plays a unique role in the health of the nail.

The nail plate, visible as the hard part of the nail, is more than just a canvas for nail polish or nail art; it serves as a natural protective shield.

The nail bed, lying beneath, is vital for supporting and nourishing the nail plate, and the surrounding tissues, including the cuticle and nail folds, which act as protective barriers against infections and injuries.

Maintaining the health of these structures is essential. Every action, from the simplest manicure to more complex treatments, has a direct impact on the nail's health.

Whether you are a nail technician or a nail enthusiast, with the knowledge contained within this eBook, you can ensure everything you do results in not just beautiful nails but healthy ones too.

Anatomy Terms

When discussing anatomy there are several important terms used that indicate the position on the body.

These are Proximal, Distal, Lateral, Dorsal and Ventral.

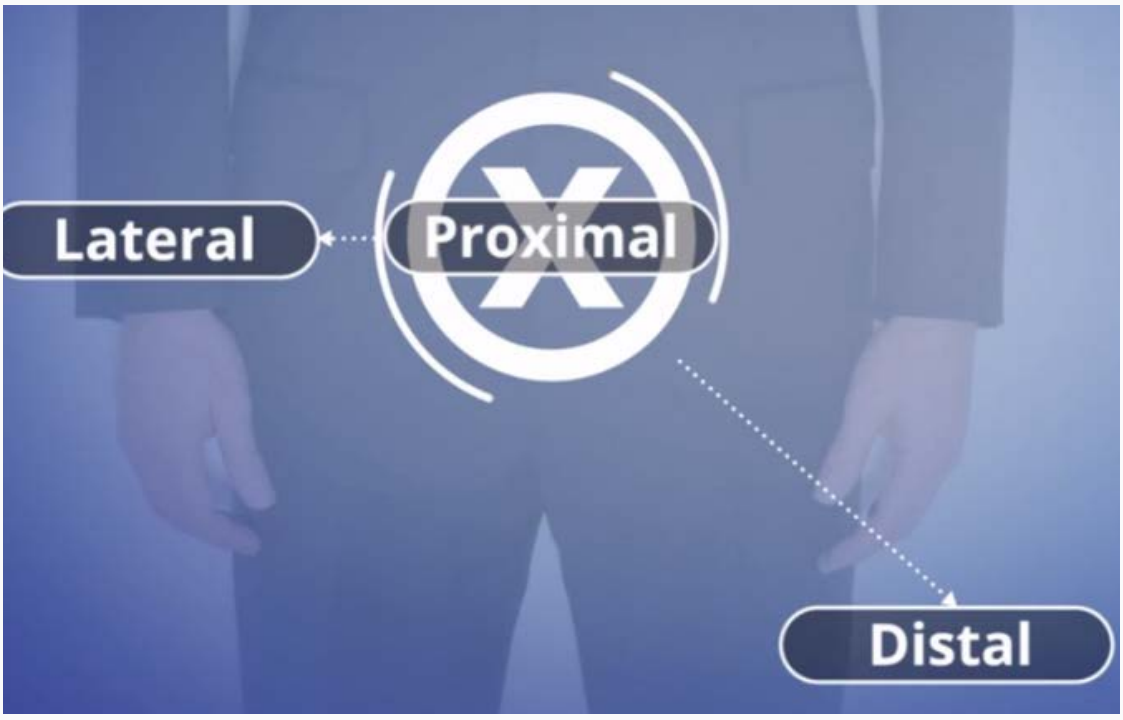
Each of these words indicate the position on the body in relation to their closeness or proximity to the centre of the body, the point of attachment or other body parts.

We will use these terms throughout this eBook so having an clear understanding will ensure your comprehension of where each part of the Nail Unit is located.

Proximal is the term used for being nearer to the centre of the body or point of attachment. Think ‘in the proximity of’ or ‘closer to’ the centre.

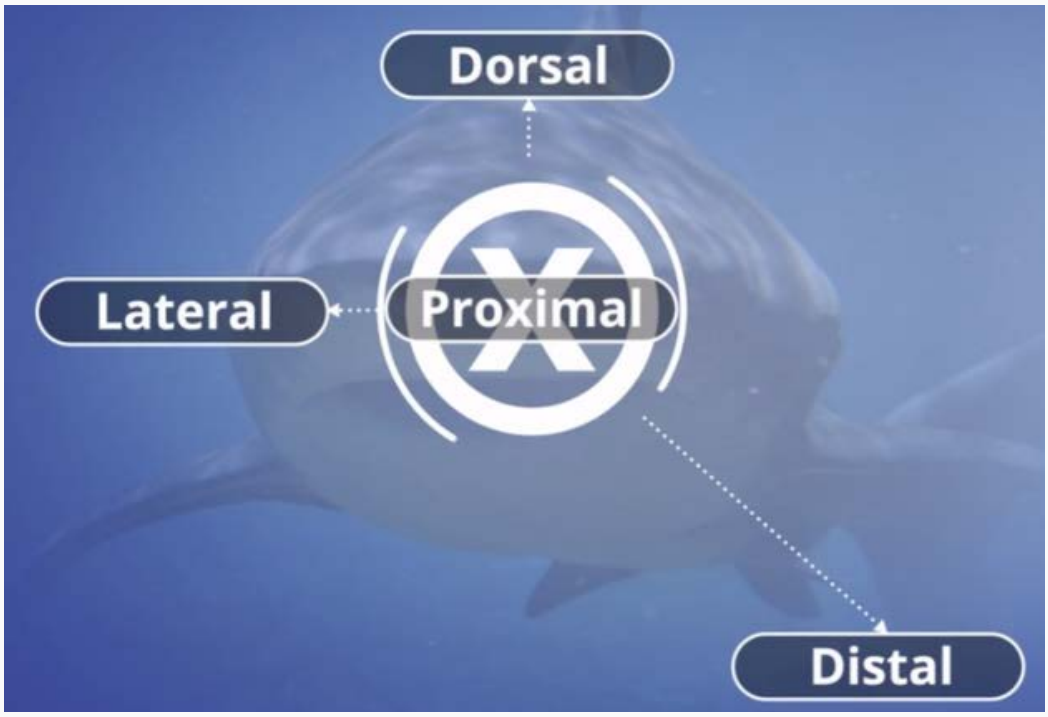
Distal is the opposite of proximal, meaning further away from the center of the body or point of attachment. Think at a ‘distance’

Lateral means to the side. For example our arms are lateral to our body.

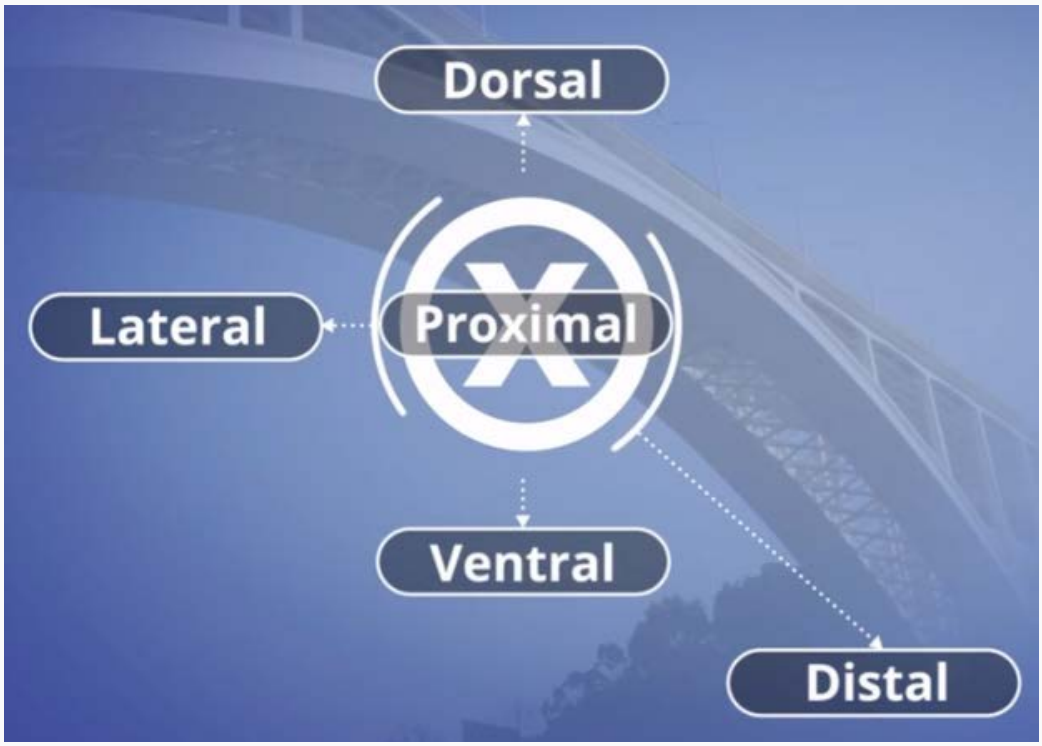


Anatomy Terms

Dorsal means above or on the upper side. Remember this by thinking of the dorsal fin of a shark, which is positioned above the shark.



Vental is the opposite of Dorsal, meaning on the underside.



An Overview of the Nail Unit

Before we delve into the functions of each part of the Nail Unit, we will first highlight them on the finger, so you can understand their location.

Below is an exploded view of the nail unit. Understanding the location and structure of these elements is the first step towards mastering nail care.

As we progress, keep this visual reference in mind.

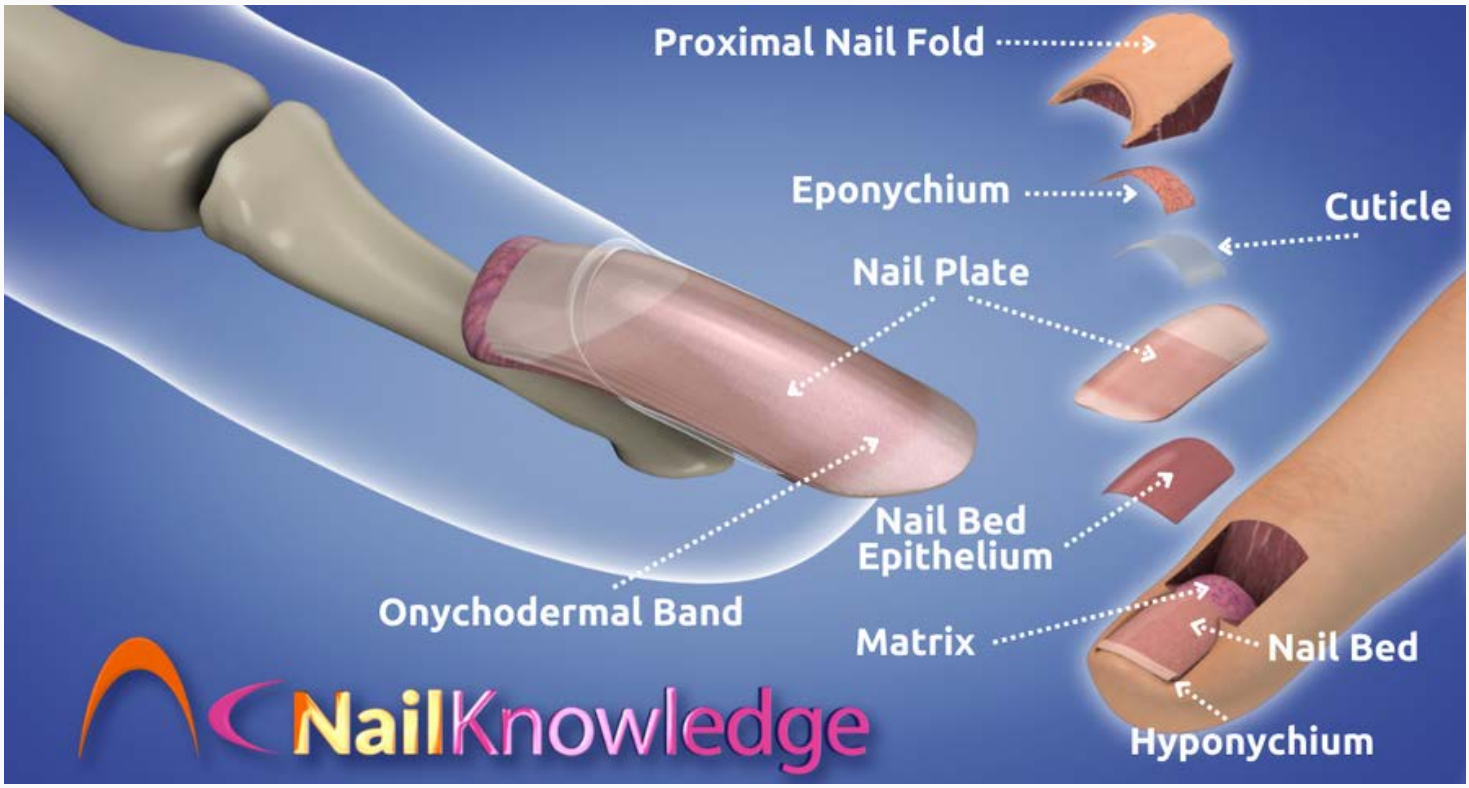


Figure 1: An exploded view of the finger's nail unit.

Moving from top to bottom of this exploded view of the finger and nail unit:

Proximal nail fold

This is a fold of skin protecting the delicate structures that lie beneath it. It protects one of the most important nail seals of the nail unit - the cuticle.

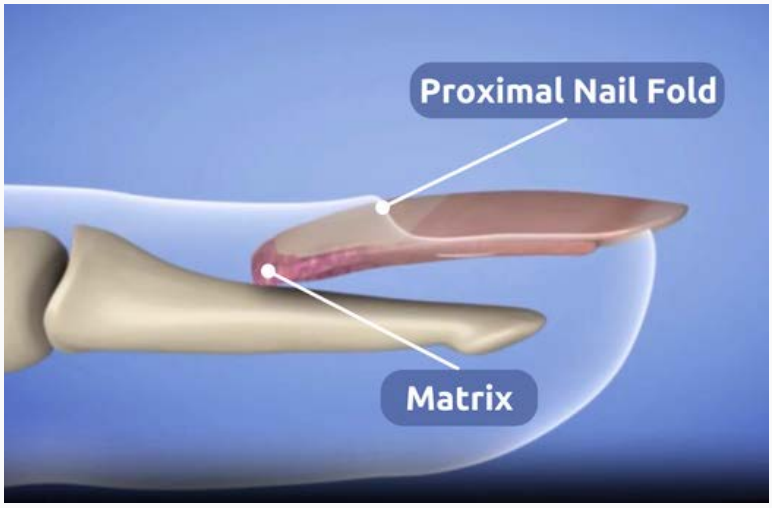


Figure 2: The proximal nail fold plays an important role in protecting the nail matrix.

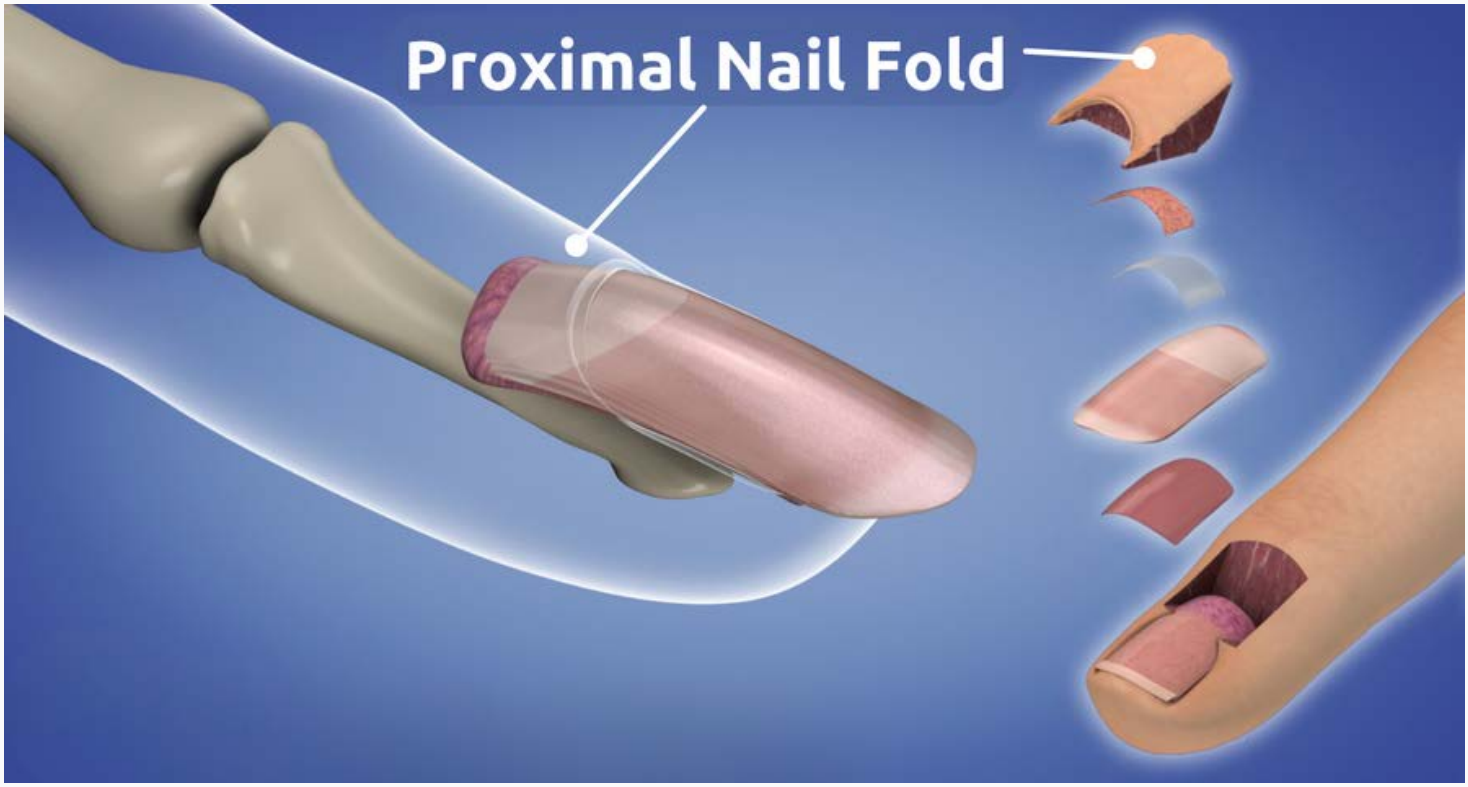


Figure 3: The proximal nail fold is the top most part of the nail unit.

Eponychium

Underneath the proximal nail fold is the eponychium. This is a specialised area attached on the ventral (underside) of the proximal nail fold that sheds the thin layer of non-living cells called the cuticle.

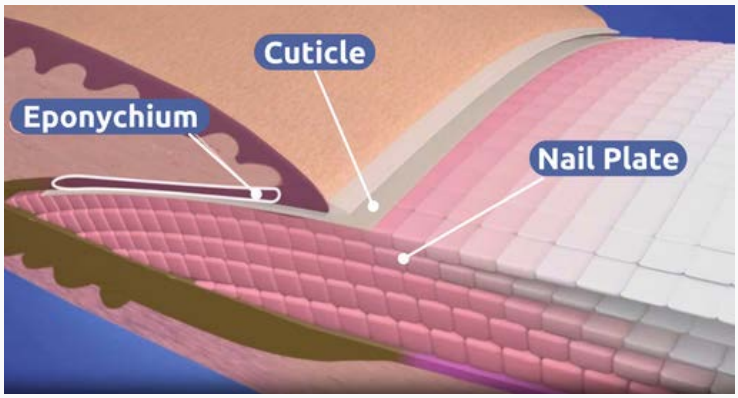


Figure 4: The eponychium forms the cuticle. The cuticle functions as a barrier, sealing the nail plate and proximal nail fold together.

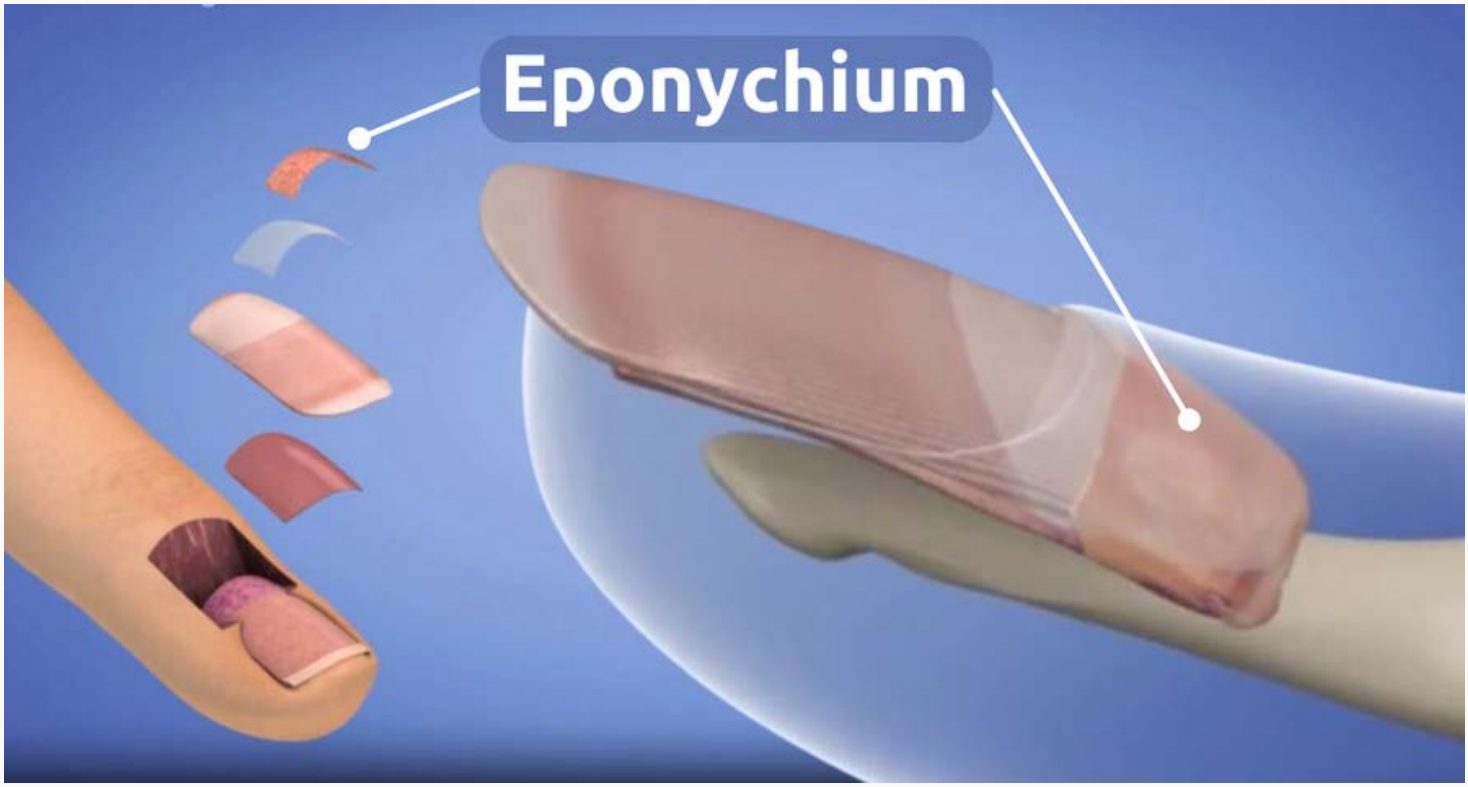


Figure 5: The eponychium which creates the cuticle is on the ventral side of the proximal nail fold.

Cuticle

The cuticle is one of the four guardian seals of the nail unit. This single layer of non-living skin cells gets help from the proximal nail fold, and together they form one of the most important seals of the nail unit.

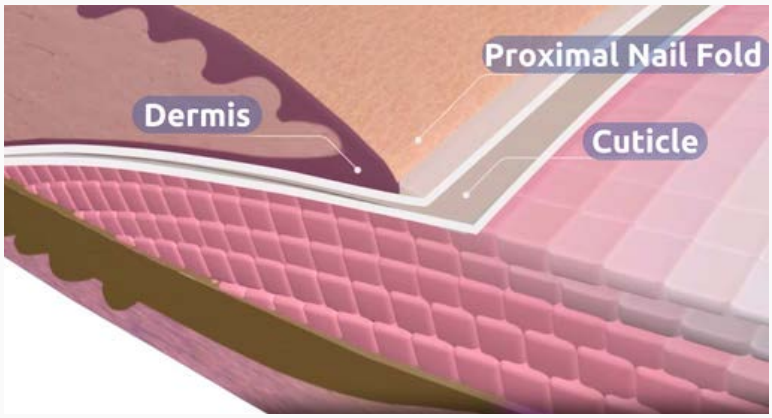


Figure 6: The position of the cuticle as it emerges from beneath the proximal nail fold, the cuticle is produced by the eponychium.

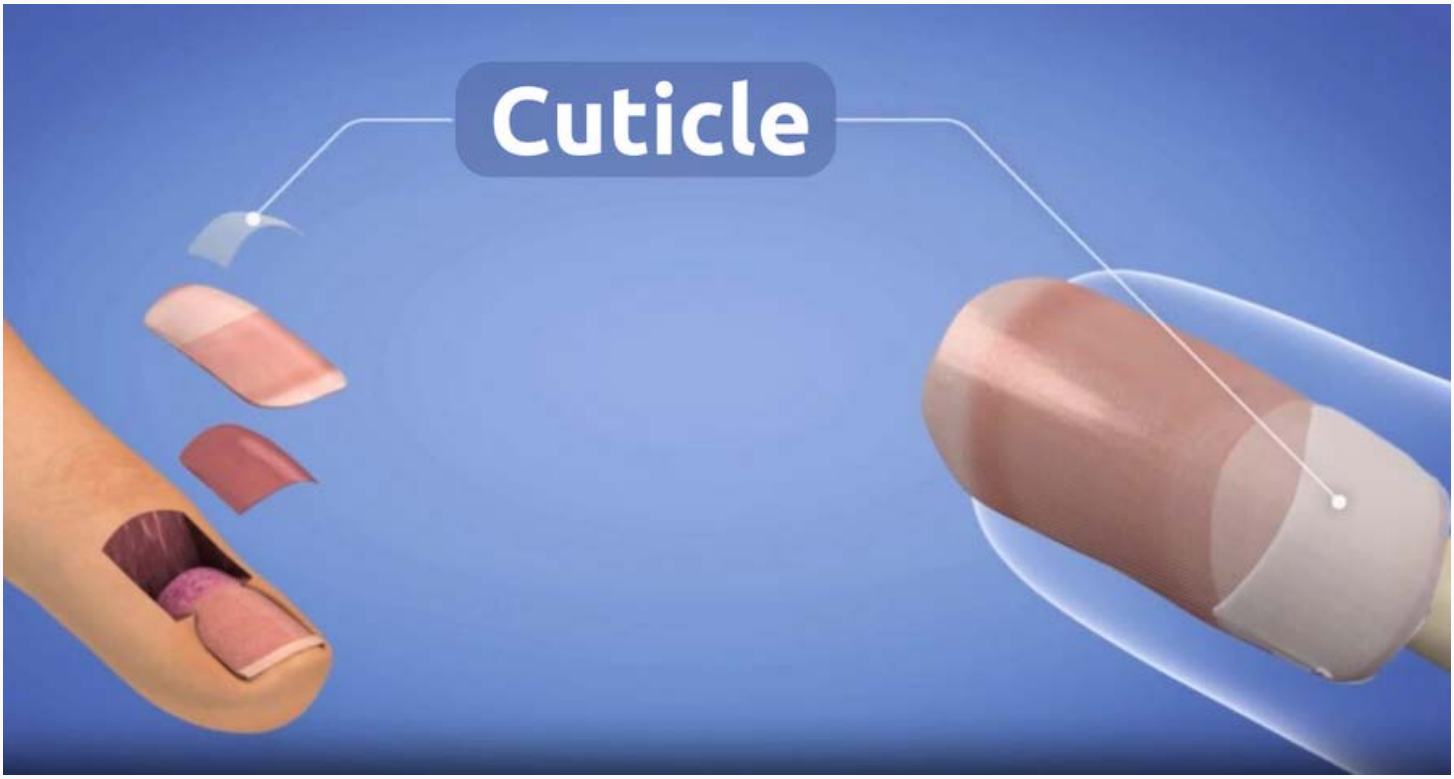


Figure 7: The cuticle has a very important, protective function.

The Nail Plate

A structure of layers of hard, keratin filled cells that protect the underlying bone and provide a rigidity to the end of the fingers.

Figure 8: The nail plate is translucent showing the colour of the nail bed beneath it.

Figure 9: The nail plate is a hard protective shield for the end of the finger, protecting the bone and the sensitive nail unit structures below it.

Onychodermal Band

The onychodermal band is the "natural smile line" of the nail unit, where nail bed epithelium bunches up to pass through the tight seal of the hyponychium creating a greyish line at the edge of the nail bed under the free edge of the nail plate.

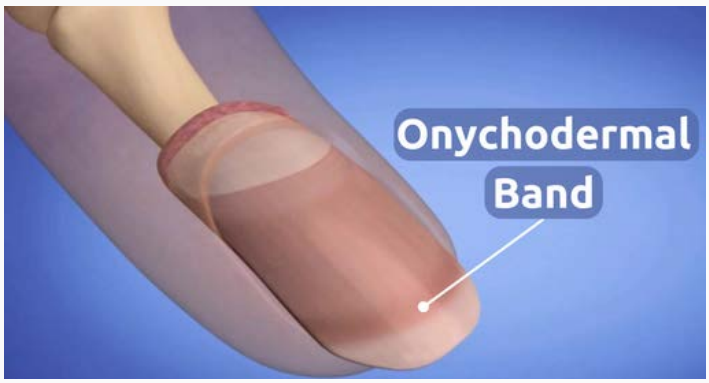


Figure 10: The onychodermal band is located at the underside of the free edge of the nail.

Figure 11: Visible through the nail plate is the onychodermal band, where the nail bed epithelium bunches up before passing the hyponychium.

Lunula

The lunula is the distal edge of the nail matrix and is the half-moon shape at the proximal nail fold. It is not always visible through the nail plate but its almost always visible on the thumbs.

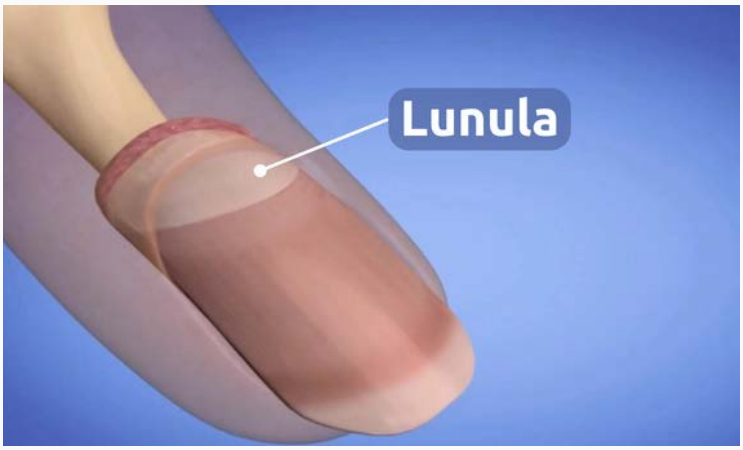


Figure 12: The lunula appears white, which is due to the immature nail plate cells, still full of keratin.

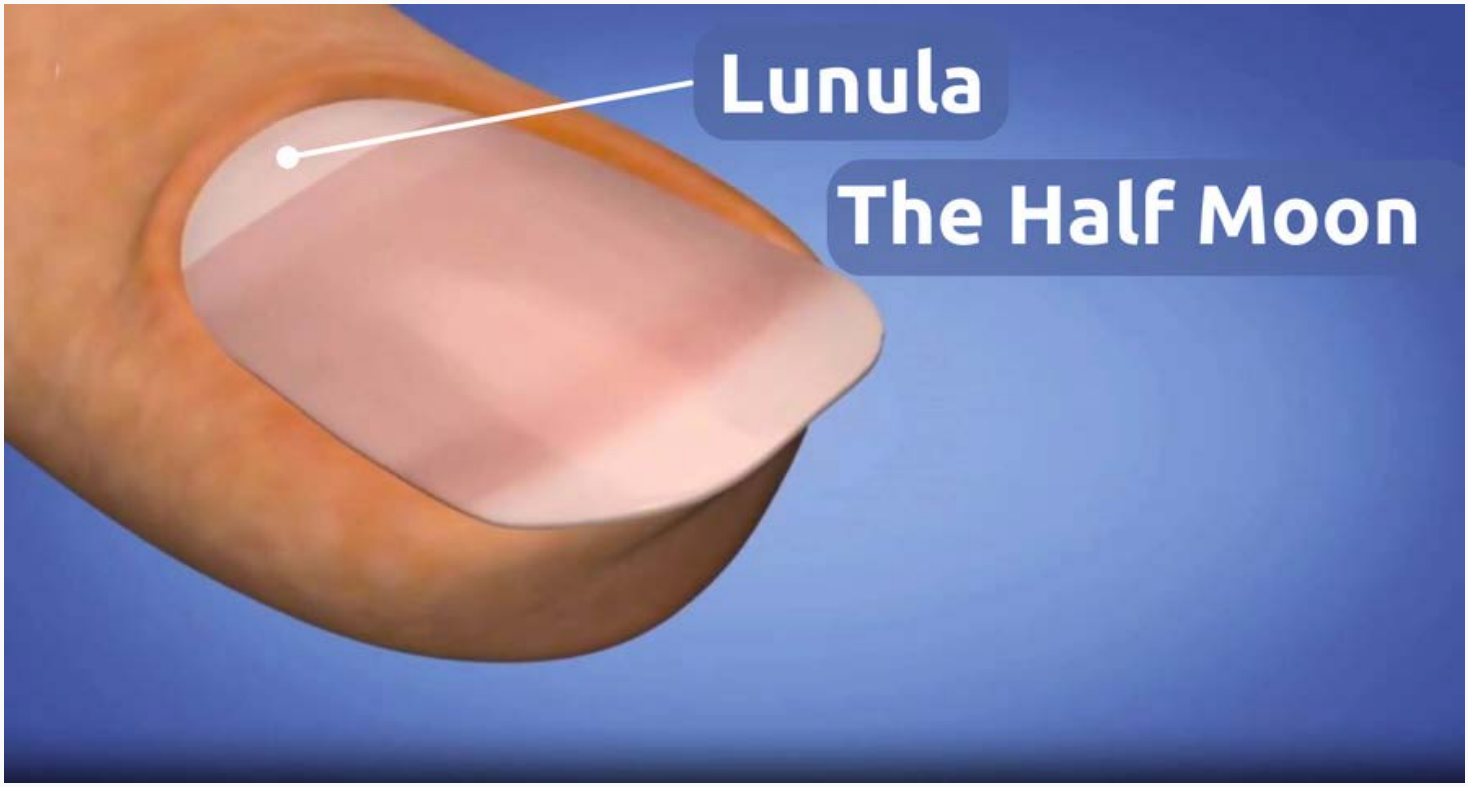


Figure 13: Visible most commonly on the thumbs is the lunula, which is the distal end of the nail matrix visible through the nail plate.

Nail Bed Epithelium

A thin and specialised layer of non-living skin cells created by the matrix that attaches the nail plate to the nail bed and making movement of the nail plate possible and providing another important seal under the free edge.

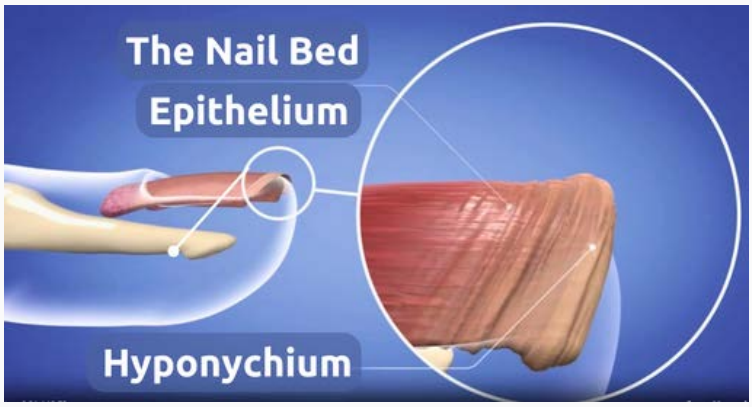


Figure 14: The nail bed epithelium bunches up as it meets the hyponychium, this bunching can be seen through the nail plate as the onychodermal band.

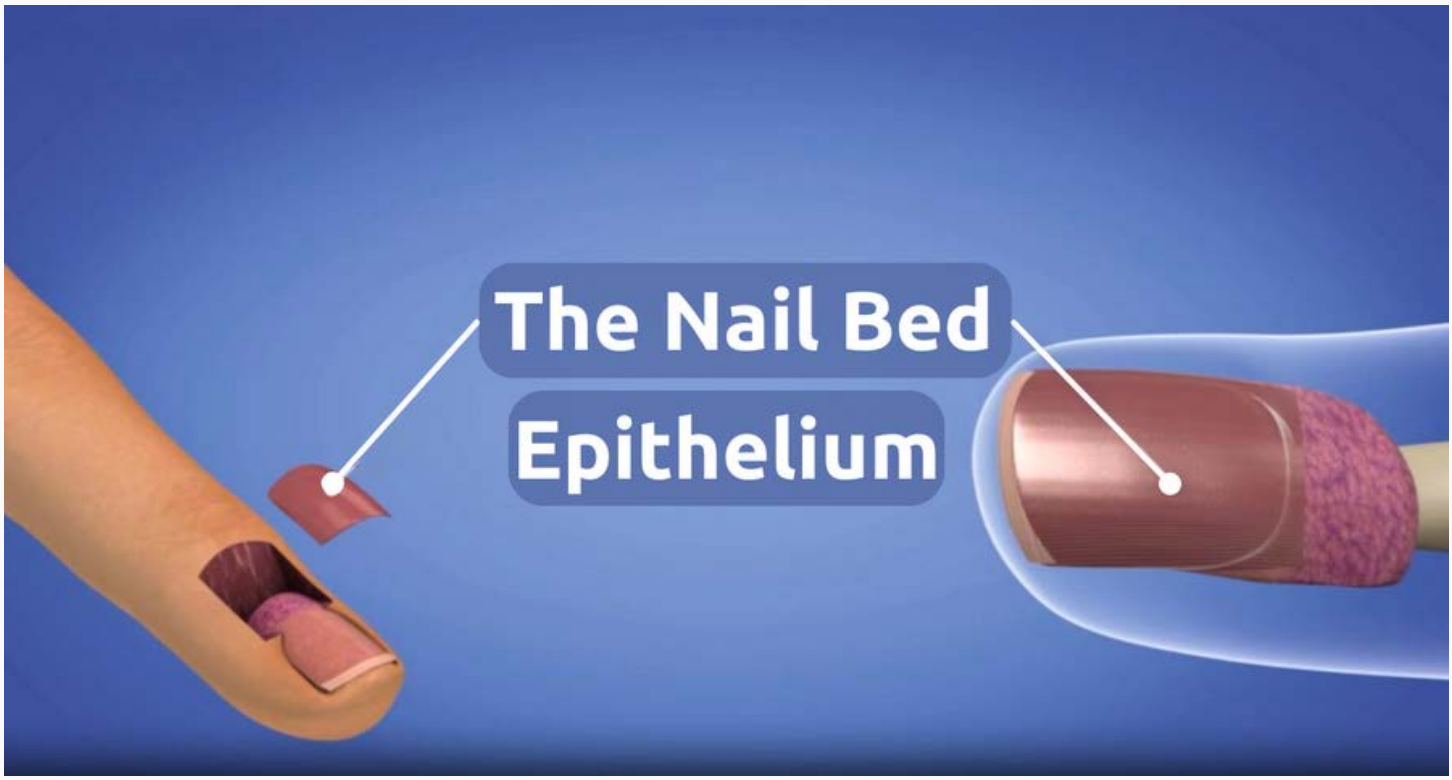


Figure 15: Connecting the nail plate to the underlying nail bed is a specialised layer of non-living cells called the nail bed epithelium.

Nail Bed

An area rich in blood vessels and nerve endings under the nail plate providing essential moisture to keep the nail plate healthy and efficient.

Figure 16: The nail bed is crucial to the health and maintenance of your nails .

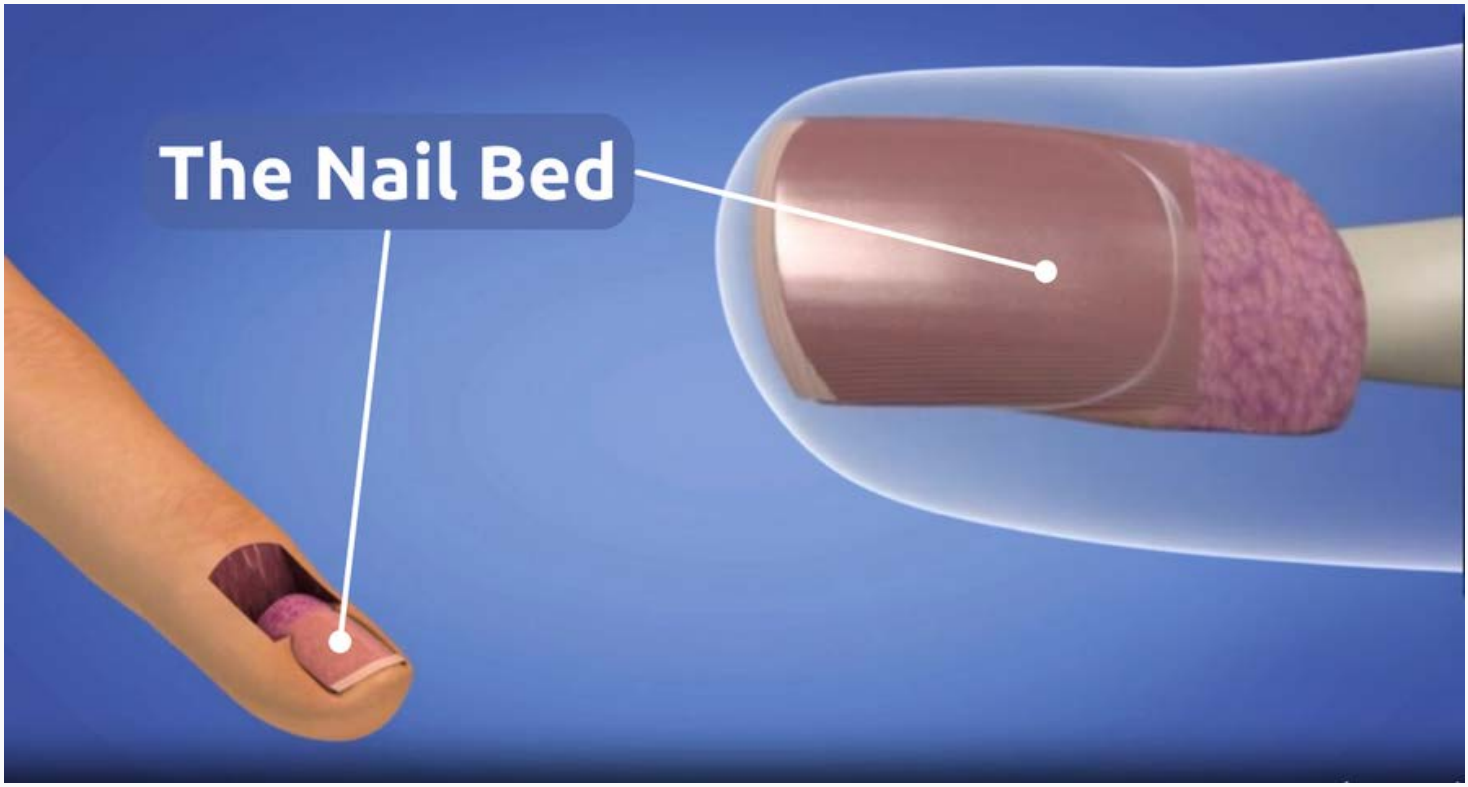


Figure 17: The nail bed provides support, lipids and lubricants to the growing nail.

Nail Matrix

The nail matrix is the most important structure within the nail unit. This is where new nail plate cells are created and as these new cells are created, older cells are pushed forward and the nail plate grows. The shape and size of the matrix determines the thickness and width of the nail.

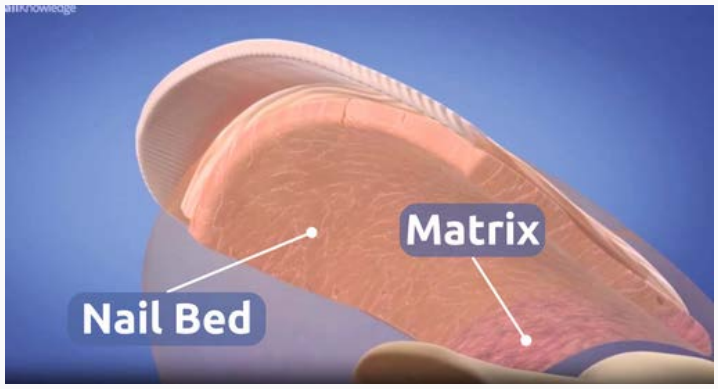


Figure 18: The nail matrix is the most important part of the nail unit.

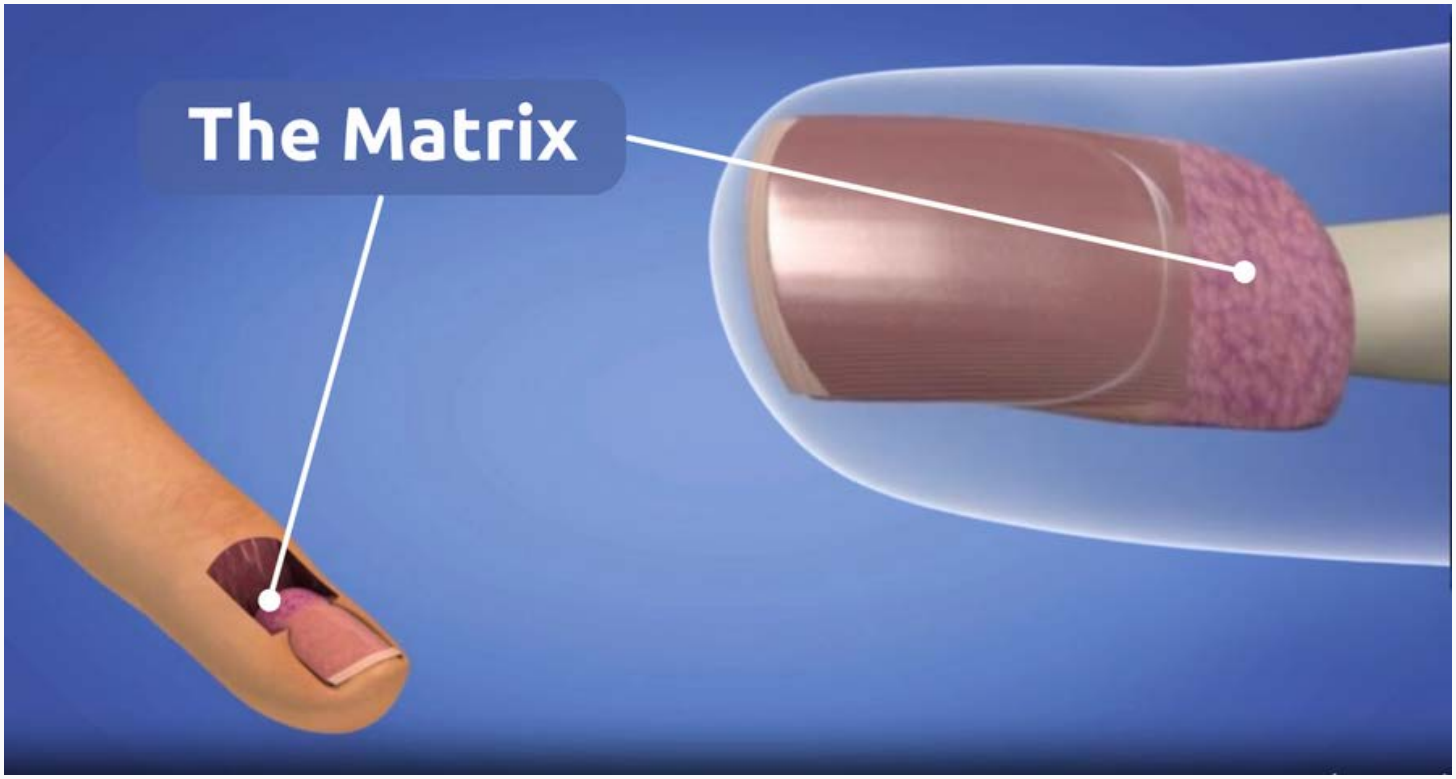


Figure 19: The nail matirx is responsible for the production of the nail plate.

Hyponychium

The hyponychium is one of the four guardian seals of the nail unit. This is an area under the free edge of the nail that provides a strong seal to protect the nail bed.

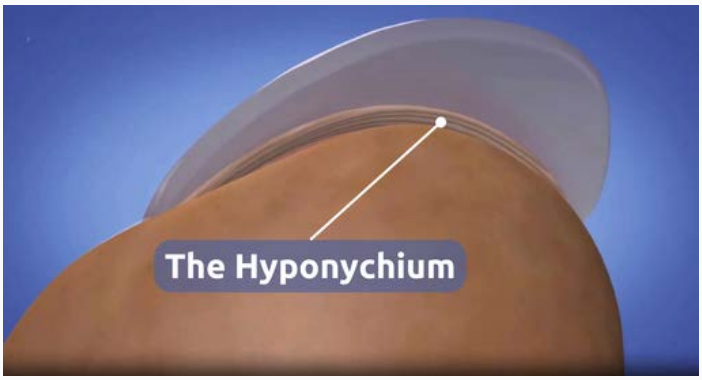


Figure 20: The hyponychium is the nail seal at the distal end of the finger, providing a strong protective barrier under the nail's free edge.

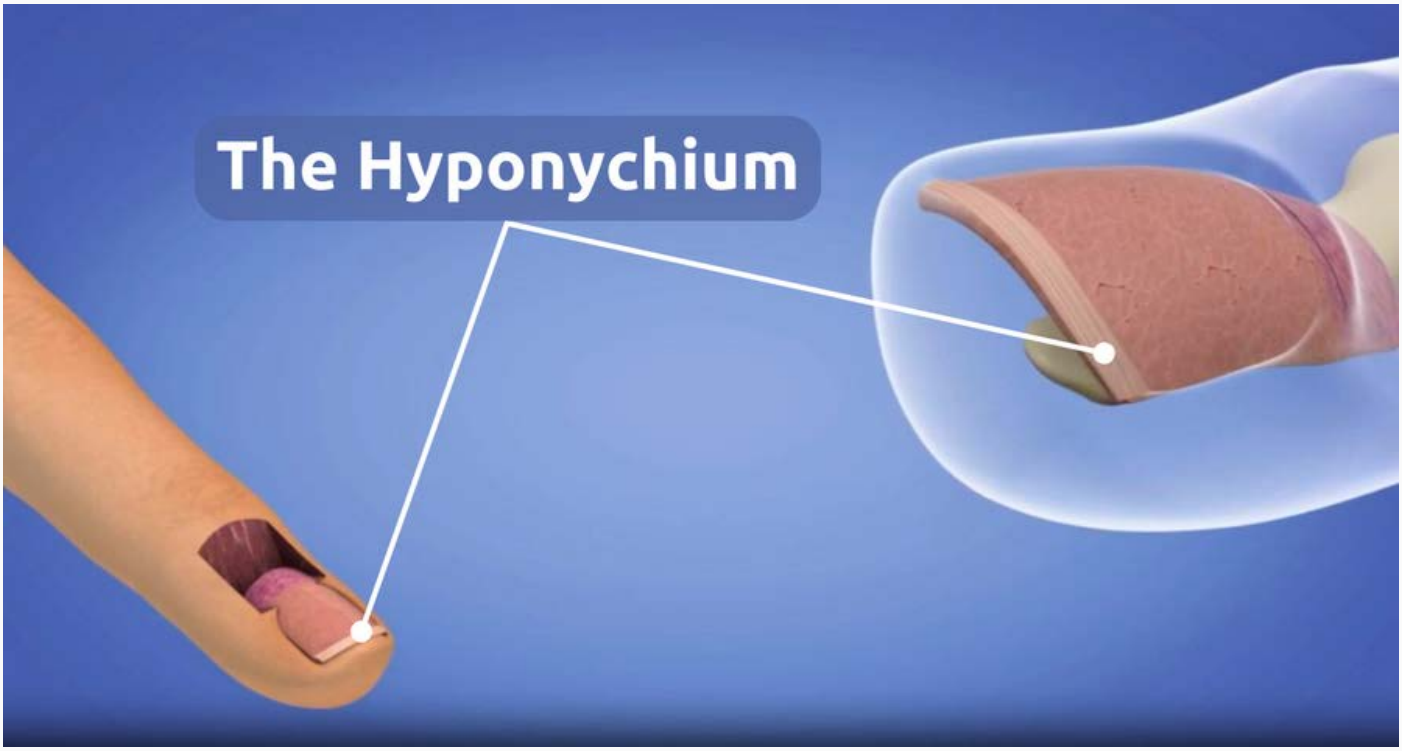


Figure 21: Located under the free edge is the hyponychium

Lateral Nail Folds

Located on either side of the nail plate, these folds are protective walls that guide and support the nail as it grows. They form a crucial component of the nail's protective barrier, safeguarding the edges of the nail plate from environmental damage and pathogens.

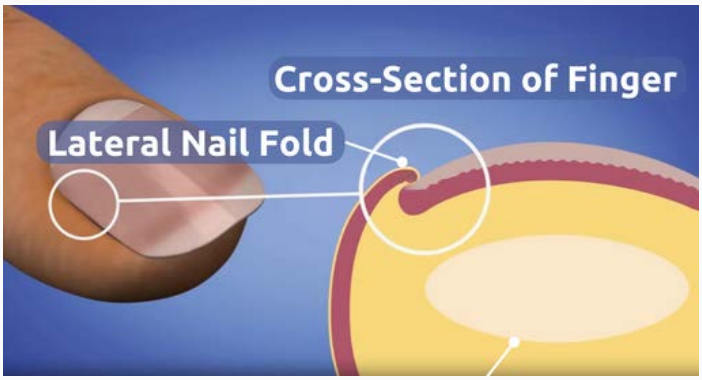


Figure 22: The lateral nail folds are two of the four guardian seals and guide the nail as it moves along the nail bed.

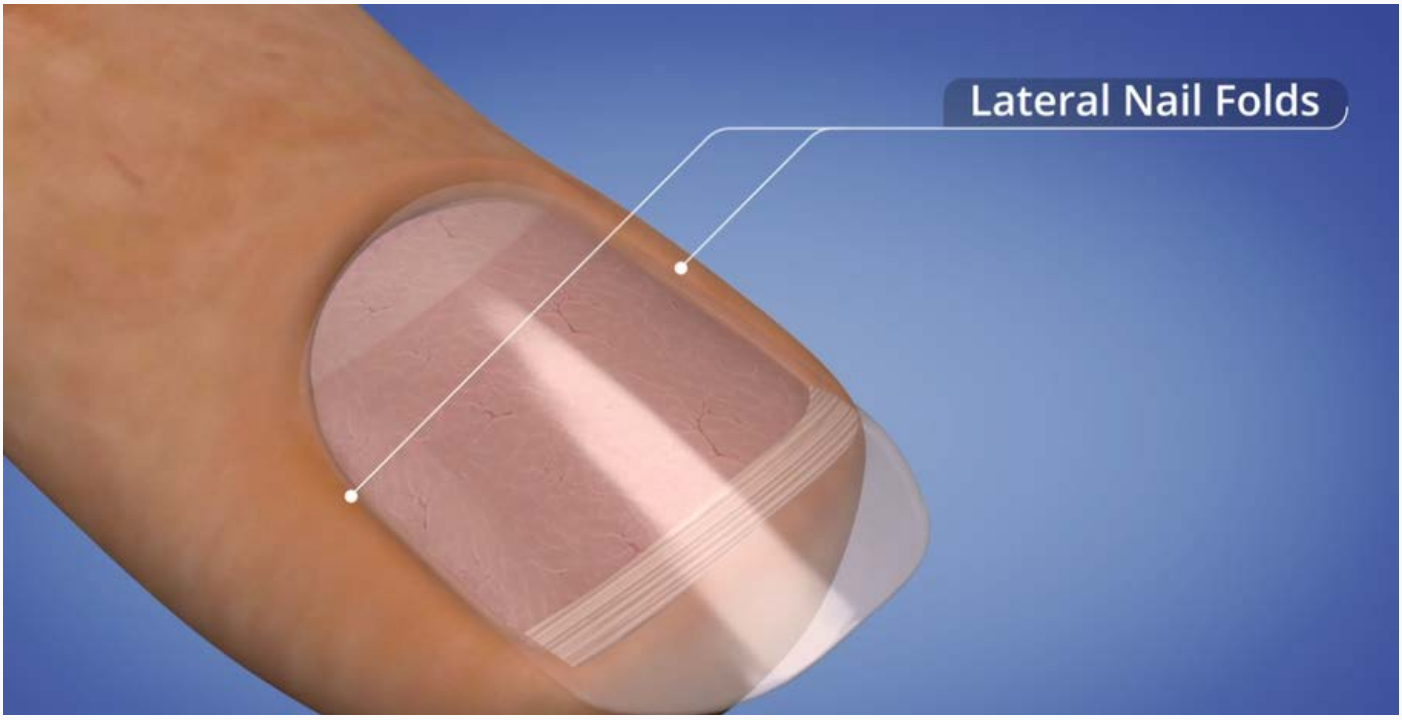


Figure 23: The lateral nail folds are two of the nail's guardian seals. They protect the sides of the nail and the nail bed from environmental damage and pathogens.

Proximal Nail Fold

The proximal nail fold plays a crucial role in maintaining healthy nails. It encompasses the layer of epidermis and dermis that covers the nail matrix, extending from the proximal edge of the nail plate to the first joint of the finger. When the proximal nail fold meets the nail plate, it folds back on itself, forming a colorless, keratinised frame of the epidermis. Together with the underlying cuticle, this frame creates a significant nail seal at the proximal end of the nail plate.

By sealing in the nail matrix along with the lateral nail folds and the hyponychium, the proximal nail fold acts as a protective barrier, preventing infections from infiltrating under the nail plate, reaching the nail matrix, and potentially extending down to the bone or distal phalanx of the finger. On the ventral side of the proximal nail fold, there is a specialised area called the eponychium, responsible for creating the cuticle. Cutting or aggressive filing into the proximal nail fold is not recommended.

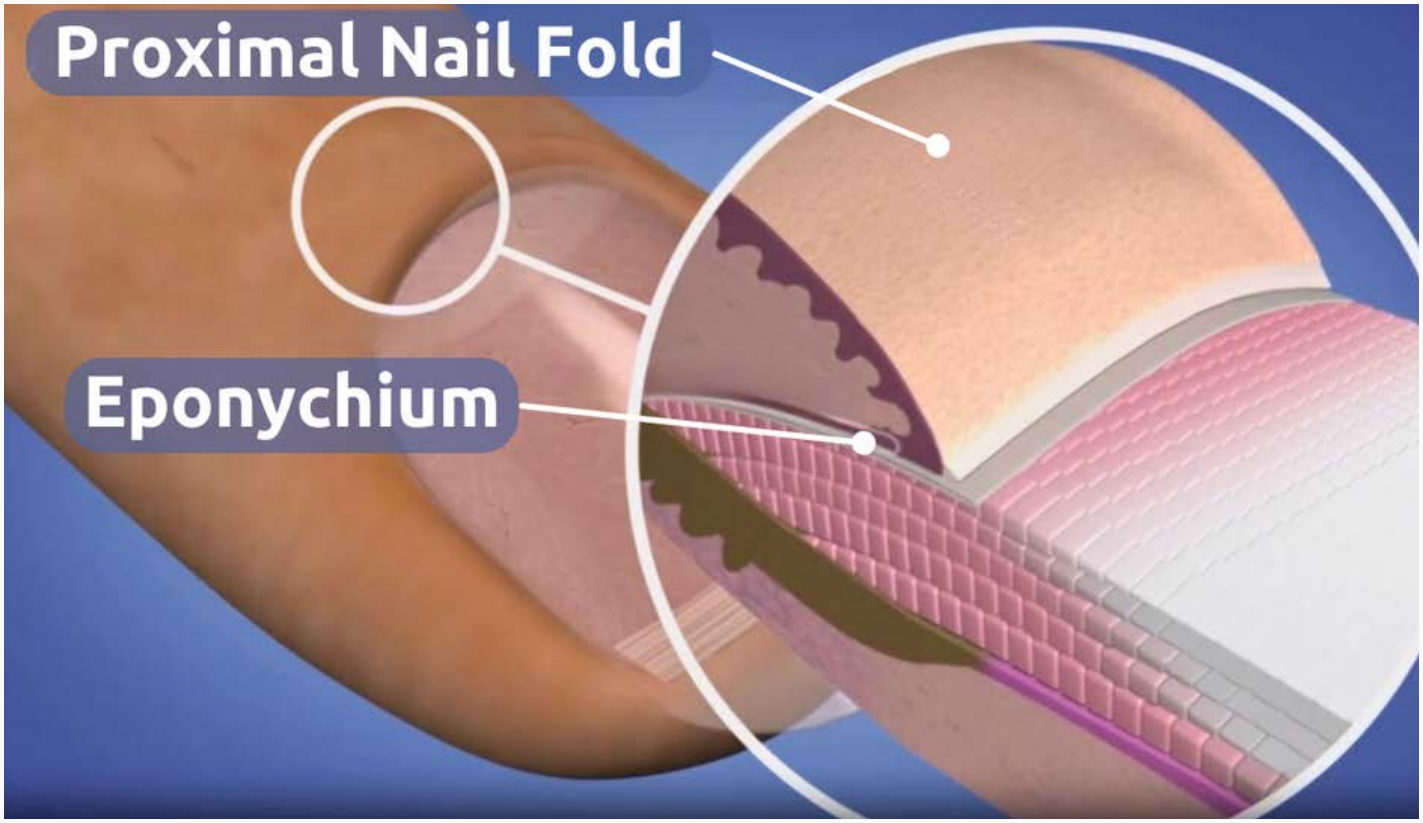


Figure 24: The proximal nail fold and the eponychium which creates the cuticle.

This seal is essential for nail health, and removing it exposes the epidermis behind the keratinised frame, increasing the risk of infection.

If removed or damaged, the skin's defence mechanism may cause the proximal nail fold to grow back thicker. The proximal nail fold, along with its colourless keratinised frame, should be left intact. However, any excess cuticle that extends beyond this frame can be safely removed.

While the proximal nail fold and its frame are capable of regenerating if cut, continuous cutting can lead to thickening, infections, and scar tissue formation as the skin tries to protect itself. Therefore, it is best to avoid cutting into the proximal nail fold to help it maintain its natural function and integrity. It takes time for this region of the nail unit to recover, sometimes all we can hope for is an improvement. Just because removing the keratin seal at the proximal nail fold 'looks good' doesn't mean it's wise to do it.

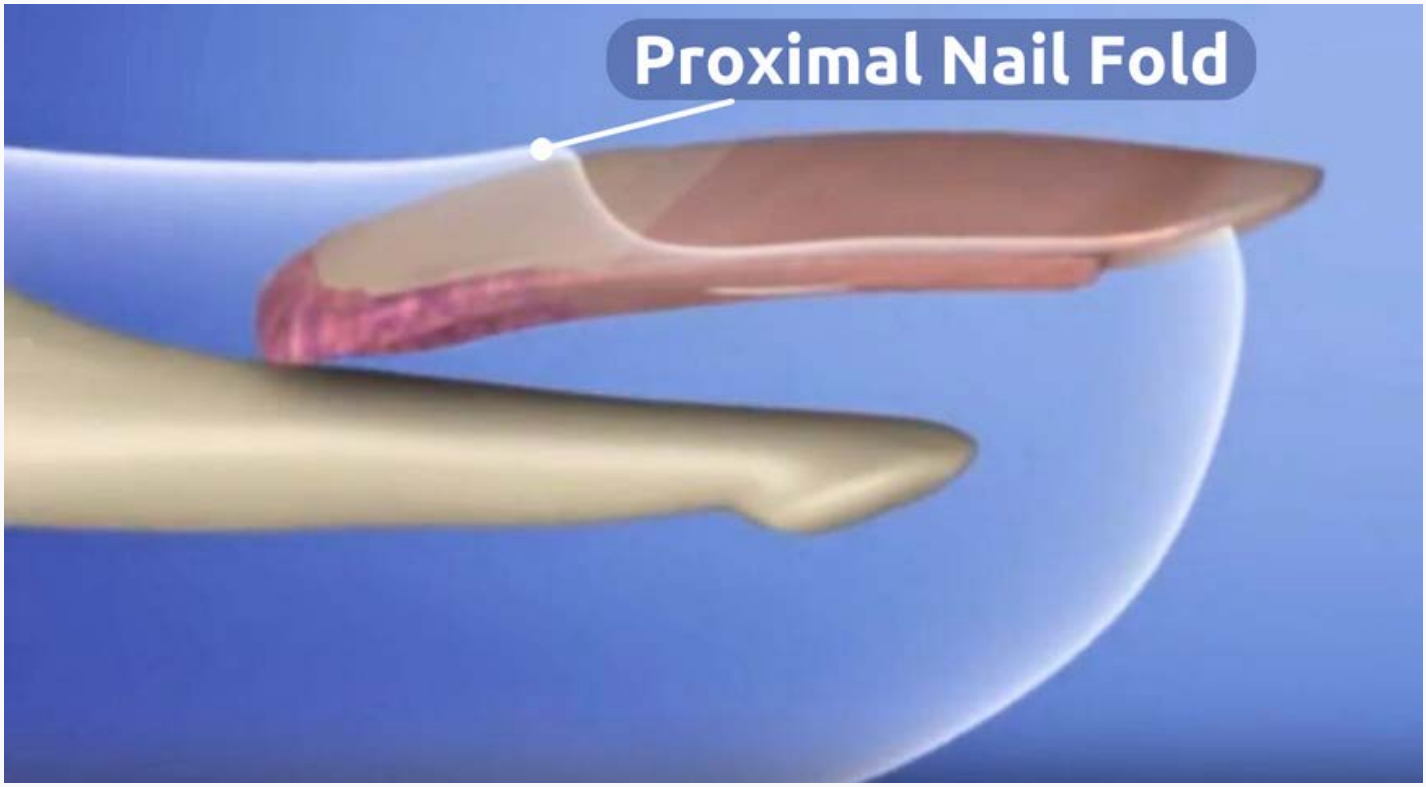


Figure 25: The proximal nail fold with its frame of keratinised skin where it meets the emerging cuticle.

Eponychium

The eponychium, residing on the ventral side of the proximal nail fold, is a specialised area of skin cells responsible for the production of the cuticle. This living skin layer extends from the nail matrix, reaching almost up to the frame of keratinised epidermis at the base of the nail plate. It's essential to differentiate between the eponychium and the cuticle as they both serve distinctly different roles.

While the eponychium is the living skin that generates the cuticle, the cuticle itself is composed of non-living skin cells positioned between the nail plate and the proximal nail fold, derived from the eponychium. The eponychium's primary function is to create the cuticle between the epidermis of the proximal nail fold and the nail plate, forming an integral part of the nail's protective barrier.

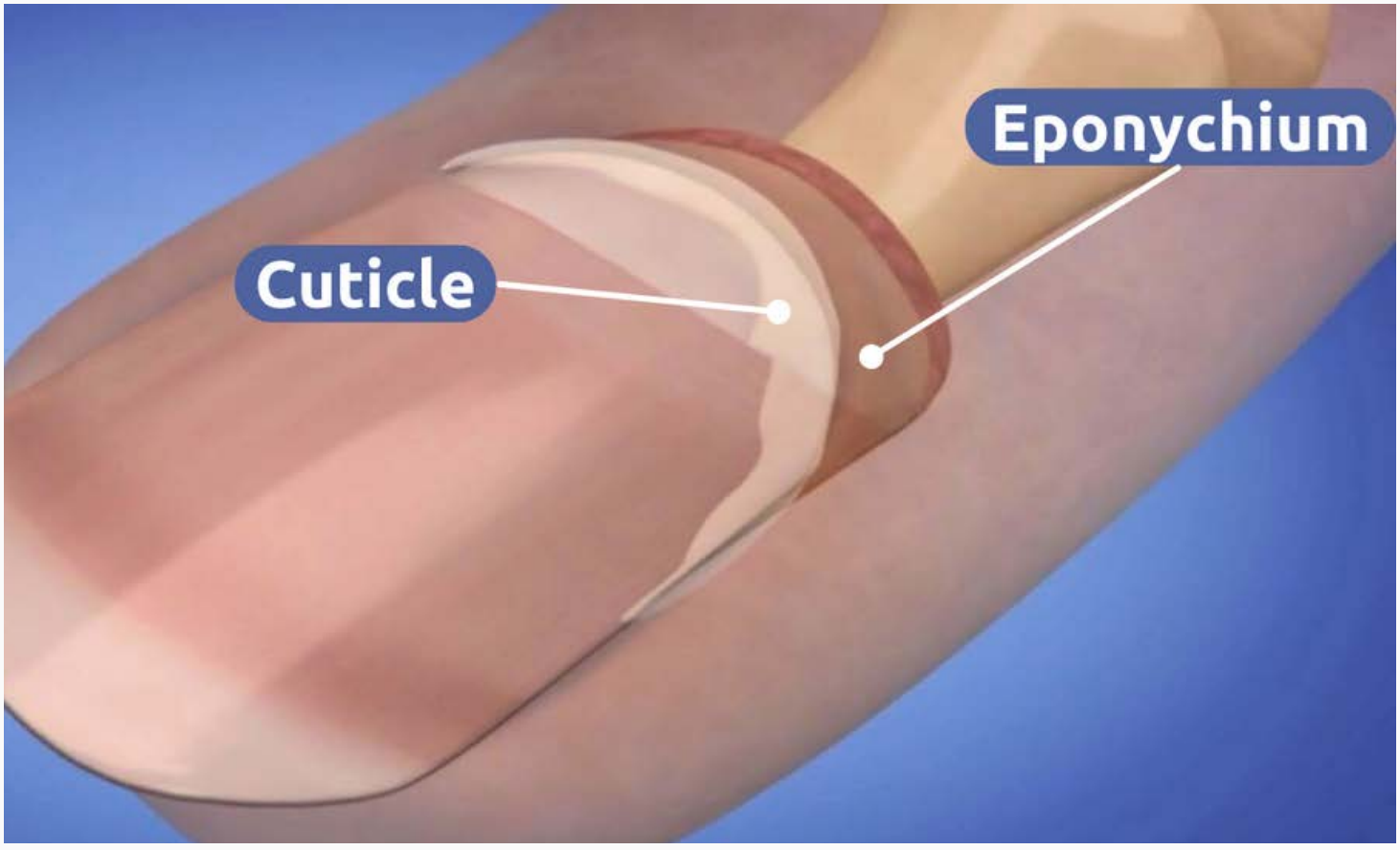


Figure 26: The eponychium on the ventral side of the proximal nail fold, producing the cuticle.

Eponychium

The cuticle, in conjunction with the proximal nail fold, lateral nail folds, and hyponychium, safeguards the nail matrix and prevents the infiltration of infections, allergens, and pathogens into the delicate areas of the nail bed and nail matrix. Cutting or using your efile in the area of the eponychium is not advisable, as it compromises the integrity of the nail seal and exposes the epidermis beneath the keratinised frame of the skin.

This can potentially lead to infections within the nail unit, or possibly Hellers Median Nail Distrophy while also prompting the skin's defence mechanisms to induce thicker regrowth of the proximal nail fold. It is crucial to protect the eponychium, ensuring its continuous role in maintaining the nail's health and protection. Its presence is integral to forming a strong seal that shields the nail matrix and prevents the entry of harmful substances.

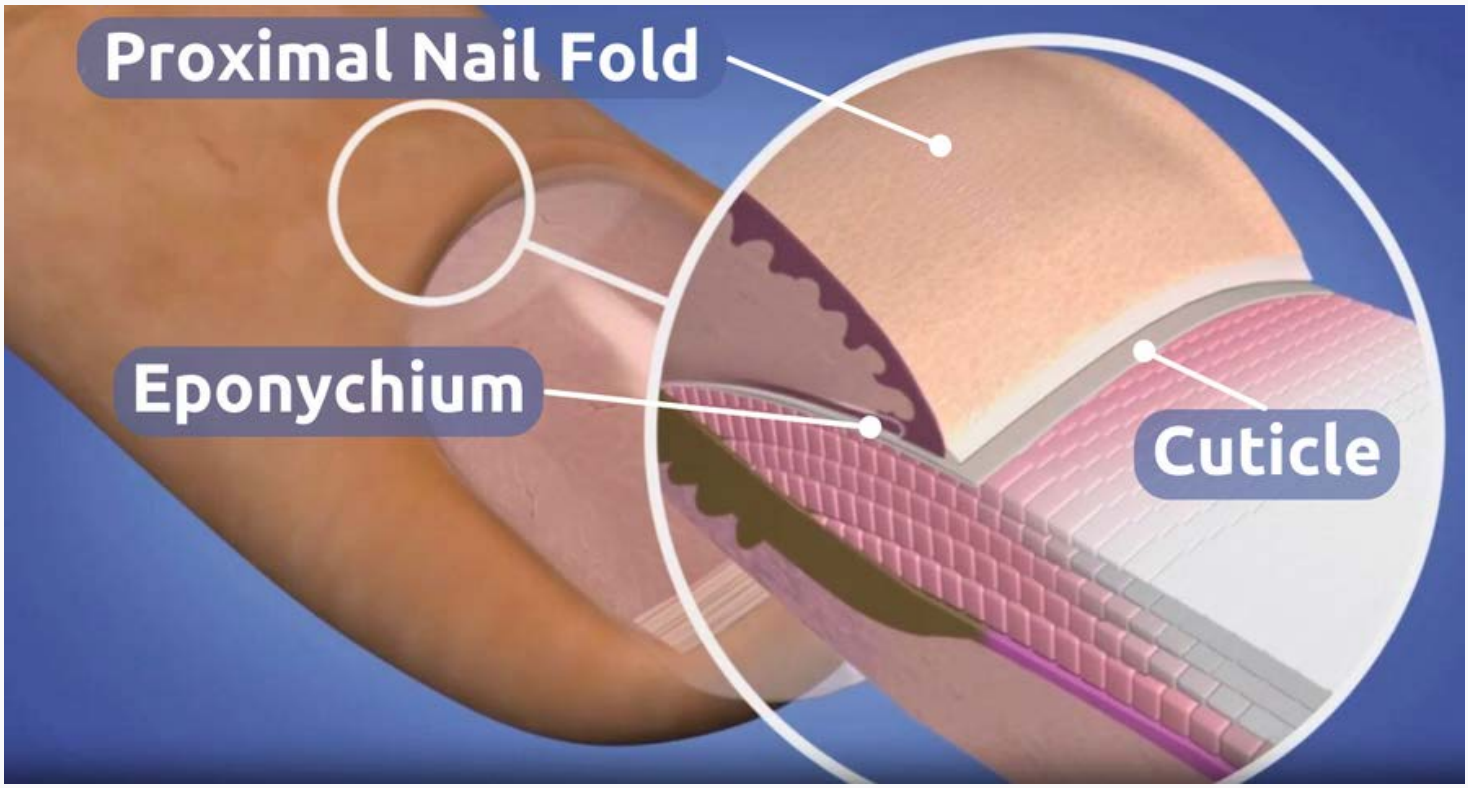


Figure 27: The sticky cuticle forms a guardian seal joining the proximal nail fold to the nail plate.

Cuticle

The cuticle, created by the eponychium on the ventral side of the proximal nail fold, is a layer of sticky, non-living skin cells. These cells possess a unique adhesive quality that firmly binds them to both the emerging nail plate below and the keratinised epidermis frame above. This adhesive property is vital as it becomes the essential guardian seal at the base of the nail plate.

Functioning as a thin, colorless layer, the cuticle adheres tightly to both the nail plate and the proximal nail fold, creating a guardian seal. This seal plays a crucial role in shielding the delicate matrix situated behind and beneath the proximal nail fold. It acts as a formidable barrier, preventing the entry of pathogens, chemicals, and fungus spores into the nail unit. By efficiently obstructing these intruders, the cuticle safeguards the growth and development of the nail plate, ensuring its healthy progression.

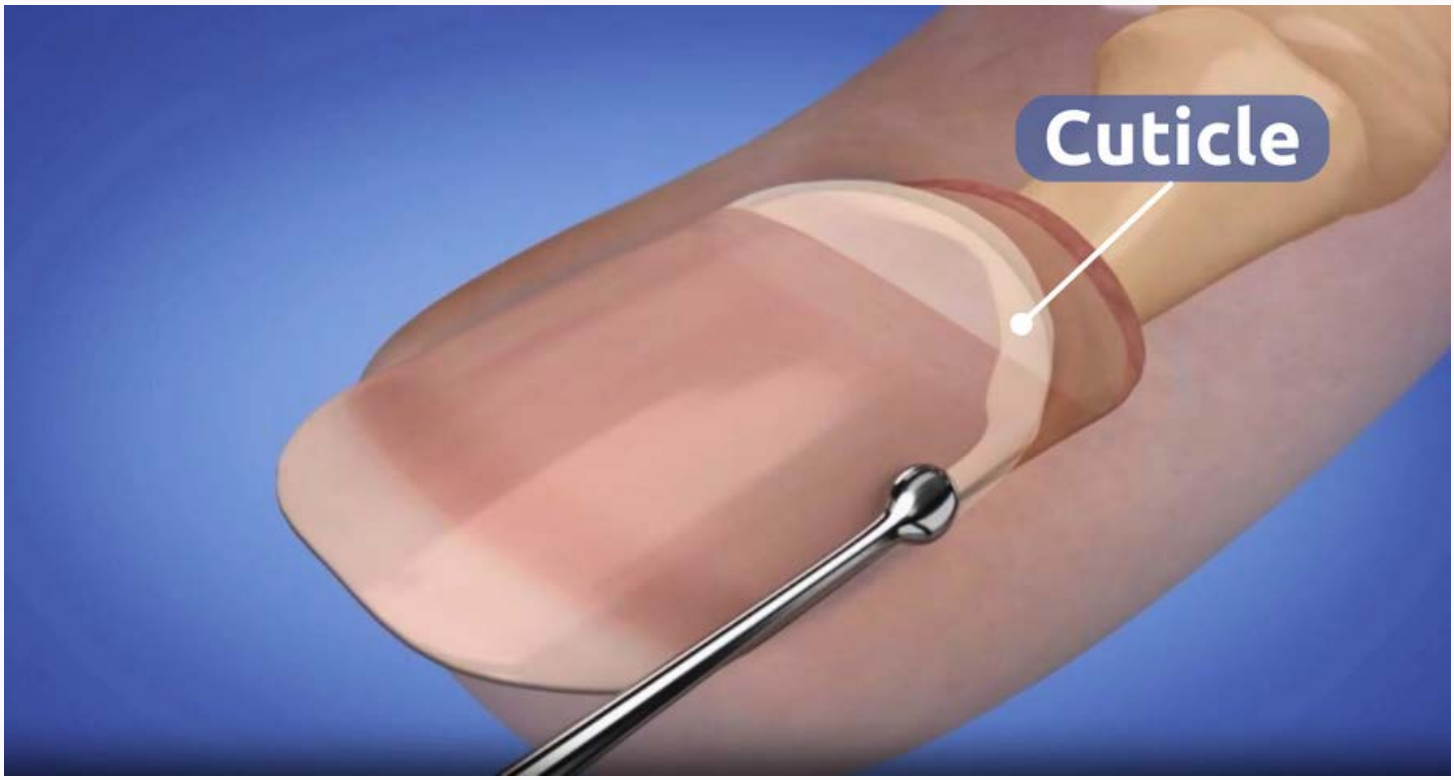


Figure 28: The position of the cuticle as it emerges from beneath the proximal nail fold, the cuticle is produced by the eponychium.

Cuticle

Although the cuticle serves a vital purpose, it is important to note that it consists of non-living skin cells. As a result, it can be safely removed before manicures and pedicures. However, it is essential to exercise caution and avoid cutting or pushing deep under the proximal nail fold, as doing so may compromise the eponychium and expose the area to potential infections.

To soften the cuticle before removal, various techniques can be employed. Traditionally, soaking the nails in softened water was a common method.

However, this approach may have adverse effects on the nail plate. The nail plate, being hydrophilic, readily absorbs water, temporarily altering its shape and softening its texture.

Applying overlays to water-logged nail plates increases the risk of lifting once the nails regain their original shape. Modern techniques have shifted towards more efficient cuticle softening products.

These can include alkaline-based solutions like sodium hydroxide, which effectively break the bonds between dead skin cells and soften the layer. However, it is crucial to neutralise these solutions promptly to prevent any ongoing activity and minimise the risk of damage to the nail plate.

There are currently some good, less aggressive cuticle removers on the market. Alternatively, applying high-quality nail oil after removing any overlays will soften the cuticle enough to gently remove it.

Using oil allows for safe removal using a suitable cuticle tool, such as a curette ensuring no damage occurs to the nail surface or the proximal nail fold. Wash hands and nails well with soap and water before applying a new overlay.

Another method involves using an e-file, although this technique requires proper education, a slow e-file speed, and an appropriate e-file bit. Utilising oil during the process can further minimize any potential nail plate damage. It takes years of practice to do this without damaging the nail plate – considering a safer option may be better for yourself and or your client.

Positioned as the middle layer between the proximal nail fold and the nail plate, the cuticle forms a crucial guardian seal at the base of the nail, ensuring the protection and well-being of the delicate matrix.

By removing the cuticle safely and effectively, better adhesion of overlays can be achieved, resulting in a clean and polished finish.

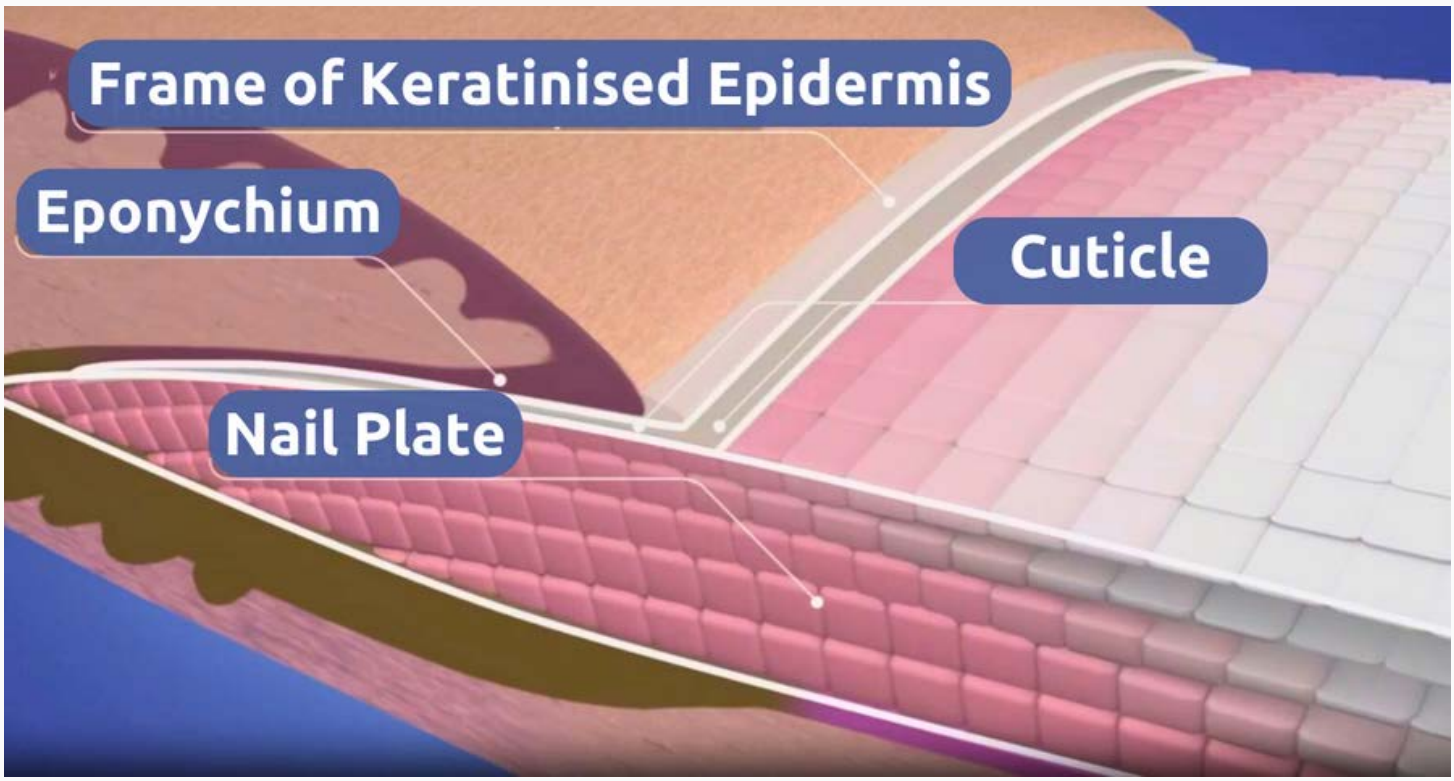


Figure 29: **The cuticle that is exposed and on the nail plate can be safely removed as it is non-living tissue, however to prevent infection of the nail unit, stop when you reach the frame of keratinised epidermis at the edge of the proximal nail fold.**

Onychodermal Band

The onychodermal band, often referred to as the "natural smile line," is found at the distal edge of the nail bed. It has a slightly greyish appearance when observed through the translucent nail plate. The onychodermal band signifies the junction where the nail bed epithelium and the hyponychium create a tight seal that ensures protection for the delicate nail bed. Located just under the free edge of the nail plate, the onychodermal band serves as an extra barrier, safeguarding the nail bed against potential allergens and pathogens.

These external intruders, if allowed to penetrate the nail bed, can lead to infections that profoundly impact both the nail itself and the matrix responsible for nail growth. The nail bed epithelium as it grows forward, gently pushes through the hyponychium, causing a slight bunching effect. This dynamic interaction is what lends the onychodermal band its distinct coloration, setting it apart from the surrounding areas.

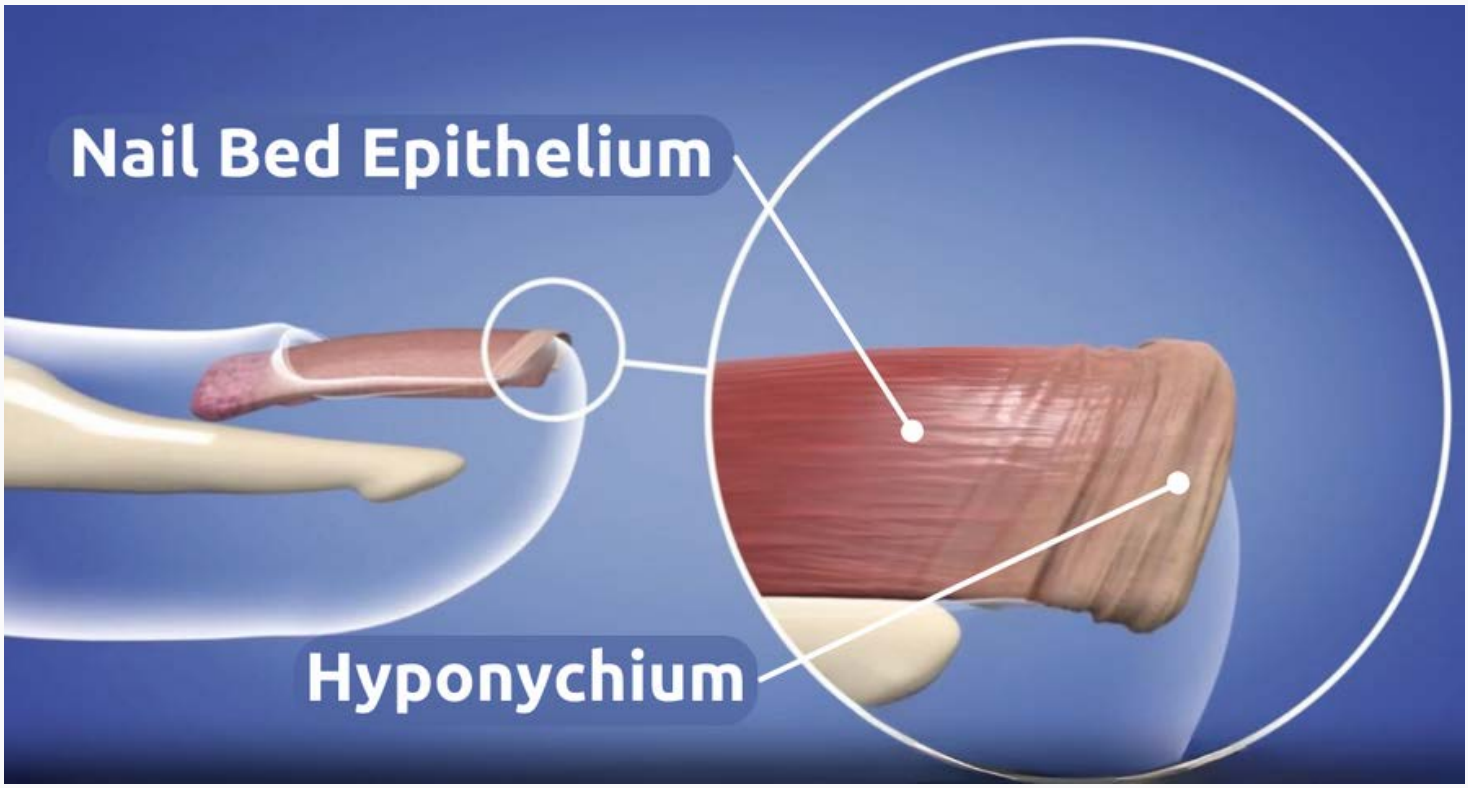


Figure 30: Nail bed epithelium as it bunches up as it meets the hyponychium, this bunching can be seen through the nail plate as the onychodermal band.

Nail Plate

The nail plate is a masterpiece of evolutionary engineering. It originates in the nail matrix, where specialised skin cells undergo modification and keratinisation, transforming skin cells into the durable, flat cells that comprise the nail plate.

Serving as the highly visible part of the nail unit, the nail plate extends from the nail matrix to the free edge, encompassing the entire surface of the nail bed.

Although the nail plate may appear as a single piece, it is actually composed of multiple layers of three different types of nail cells. As it grows, it gradually moves across the nail bed, securely attached to the underlying nail bed by the nail bed epithelium. The lateral nail folds, along with the nail grooves present at the bottom of both lateral nail folds, keep the nail plate in place, maintaining its proper alignment.

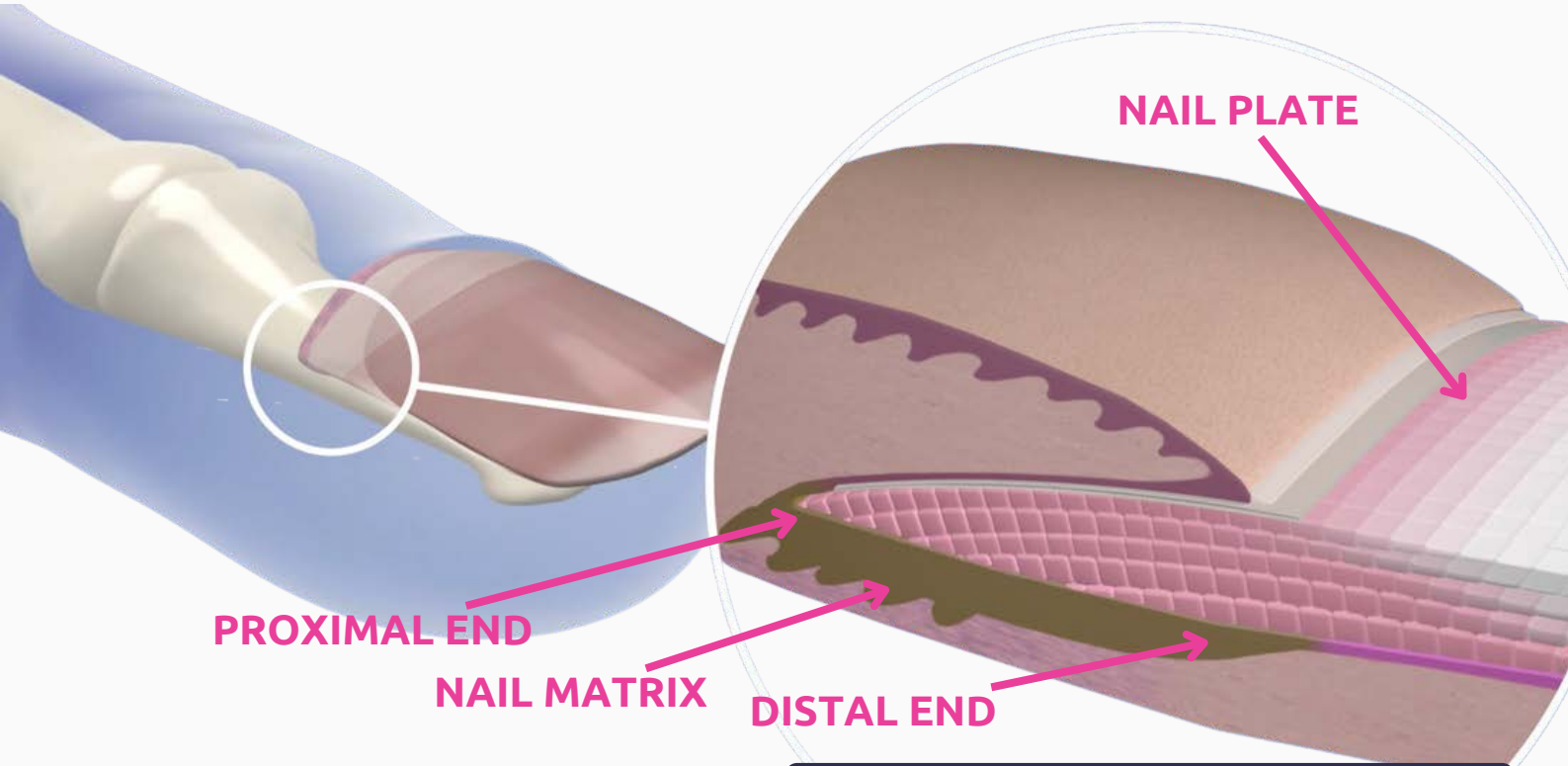


Figure 31: The nail matrix produces the cells of the nail plate. The proximal end producing the upper layers, the ventral part the middle layers and the distal end the bottom layers.

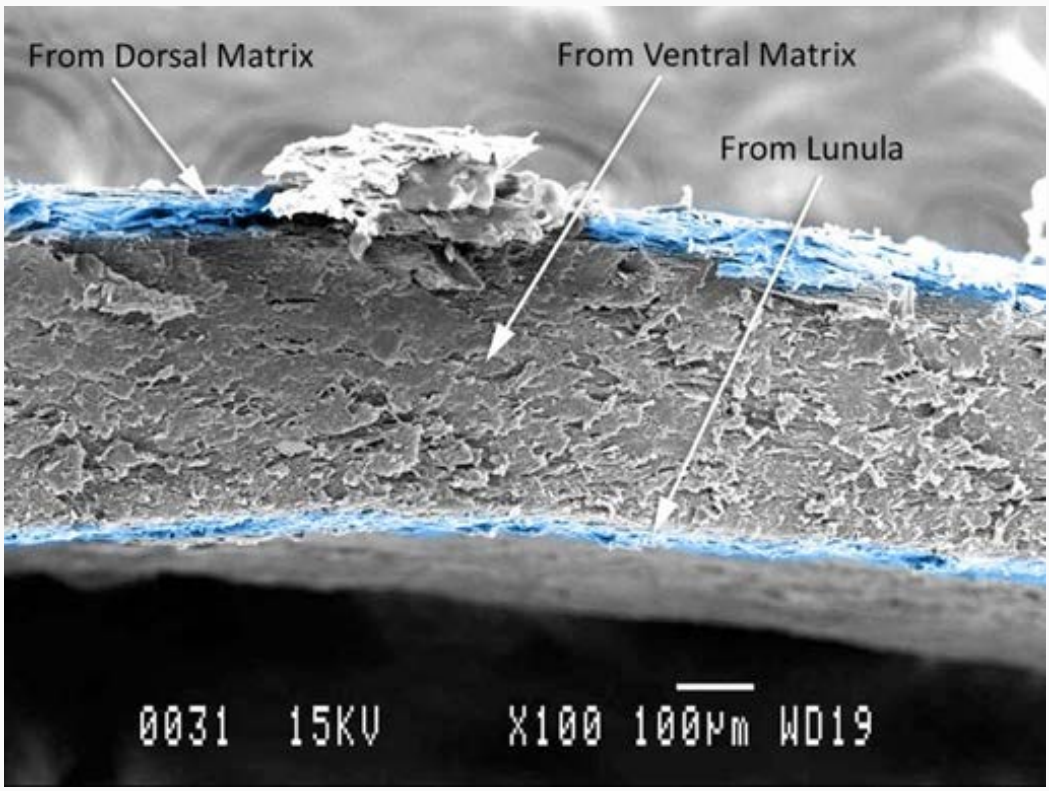


Figure 32: Looking at a cross-section of the nail plate under a microscope.

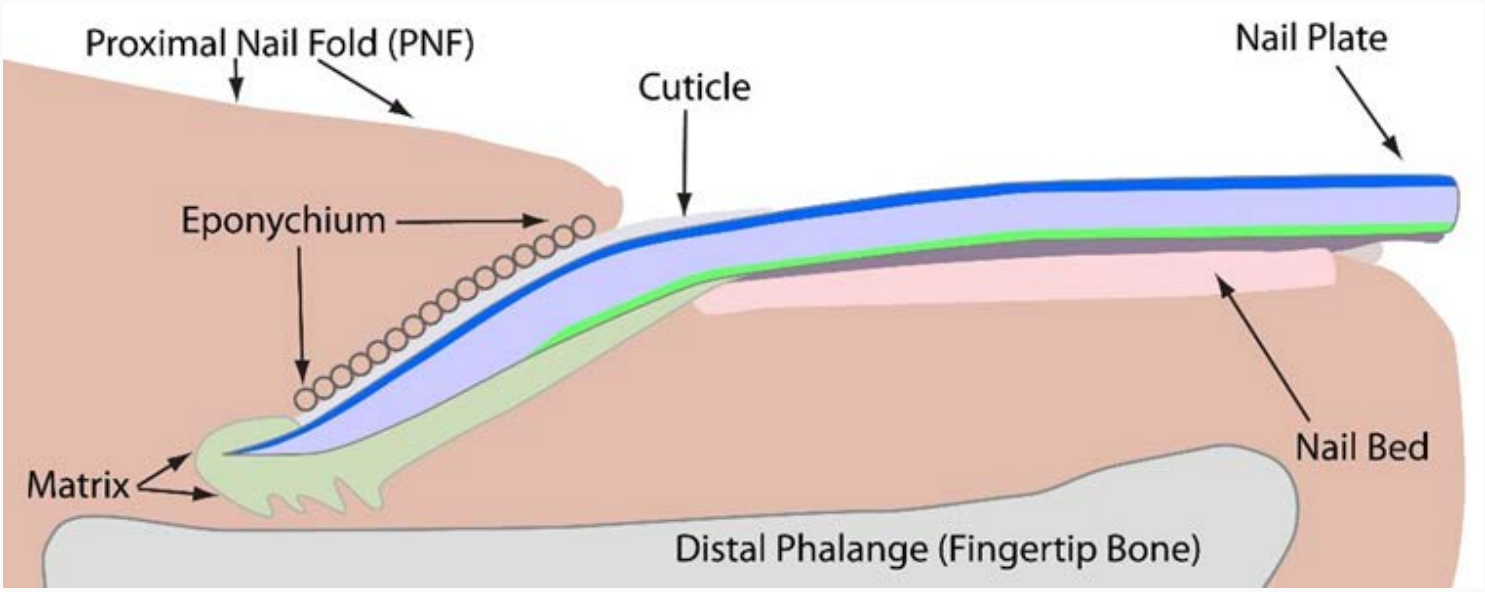


Figure 33: The top layer of the nail plate (blue) is around 10% of the nail, the middle layers (purple) make up around 80% while the bottom layers (green) are around 10%.

The upper layer of the nail plate is our chemically resistant layer, not affected by changes in the pH value, it is also the oldest part of the nail plate which is why we see delamination in the upper layer and not under the free edge where nail plate cells are much newer. The middle layer (produced by the ventral matrix) of the nail plate is responsible for the flexibility and strength of the nail plate. Its structure is visibly different from the rest of the nail plate. The lower layers of the nail plate travel faster towards the free edge than any of the others. They are only exposed to the outside world when they release from the nail bed and become the underside of the free edge. All of these nail plate layers can be affected by skin disorders in the nail matrix or nail bed.

Keratin within the Nail Plate

The strength and hardness of the nail plate is due to keratin, a protein made of many links of amino acids. There are two main types produced by these specialised cells as they mature to form the nail plate. Non-crystalline keratin fills the cells as they mature and makes them hard. While crystalline keratin form fibrils which are long, thin, thread-like structures. These embed in the non-crystalline keratin of adjoining cells to bond them together. This interlocking creates a strong bond between cells in the nail plate, enhancing the nail's structural integrity. It acts a little like the cement between bricks in a wall and a very organised structure is formed.

There are three main sections of layers within the nail plate. The layers in each section are adapted for their specific role. The lower layers have a strong adhesion to the nail bed epithelium which we will discuss later in this eBook. This helps to anchor the nail plate in place. The middle layers make up approximately two thirds of the nail plate thickness. The tough upper layers are slightly thicker than the lower layers and form a protective barrier.

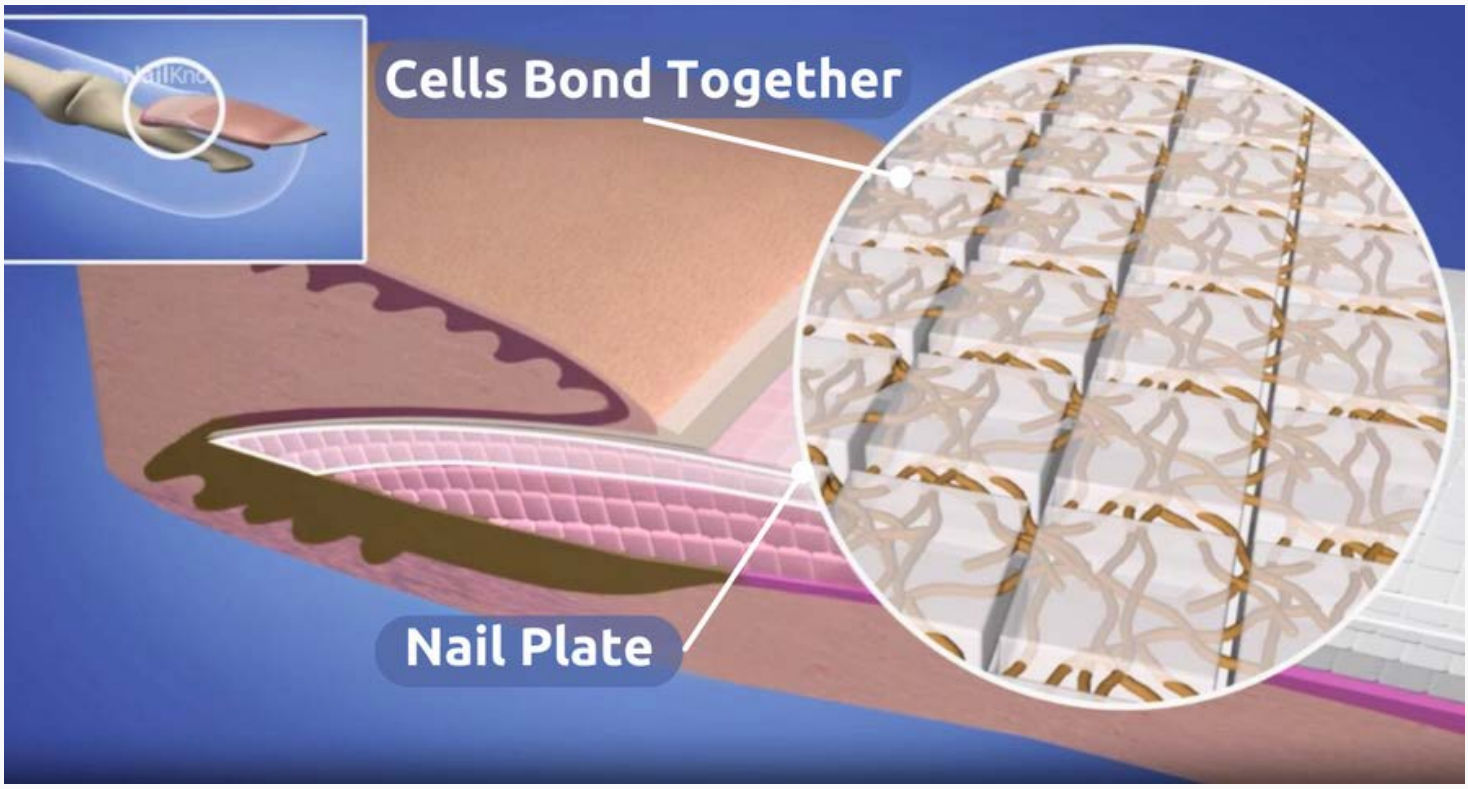


Figure 34: Keratin is an essential compound providing structure and toughness to the nail plate.

Figure 35: Two forms of keratin are found in the nail plate. Non crystalline which fills the cells and crystalline which bonds the cells together by creating a mesh of fibrils.

This combination of different types of keratin, and the way they interact, as well as the layering within the nail plate, is essential for creating a nail plate that is both hard and durable, yet flexible enough to avoid being brittle and prone to breaking. A note of caution should be sounded regarding any work on the upper layers of the nail plate. **Due to their protective role in the health of the nail unit they should never be buffed off during any nail service. Buffing off the top layers exposes the less dense layers below. This weakens the nail and opens it up to penetration by unwanted substances, solvents, bacteria, fungi or viruses.**

In the upper layers, the keratin bonds attach the tightly packed cells together in different directions. This makes these layers tougher, less permeable and more resistant to substances that can attack and cause infection or a reaction. In the middle layers the bonds lie very neatly from side to side. This is why, when you break a nail it is usually from the side or straight across. This reduces the risk of longitudinal breaks from the free edge. Longitudinal breaks can break the hyponychium seal and continue to the nail bed with all its nerve endings. This is very painful.

In addition, pathogens can enter and infect the nail bed and potentially spread to the matrix and even the underlying bone. This can create very serious problems that are hard to treat.

The nail plate needs some flexibility to make it less prone to breakage. To achieve this, the layers must slide against each other to a certain extent. This movement is maintained by lipids and lubricants that penetrate the small spaces between the nail plate cells. The lipids and lubricants come from the nail bed and are also released from cells during keratinisation.

If the nail plate doesn't have enough lubricants and flexibility it will be too hard and brittle and can snap easily.

If it has too much flexibility it can bend easily and may tear. There needs to be the right balance of hardness and flexibility. Wearing a coating on the nail can help to keep natural lubricants inside the nail and reduce loss of them from the upper layers. If nails are kept bare, regular application of a good quality nail oil will help to replace and maintain lubrication and stop the nails becoming brittle.

Probably the most common natural nail condition seen is delamination, also known as peeling nails or lamellar dystrophy. Imagine the nail plate is a stack of thin, delicate paper sheets. The free edge of the nail, where delamination often occurs, can be compared to the edge of this paper stack.

Normally, these sheets lie flat and closely adhered, presenting a smooth and uniform appearance. However, in the case of delamination, these 'sheets' begin to separate and peel away from one another, much like how individual pages might start to fray or curl at the edge of a well-used book. This peeling not only disrupts the smooth surface of the nail but can also reflect deeper health or environmental influences impacting the nail's strength and condition. Minor trauma from daily living damages the free edge. It is often too small to be seen - but it is there. This area also has the least amount of natural oils, so once the bonds on the free edge have broken water can penetrate easily and break even more bonds between layers. This causes more delamination and very weak nails which will become even weaker and flake apart faster.

The structure of the nail plate is a masterpiece of engineering. The integrity of the nail plate needs to be maintained at all times to prevent damage or invasion from resident or transient microbes but also to create a safe and strong foundation for artificial nail products of any kind.

Figure 36: Delamination or the peeling away of layers of the nail plate is common at the free edge.

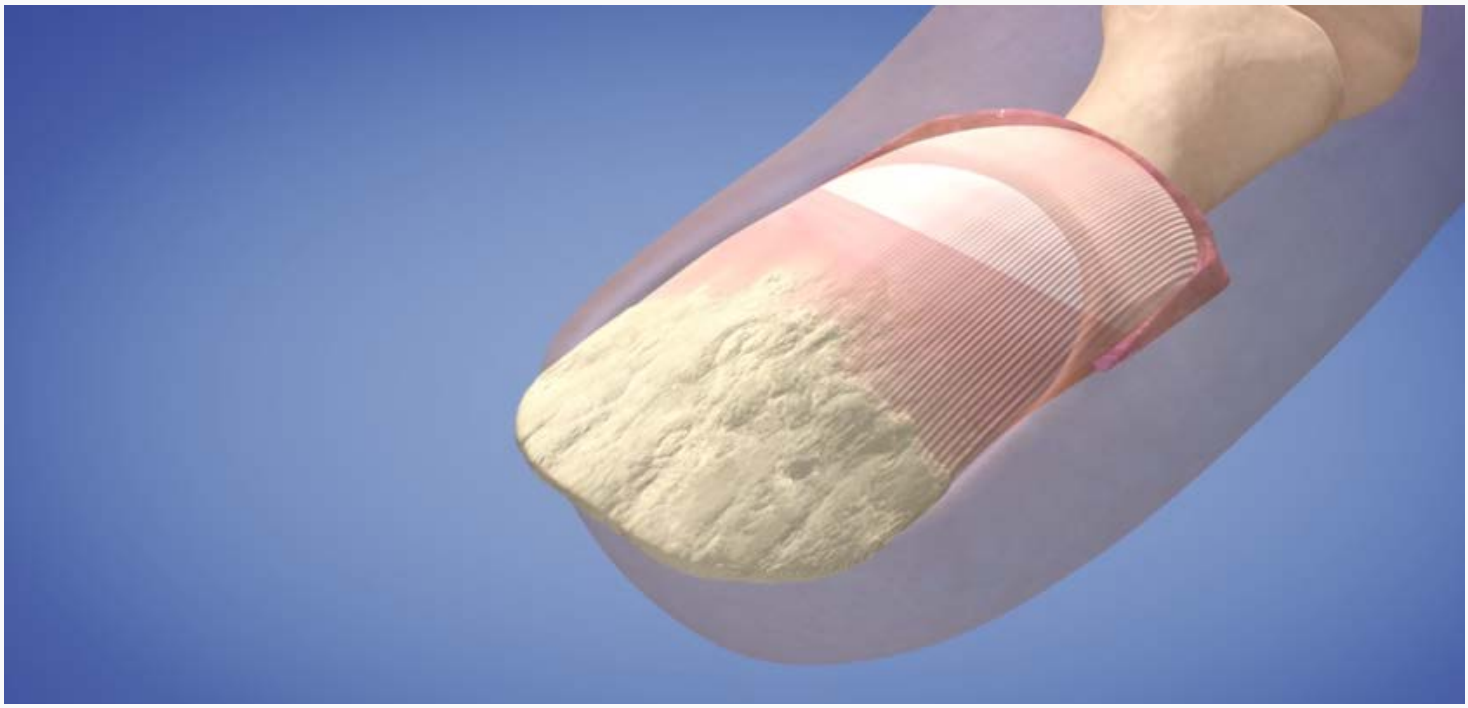


Figure 37: Fungal infection on the nail plate. This is a serious condition and one that a nail professional is not qualified to work on.

Nail Bed Epithelium

The nail bed epithelium, a delicate and thin, non-living layer of epithelial tissue, plays a crucial role in the function and stability of the nail plate. Positioned on top of the nail bed dermis and beneath the nail plate, it enables the smooth gliding motion of the nail plate while maintaining a strong attachment to the underlying nail bed.

One of the key mechanisms that ensure the secure attachment between the nail bed epithelium and the nail plate is the presence of interlocking ridges and grooves.

These specialised structures create a firm connection, preventing any unnecessary separation or movement of the nail plate from the nail bed. By interlocking in this manner, the nail bed epithelium provides stability and support to the nail plate, allowing it to withstand everyday activities without compromising its position or integrity.

Figure 38: Nail bed epithelium connects the underlying dermis to the nail plate.

Nail Bed Epithelium

Furthermore, the nail bed epithelium acts as a protective barrier, safeguarding the nail bed from external factors and potential damage. It helps shield the sensitive nail bed dermis, preserving its health and preventing harmful substances from permeating the underlying tissues.

As the nail plate glides effortlessly across the nail bed, this thin layer ensures a smooth and seamless movement. It acts as a resilient foundation for the nail plate, contributing to the overall strength and integrity of the nail unit. Its interlocking ridges and grooves, along with its thin and delicate structure, allow for the movement of the nail plate while maintaining its connection to the underlying nail bed. If a nail plate is lost either due to an accident, a systemic condition or an allergic reaction, tissues within the nail bed will cornify to protect the delicate dermis below resulting in hyperkeratosis which is extremely hard to treat.

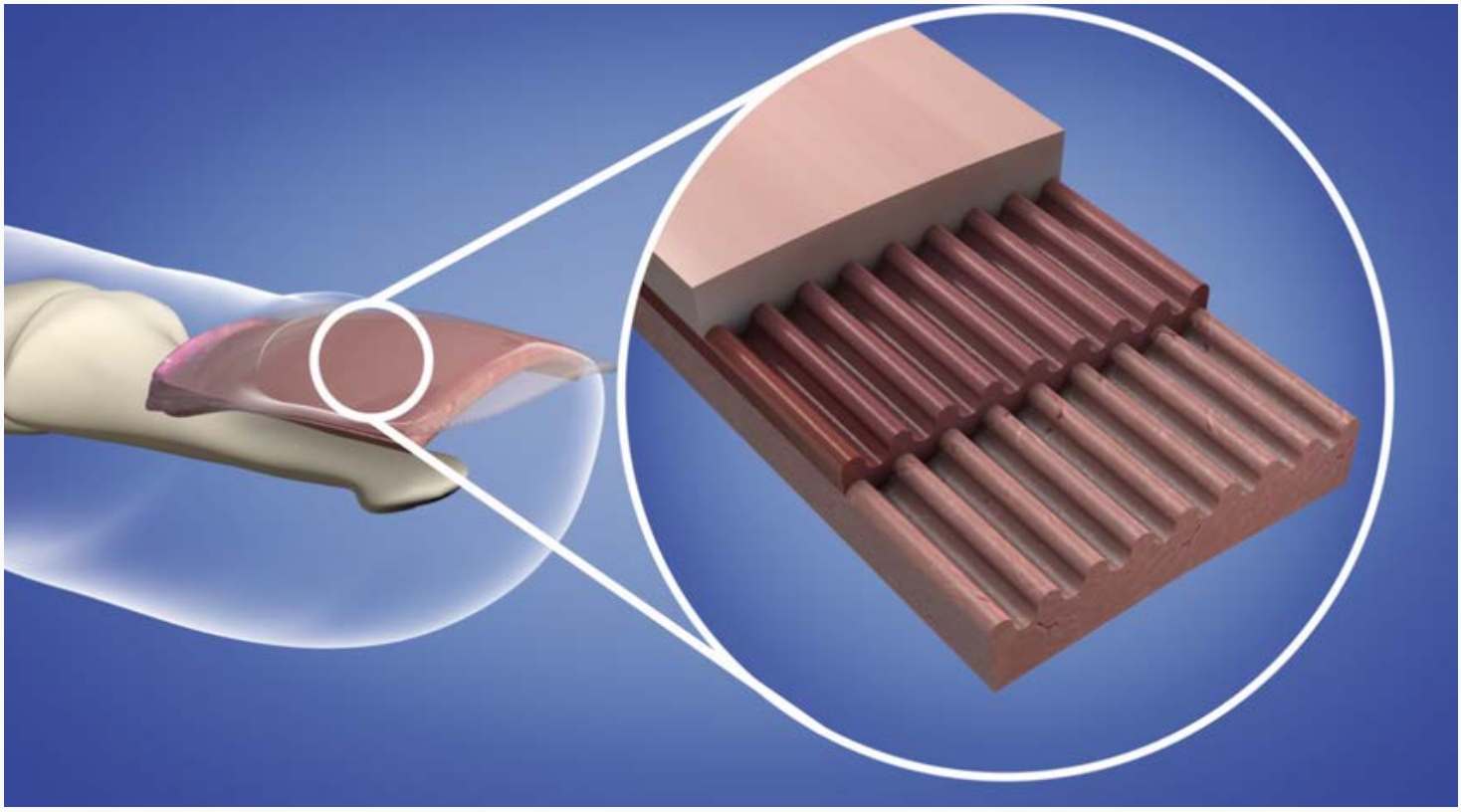


Figure 39: **The nail plate is tightly held in place by the nail bed epithelium, which interlocks with the grooves of the nail plate and the nail plate dermis.**

Nail Bed

The dermis of the nail bed is abundant in essential resources for nail health. A rich blood supply provides vital nutrients and oxygen. Sebaceous glands within the dermis secrete oils that contribute to the moisture balance of the nail plate, promoting flexibility and preventing dryness. Lymph vessels present in the dermal layer assist in maintaining a healthy immune response, helping to protect the nail bed from potential infections or irritations.

The nourishing blood supply, sebaceous glands, and lymphatic system within the dermis maintain the overall health and vitality of the nail bed.

One of the nail bed's roles is to supply the nail plate with natural oils and moisture to keep it flexible.

These oils do penetrate all the way through the nail plate but the upper layers are older and harder - so less moisture and oils make it through to the very top of the nail plate.

As well as less moisture and oils making their way to the top of the nail, the dorsal side of the nail plate is exposed to environmental factors as well as water, solvents such as nail polish remover and potentially harsh chemicals, like detergents, which can strip away this moisture and lubricating oil.

This is why it is important to replace lubricants, with a good nail oil, to help protect the nail plate and prevent the nail from becoming brittle. The nail bed acts as a vital support system for the nail plate. The nail bed epithelium and underlying dermis work harmoniously to anchor and lubricate the nail plate, allowing it to slide forward while ensuring its firm attachment.

Understanding the significance of the nail bed highlights the importance of proper nail care and maintenance to promote healthy and resilient nails.

Nail Bed

If you have seen anyone that has lost a nail plate through accidental damage, these grooves are clearly seen and appear very wet and bloody, due to the blood supply and natural oils and moisture provided by the dermis.

The nail bed epithelium has a matching series of grooves that interlock with the nail bed to keep the nail plate firmly attached while allowing it to slide forward as it grows with newly formed nail plate cells pushing out from the matrix. The groves and ridges, as described, work like a zip. Once the first physical connection is breached then the rest of the connections can open up very easily.

This allows any pathogen to invade the nail bed, cause damage, reach the nail matrix and even the underlying bone. Similar problems are caused if you breach the seal at the proximal nail fold.

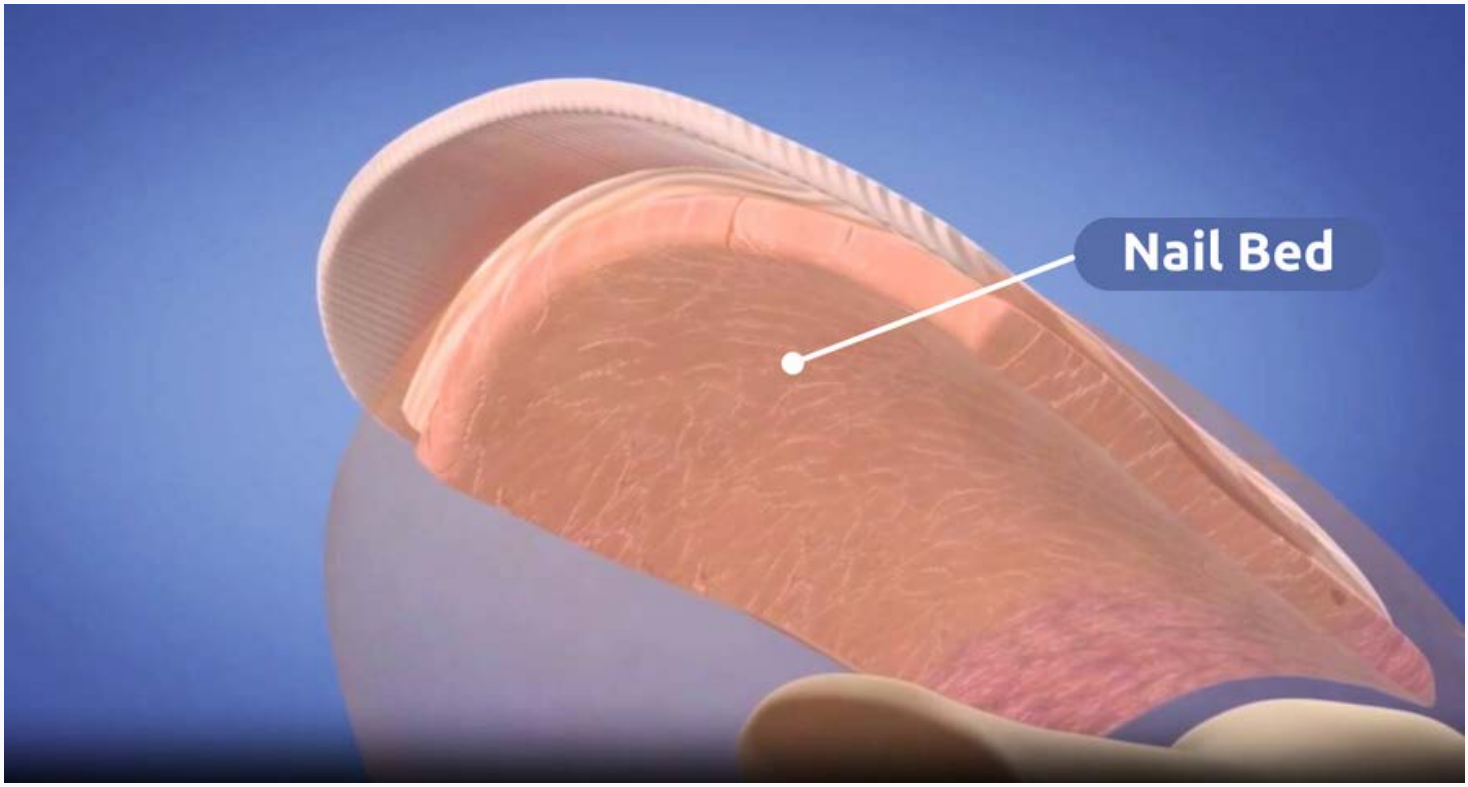


Figure 40: The dermis of the nail bed has a rich supply of blood, sebaceous glands and lymph vessels to keep the nail plate healthy and moisturised.

Nail Matrix

At the heart of the nail unit lies a remarkable structure known as the nail matrix, which plays a pivotal role in the growth and development of the nail plate.

The nail matrix is where new cells for the nail plate are generated, giving rise to a continuous cycle of nail renewal and growth. Situated at the base of the nail, the nail matrix is responsible for the creation of fresh nail plate cells.

As new cells are formed in the matrix, they gradually push forward, displacing older cells and propelling the nail plate to extend beyond the fingertip. This perpetual process of cell production and migration allows the nail plate to grow steadily over time.

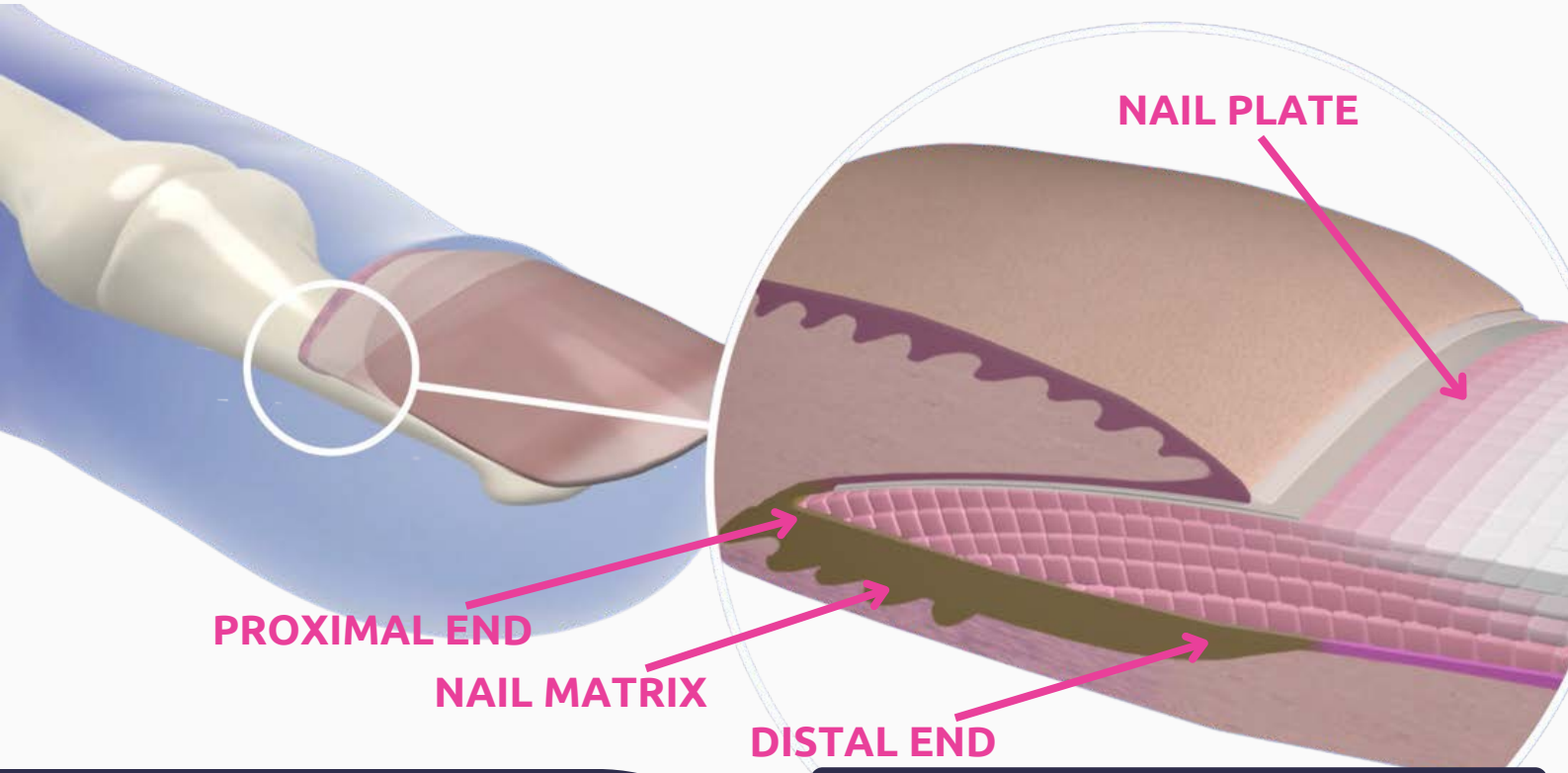


Figure 41: The nail matrix produces the cells of the nail plate. The proximal end producing the upper layers, the ventral part the middle layers and the distal end the bottom layers

Nail Matrix

The size and shape of the nail matrix exert a profound influence on the characteristics of the nail. A larger and wider matrix corresponds to a thicker nail, while a smaller matrix leads to a comparatively thinner nail. This fundamental relationship underscores the significance of the matrix in determining the thickness and width of the nail plate.

The nail matrix is an exceptionally delicate structure, and any damage inflicted upon it can have various repercussions on the overall health and appearance of the nail. Skin disease or trauma to the matrix can manifest as visible imperfections, such as white spots or ridges, within the growing nail plate. Additionally, compromised matrix integrity can weaken the nail plate as a whole, making it more susceptible to breakage or deformation.

The nail plate is made up of layers of specialised skin cells that act differently from the skin cells found elsewhere across the body. These skin cells are created in the nail matrix, and continually produced. As new cells are produced they push the older cells outwards.

The proximal area of the matrix is where the upper layers of the nail plate are formed, the ventral area forms the middle layers while the lower layers come from the distal end of the matrix. The cells start off slightly soft but then as they age, harden and fill with a type of protein called keratin. Skin diseases such as psoriasis, can affect any or all of these layers causing any number of problems in the nail unit.

The closer to the matrix a cell is, the softer it will be, and the easier it is to damage it. The further from the matrix a cell is, the harder it will be. This amazing combination of nail plate cells bond together to form layers which are in turn bonded together to form the nail plate.

Nail Matrix

The length of the matrix determines the thickness and shape of the nail as it grows; which is why the thickness and shape of the nail plate cannot be changed.

If the nail matrix is longer it will create more layers in the nail plate, and the more layers the nail plate has the thicker it will be. Therefore, the longer the matrix the thicker the nail. The shorter the matrix the thinner the nail. The shape of the matrix determines if the nail is going to have a deep C curve or be flatter. The flatter the matrix, the flatter the nail. While a more curved matrix has the opposite effect and creates a deeper C curve in the nail plate.

The matrix needs to be protected by the proximal nail fold as the modified skin cells within the matrix are still very soft as they are undergoing keratinisation. Any trauma to this area on the skin at the base of the nail, can easily damage the soft cells beneath and is the most common cause of occasional white spots, or can cause the nail plate to form a ridge or groove.

Fingernails take approximately five months to grow from the matrix to the free edge. This gives you an idea of how long damage will take to grow out when it is caused. Damage will not always be obvious immediately. It may take several weeks to show. If it is temporary damage it will grow out. However, sometimes damage can permanently reshape the matrix and a ridge or deformity will be seen in the nail plate forever.

Major trauma in this area for example, shutting your finger in a door, can interrupt the process and cause the damaged infant nail plate cells to separate from other cells in the matrix. When this happens the old nail will eventually grow out and fall off.

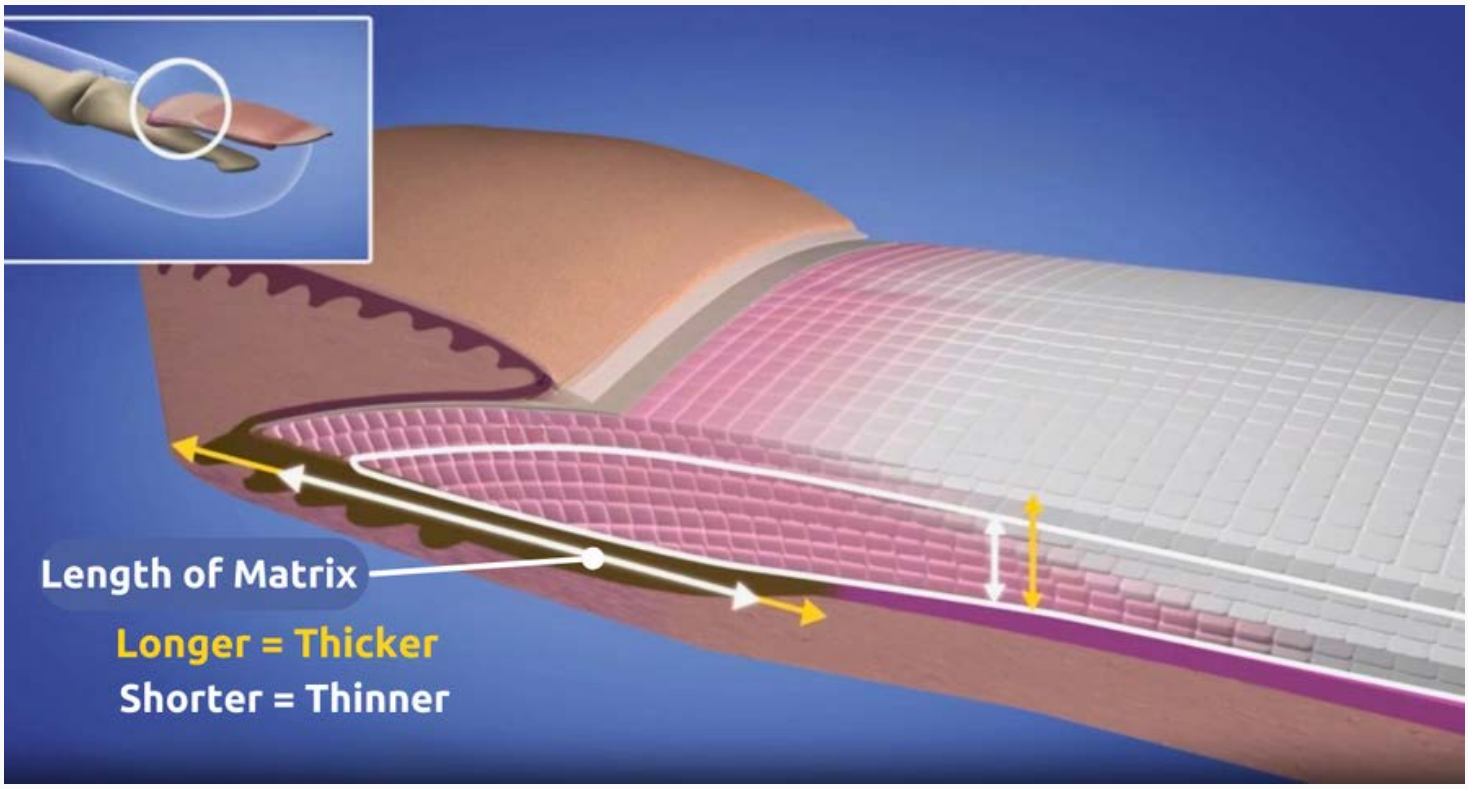


Figure 42: **The shape and length of the nail matrix dictates the shape and thickness of the nail.**

The new nail will be seen growing under the departing nail but this will be from the proximal part of the matrix and therefore quite soft until the cells appear from under the proximal nail fold. This can also happen very easily in a big toenail. If the nail is too long for shoes a lot of pressure is placed on the distal edge of the nail causing it to lift up within the matrix. This can cause the nail to separate from the matrix and result in loss of the nail. There are many other systemic reasons, for example illness, hormonal changes, general anaesthetic, chemotherapy or a restricted blood supply can interrupt the production of new nail plate cells.

The matrix sits on and is in contact with the distal bone of the finger or phalanx. The bone also plays a role in the shape of the matrix. The nail plate protects the bone from damage and also gives a firmness to the end of the finger. Without it the end of the finger would be soft and the bone susceptible to damage.

Nail Matrix

Maintaining the well-being of the nail matrix is of paramount importance for the long-term health and vitality of the nail.

Nurturing the matrix through proper care and protection safeguards against potential damage and promotes optimal nail growth. This includes adopting practices that prioritise nail hygiene, avoiding excessive pressure or trauma to the matrix area, and ensuring a well-balanced diet to support the growth of strong and resilient nails. The nail matrix's capacity to generate new cells and shape the nail plate underscores its pivotal role in defining the characteristics and overall health of the nail.

By recognising the significance of the nail matrix and ensuring its integrity, we can cultivate nails that are not only beautiful but also robust and flourishing.

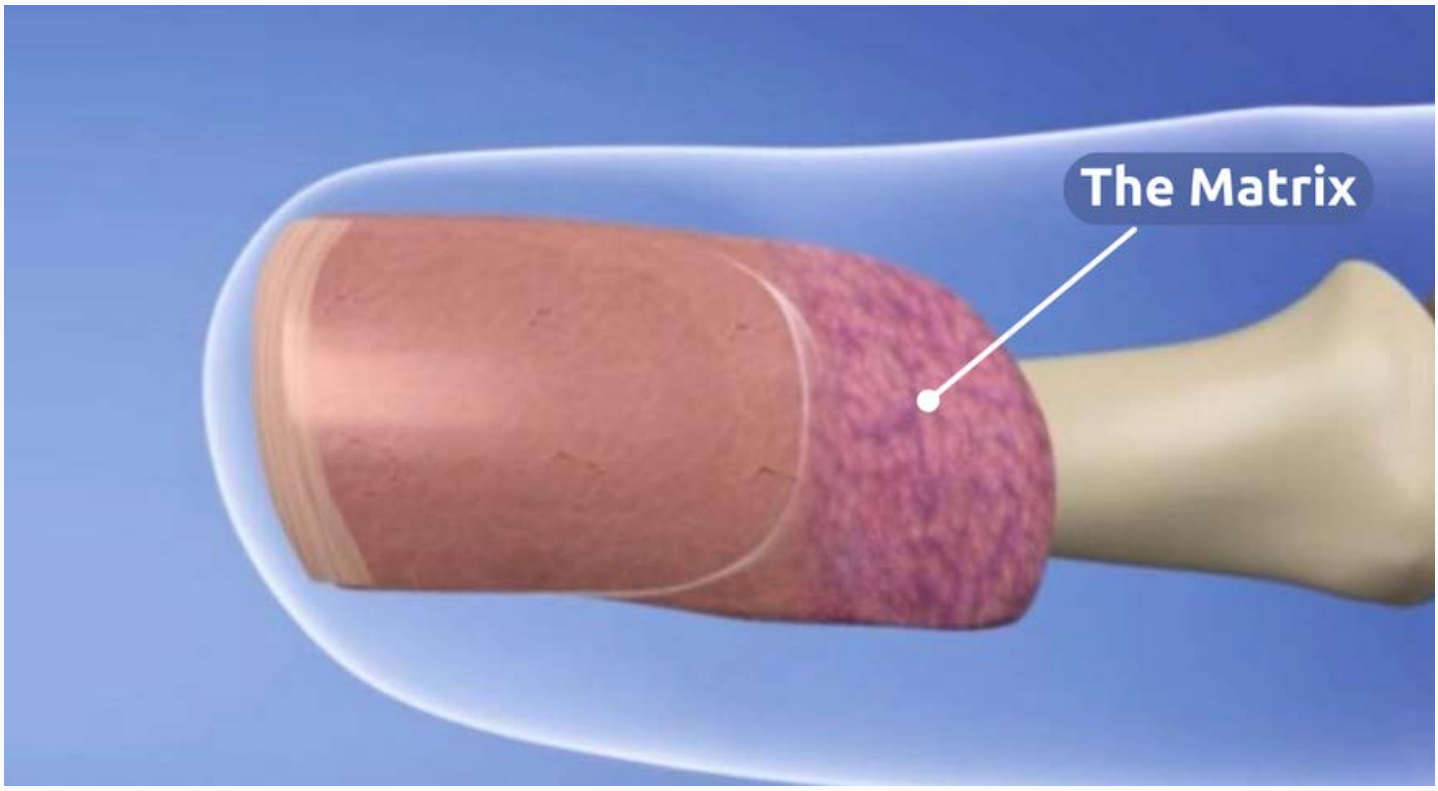


Figure 43: **The nail matrix is behind and under the base of the nail. It is protected by the proximal nail fold.**

Hyponychium

Beneath the free edge of the nail plate, at the distal edge of the finger, lies a crucial nail seal - the hyponychium. This thin but strong structure plays a pivotal role in protecting the nail unit against the invasion of harmful bacteria and other pathogens. It is one of the four main guardian seals.

Functioning as a tight seal, the hyponychium creates a barrier that shields the delicate and sensitive areas of the nail. The primary responsibility of the hyponychium is to prevent the entry of external threats into the nail unit. Its tight seal impedes the infiltration of bacteria, allergens, and pathogens that could potentially jeopardise the well-being of the nail unit.

The hyponychium safeguards the nail bed and nail plate, ensuring their protection against infection or damage.

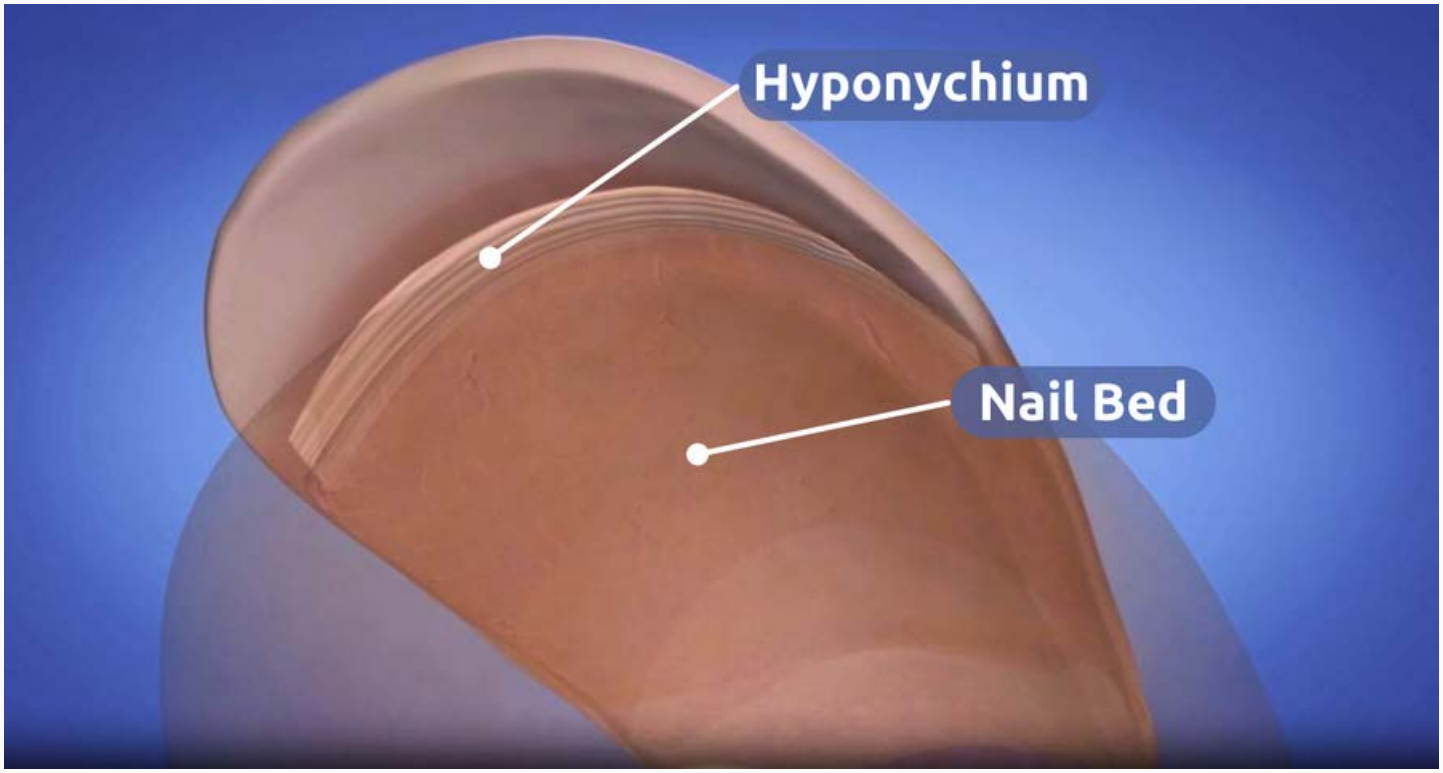


Figure 44: **The hyponychium is the nail seal at the distal end of the finger, providing a strong protective barrier under the nail's free edge.**

Hyponychium

Within the hyponychium, numerous nerve endings promptly alert us to any breach in the protective seal.

These sensory nerve endings act as a warning system, transmitting signals that trigger discomfort or pain. If the seal is broken it can allow pathogens into the sensitive nail bed area.

It is also possible for the hyponychium to thicken and discolour. This thickening and discolouration could, in toenails, be a sign of fungal infection. This can also happen due to damage to the seal or it can be due to chemical damage or a systemic disease or an allergic reaction. There is also a specific shape of damaged nail unit that can naturally grow this extended and thickened hyponychium known as inverse pterygium.

A fungal infection cannot be confirmed by visual examination alone, a test is needed to confirm it. Fungal infections almost always result in onycholysis - the separation of the nail plate from the nail bed. This is a serious condition. If the matrix or the local area is under attack from an allergen, fungus or a pathogen it can cause the nail bed to cornify to protect itself.

Onycholysis is most definitely a sign that something is wrong. A fungal infection needs to be ruled out. If this test is negative and there is no obvious trauma and artificial nails are worn, then an acrylic allergy test is advisable.

Practising good nail hygiene and using a good quality nail oil while keeping the hyponychium area free from dirt or debris, is essential for preserving its integrity. Gentle handling of the nails and avoiding behaviours that may cause trauma or damage to the hyponychium is crucial for upholding its protective function.

Lunula

The lunula, often called the ‘half moon’ due to its shape, is visible on some nails. If you cannot see it, it is just hiding under the proximal nail fold.

The lunula is the distal edge of the nail matrix, the area where skin cells are keratinised to become the hard, compact, non-living, transparent cells of the lower nail plate.

At the beginning of this journey, the nail plate cells are soft as they still have a lot of their cellular contents. This is also why they are opaque and appear white, hiding the colour of the underlying nail bed.

They have not yet fully keratinised, to become the hard, resistant nail plate cells; as a result they are very easily damaged.

For example, it is easy to spot when a person has received an aggressive manicure, there is a groove in the nail in the shape of a curve that only becomes visible as the nail grows.

This indicates an aggressive manicure technique where a hard tool or e-file bit has been pressed into the lunula area and damaged the soft nail plate. This damage will be visible until it grows out with the nail.

It is a myth that the proximal nail fold needs to be pushed back so the lunula is visible. Actually, it is preferable that the lunula is not visible then there is less chance of damage.

The vulnerability of the lunula is evident when you encounter clients with a ‘habit tic’. This condition is most common on the thumbs, as it is the one digit where the lunula is almost always visible, especially on the dominant hand.

Lunula

With a habit tic, individuals unconsciously pick at the proximal nail fold of the thumb, digging into the lunula, damaging the developing nail cells so that deep, puckered ridges are seen in the nail plate.

If an infection or other damage occurs to the proximal nail fold, this will usually result in nail plate ridges as the swollen skin presses down on the lunula. This demonstrates how soft and vulnerable the lunula is. When working in the lunula area, around the proximal nail fold, be very gentle and accurate.

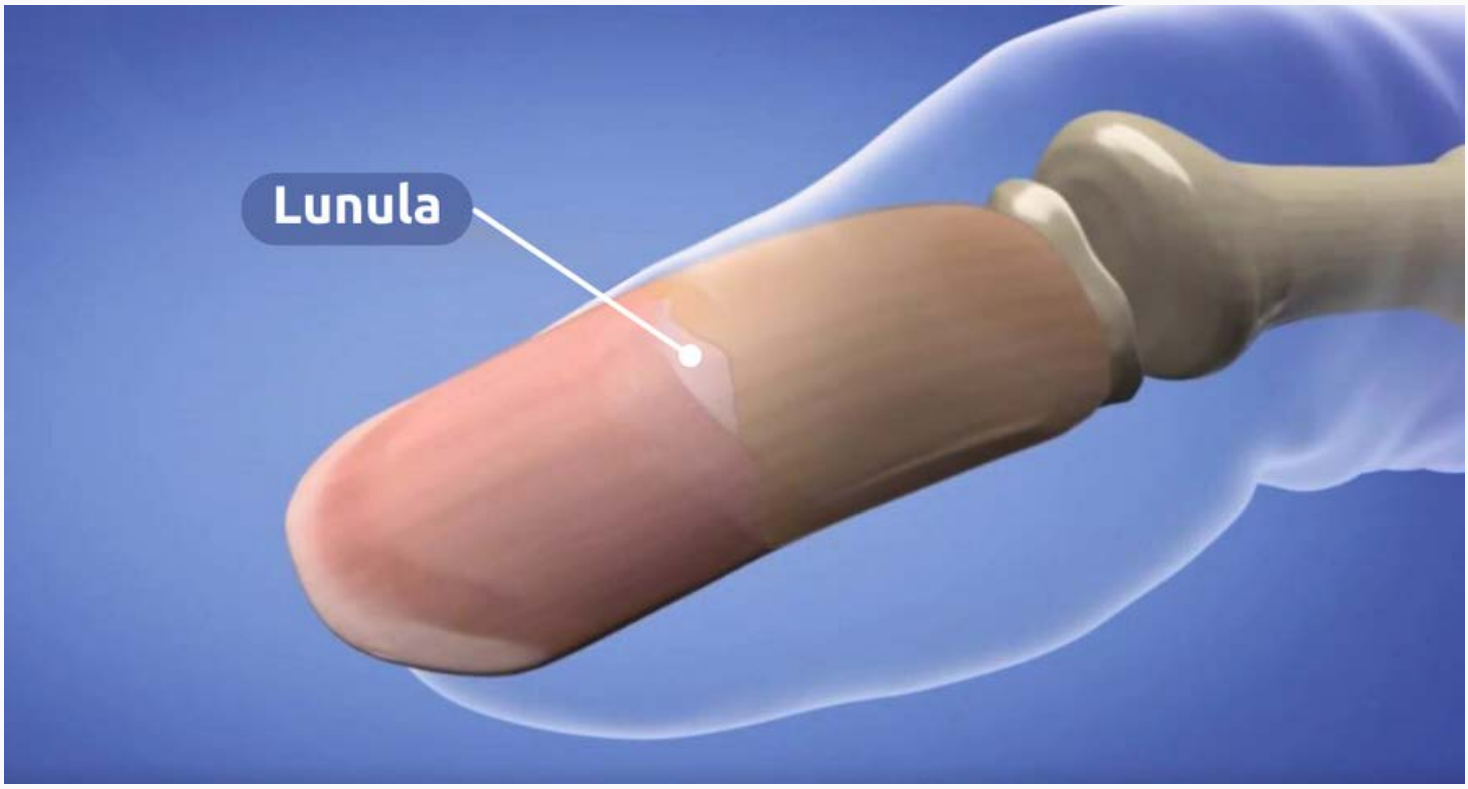


Figure 45: **The lunula is the distal edge of the nail matrix and is the half-moon shape by or under the proximal nail edge, occasionally, visible through the nail plate.**

Lateral Nail Folds

As the lateral in their name suggests, these are the side walls of the nail plate, containing a groove that guides the growth of the nail plate forward.

They can be quite deep or shallow but either way these 2 guardian seals, seal the sides of the nail bed and shouldn't be damaged for all the same reasons as the other seals. Sometimes little spikes of nail can appear in the nail folds, these are called hang nails. If a hang nail is nipped off with a tool it must not be pulled as this is the most common cause of paronychia: an infection in the side wall of the nail.

The sides of the nail plate are quite strong and it is not advised to file the nail plate down into the side walls as this will weaken it and lead to breakages as it grows out from this protection. Some cuticle from the eponychium will grow along the side walls and this can be carefully removed along with the rest of the cuticle. Maintaining all the seals of the nail unit is essential for nail health.

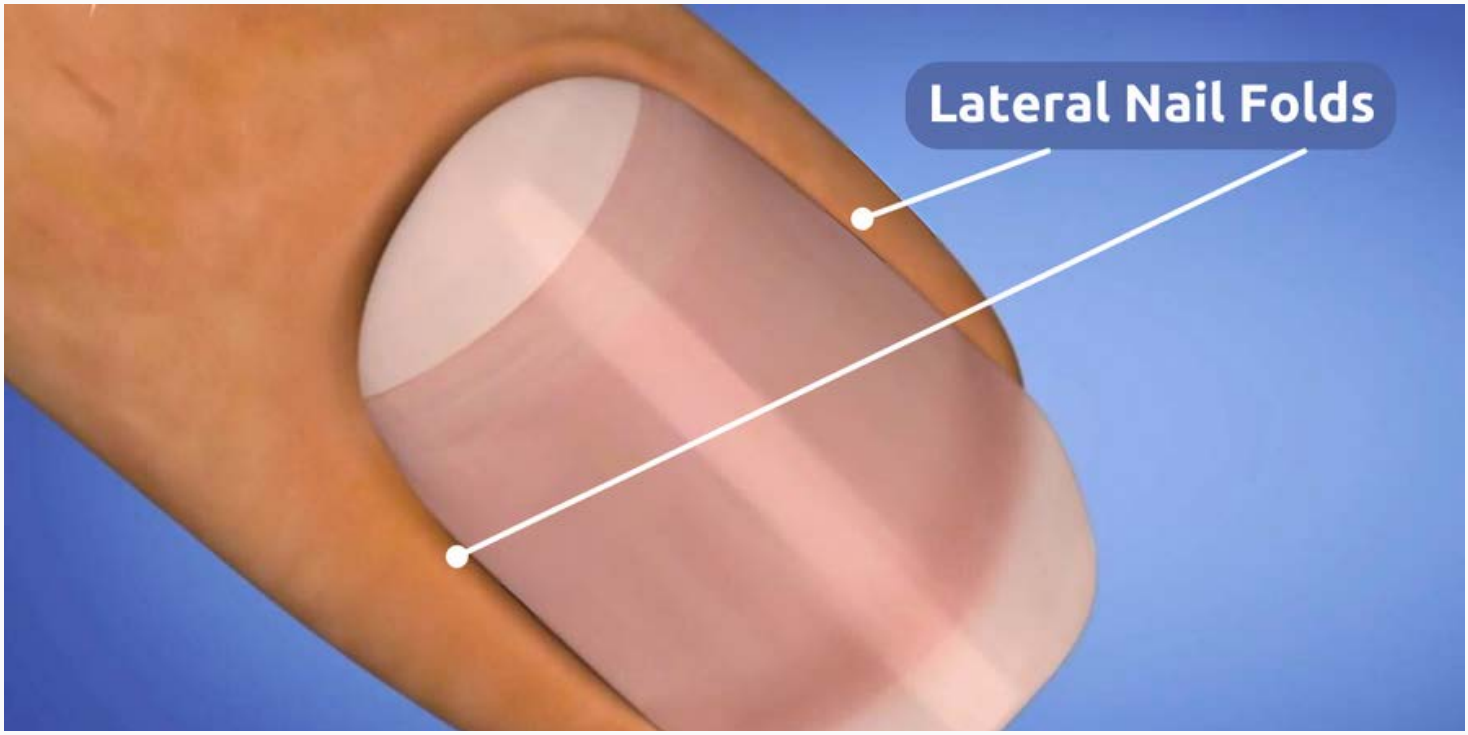


Figure 46: The lateral nail folds are the where the skin of the finger folds down along the side of the nail plate, providing protection as well as a groove that guides the nail plate as it grows.

The Natural Nail's Journey

The way that the natural nail grows is a fascinating and intricate process, involving various stages that contribute to its strength and appearance but also to its ability to recover, if and when needed.

The journey begins in the matrix where the nail plate cells are born. Initially, these cells appear white and round. As the cells develop, they are gradually pushed forward on their path from the matrix towards the fingertip. During this phase, the three different types of cells remain soft and translucent, yet they hold the potential for becoming the sturdy nail plate.

As the cells move out of the matrix, they undergo a transformative process. They harden and compact, gaining the strength needed to form a resilient nail plate. As they are pushed towards the proximal nail fold, the eponychium creates and attaches the cuticle to the nail plate creating the first guardian seal.

On the underside of the nail plate the matrix does the same and the bed epithelium attaches to the underside of the nail plate. The cells that have now formed the nail plate follow the groves in the nail bed while under the nail plate the bed epithelium has also created (matching) groves and together they hold the nail plate firmly against the nail bed.

On its way toward the fingertip, the lateral nail folds help keep the nail plate in position. Remember it is not fixed to the lateral nail folds, the edges of the nail plate just sit firmly in the paronychium cup creating two more guardian seals. Under the free edge where the nail plate becomes detached from the nail bed, the hyponychium forms where it is joined by the onychodermal band creating the fourth guardian seal.

The Natural Nail's Journey 50

Nail plate cells are created 24/7 and move forward continuously, disturbed only by trauma, shock or sudden illness that can limit the blood supply to the nail matrix and that causes a temporary stagnation in nail plate cell production.

The nail unit does all it can to maintain the nails' structure and strength, it will always reach the maximum possible result, enabling us to use our fingers and hands in so many amazing ways.

Understanding this journey empowers us to care for and appreciate our nails as they continue to evolve and grow, safeguarding not only their health and appearance but also helping us make the right choices when it comes to taking care of our client's nails in the salon or our own at home.

Summary

The nail unit is a truly amazing part of the human body, it is a masterpiece of evolutionary engineering and deserves to be cherished. Delving into the intricate world of nail anatomy reveals the remarkable design and functionality of our nails, each component plays a crucial role in the overall health and well-being of our nails and nail units.

By understanding the significance of all of these nail structures and how dependent they are on each other we can adopt effective strategies to care for our nails and choose the product that is best suited for them.

The proximal nail fold acts as a protective barrier for underlying structures, including the nail matrix.

The eponychium, attached to the underside of the proximal nail fold, plays a critical role in forming the cuticle, which acts as one of the important guardian seals protecting the nail matrix from infections.

The visible and hard part of the nail is the nail plate, its growth is dependent on the health of the nail matrix, it also serves as a protective shield for the delicate nail bed underneath. The bed epithelium also has a hand in this, sealing the nail plate on the underside and making sure it can ‘float’ across the nail bed and just under the nail bed lies the distal phalanx, that little bone is also responsible for the natural curvature of the nail plate.
The health, width and length of the nail matrix directly influences the thickness shape and structure of the nail plate.

Lying below it is the nail bed rich in blood vessels and nerve endings and exuding fluids that contribute to the nail plate's flexibility and strength. Where the nail bed ends the hyponychium begins and helped by the onychodermal band located just under the free edge of the nail plate,

along with the lateral nail folds they form three more guardian seals.

All four guardian seals work together to prevent bacteria, viruses and fungi from entering the nail unit. It is important to always handle the nail folds and hyponychium with care and remember the cuticle is non-living tissue that can be easily removed without damage to the nail plate or the nail folds.

Using quality nail & skin oils to maintain the balance of moisture will also protect the nail folds from dryness and keep the nail plate from becoming brittle.

Early detection of possible nail conditions and appropriate intervention really can prevent long-term damage, remember, the health of the nail unit is paramount.

Prioritise nail health first over aesthetic enhancements but rest assured that a healthy nail can be adorned with any or all of our artificial nail products, you or your nail technician should know which product suits your nails best.

Gentle cleaning, avoiding trauma and nurturing the nail's guardian seals, is essential to the health of our nails, they are an integral part of our body's defence system, shielding our fingertips and toes while allowing us to engage in various tasks with dexterity and grace.

As we navigate the intricate world of nail care, let us remain vigilant and attentive, seeking professional advice and guidance whenever needed.

Glossary

Cuticle
Thin layer of elastic non-living skin cells forming a seal with the proximal nail fold.

Dermis
Under the epidermis, contains collagen, elastin, blood vessels, and glands.

Distal
Opposite of proximal, further away from the center of the body.

Dorsal
Above or on the upper side.

Epidermis
The uppermost skin layer, providing protection.

Eponychium: Area on the ventral area of the proximal nail fold, shedding the cuticle.

Hyponychium
Area under the nail's free edge, providing a strong seal for protection.

Keratin
A tough, fibrous protein forming the main component of nails, skin, and hair.

Lamellar Dystrophy
Condition where the nail plate layers peel or delaminate.

Lateral
To the side; e.g., arms are lateral to the body.

Lunula
The visible part of the nail matrix, often appearing as a half-moon.

Nail Bed Dermis
Area under the nail plate, rich in blood vessels and nerve endings.

Nail Bed Epithelium
Specialised non-living skin layer attaching the nail plate to the dermis of the nail bed.

Nail Matrix
Area under the proximal nail fold, producing cells for the nail plate.

Glossary

Nail Plate
Layers of hard keratinised cells protect the underlying bone and provide rigidity to the end of the finger.

Onychodermal Band
Visible area of ‘bunched up’ nail bed epithelium, identified as the natural smile line.

Onycholysis
Separation of the nail plate from the nail bed.

Paronychia
Infection in the nail's side wall.

Proximal
Nearer to the center of the body or point of attachment.

Proximal Nail Fold
Skin fold at the nail plate base, nearest to the body centre.

Sebum
Oil-like substance produced by sebaceous glands.

Ventral
Opposite of dorsal, on the underside.

About the Author

Tracy Anne Shelverton

With 35+ years' experience in the nail industry Tracy has always loved all things nails including competing and judging in International Nail Competitions but her true passion was always the natural nail and the nail unit.

For the last 8 years Tracy has dedicated her nail career to education and finding safe workable solutions to ensure the integrity of the natural nail is maintained and or improved in the nail salon or podiatrist practice.

Tracy is a hand healthcare specialist specialised in the anatomy and pathology of the hands and nail unit. She is a teacher for Oncology Hand Care and registered OHV'r at IKNL and Kanker.nl, a columnist for Nail Design Magazine in The Netherlands, Belgium, France and Denmark and International Judge INJA.

She is the owner of Gorge Natural Nail Academy, a developer of tools and nail files aimed exclusively at the natural nail and the proud importer of Famous Names Products in the Benelux region.

About the Experts

Supporting Tracy and contributing to this eBook was our team of world-renowned professionals at NailKnowledge; highly experienced individuals dedicated to advancing the field of nail care and education:

Doug Schoon

Doug Schoon is an internationally-recognised scientist, author, and educator with over 30 years of experience in the cosmetic, beauty, and personal care industry. He is best known for his expertise in nail care and product chemistry. Doug holds a degree in Chemistry and is renowned for his in-depth knowledge and research in the field.

Marian Newman

Marian has worked in every aspect of the nail industry since opening a 'nails only' salon in 1987. Author, teacher, brand educator, she was regarded as one of the top nail practitioners in the world, with a long history of working with some of the world's leading designers, as well as the London, New York, Milan and Paris fashion shows.

Vitaly Solomonoff

A cosmetic chemist and formulator with a background and experience in clinical medicine (dermatology), Vitaly is an educator and international nail judge.

About NailKnowledge

Your Source for Nail Education and Inspiration

NailKnowledge is on a mission to revolutionise the standard of education within the Nail Industry - to support Nail Technicians throughout their careers, empower nail enthusiasts, and ensure the safest possible nail practice for all.

Why NailKnowledge Matters

In recent years, we've witnessed a rise in allergies among both nail technicians and clients. Additionally, the market has been flooded with cheap nail products from overseas, often lacking brand education or quality standards. In this ever-evolving landscape, our mission has never been more important.

Expert Collaboration for Quality Education

To achieve our mission, we've assembled a team of worldwide leading experts in the nail industry. This collaborative effort, coupled with the skills of talented animators and designers, allows us to create high-quality educational content that will transform the way both Nail Professionals and Enthusiasts learn.

What We Offer

Our courses cover a wide range of topics, including nail anatomy, product chemistry, health and safety, and allergies. Whether you're a Nail Technician seeking to enhance your skills or a Nail Enthusiast looking to deepen your knowledge, NailKnowledge has something for you.

Fact-Based Learning

We believe in fact-based learning that provides you with the latest industry insights and practices. Our flexible, interactive, and visually engaging courses are designed to cater to your specific needs and interests.

Join Us on Your Nail Journey

Visit NailKnowledge to explore our diverse range of courses and eBooks. Whether you're following your passion, aiming to master product chemistry, or seeking additional qualifications to set yourself apart, NailKnowledge is here to support and empower both professionals and enthusiasts in their nail journey.

“In my view, Tracy Anne Shelverton is one of the leading nail educators in the world today, she possesses an important trait that all educators should aspire to achieve. It’s NOT about being right, it’s about being correct.”

Doug Schoon
Internationally-recognised Scientist, Author and Educator

NailKnowledge

www.nailknowledge.org