

The Science

ANATOMY AND PHYSIOLOGY: NAIL TREATMENTS

Hairdressers learn about the structure of hair, how it grows and where it comes from; beauty therapists learn about the structure of skin, the underlying muscles and bones and the basic workings of the human body. They do this in order to understand the area that is being treated, how to vary treatments for individuals, how to recognize potential problems and how to put right something that has gone wrong. Nail technicians must do the same. They must learn about the area of the human body they deal with. This will ensure that they work safely, understand when and how to adapt treatments, give the best possible advice to their clients, and know how to deal with problems.

Areas of the body are not isolated. The body functions because several systems within the human body work together. When one of these systems does not work properly, many areas of the body and other systems are affected. The main 'systems' in the human body are, the nervous system; cardiovascular system (heart, lungs and circulation); digestive system; skeletal system; endocrine system (glands); urinary system; and reproductive system. Many organs are concerned with and form part of these systems and, when they all function correctly and efficiently, we have a healthy body.

Although it is not necessary to have an in-depth understanding of all the workings of the human body, it is useful to have a basic understanding of how all areas affect the parts relevant to a nail technician.

A natural nail is an adaptation of the skin and is surrounded by skin. By understanding how the skin is formed and why, helps us to understand how a nail is created and what may be happening if the nail is growing less than perfectly. The hands and feet are a collection of bones, connected by muscles, nourished by a blood supply, and surrounded by skin.

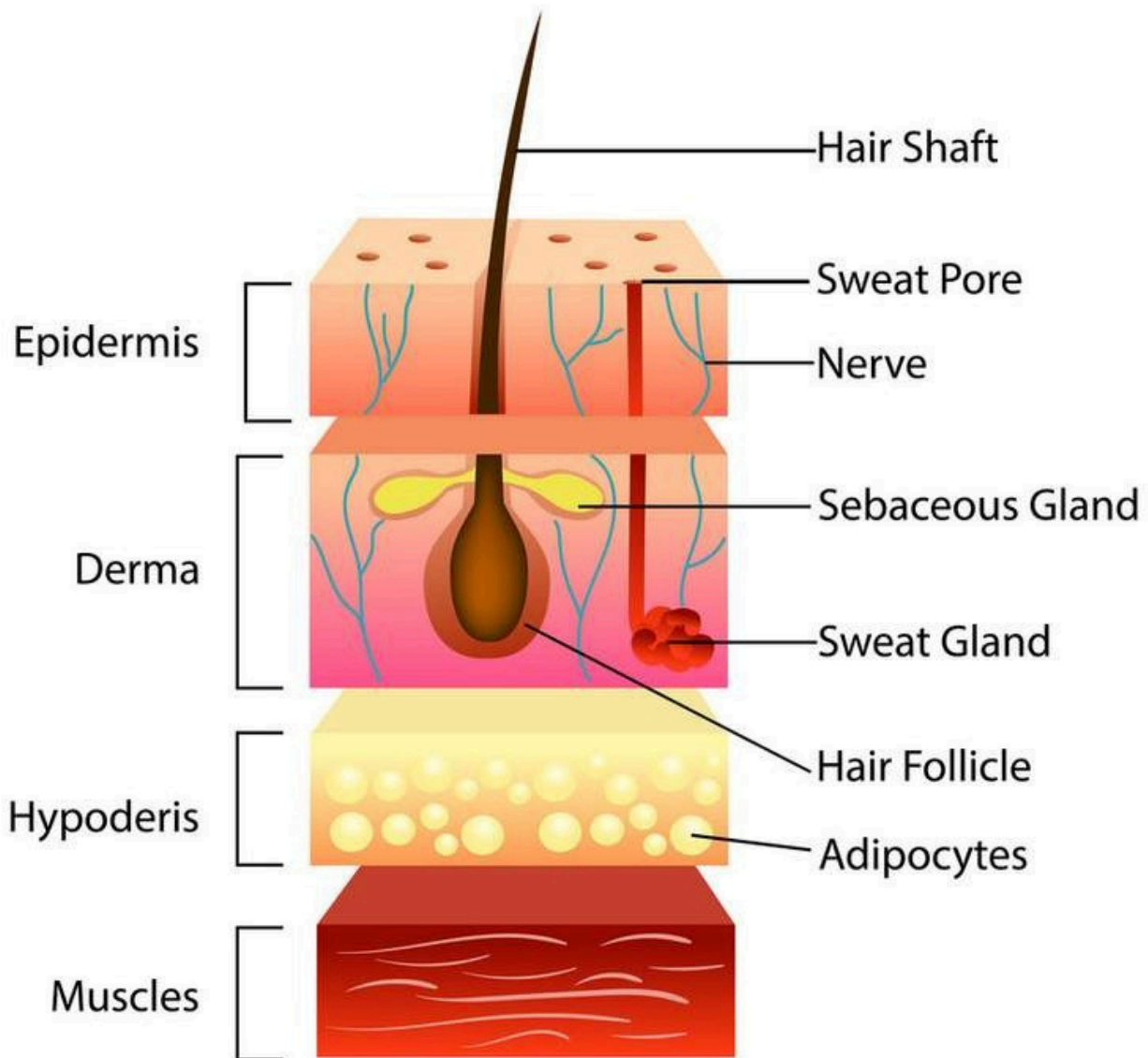
ANATOMY OF THE SKIN

The largest organ of your body is your skin. This amazing organ is a fine-tuned barrier that selectively allows certain substances into the body, while keeping harmful pathogens and pollutants out. It is a sophisticated filtration system that protects us from negative environmental factors.

Our skin is vital for preventing internal organs and tissues from being exposed to ultraviolet (UV) radiation, pollutants, toxins, temperature extremes (thermoregulation), and microorganisms such as viruses and bacteria (immunologic surveillance). Additional essential functions of our skin include sensory perception and fluid control.

The epidermis, dermis, and the hypodermis are the three main layers of skin. The layer we see in the mirror is the epidermis. This visible outer layer is made up of approximately four to five layers of skin cells. The thickness of the epidermis is dependent on where it is located on the body. Our sturdiest and thickest layers of skin are found on the palms of our hands and the soles of our feet.

These five layers of skin cells are 1.5 mm thick and regularly take a beating in daily use, so it is understandable that is where the thickest layer of skin would be found. The areas of the body with 4 layers are known as "thin skin." The thinnest layers of skin at 0.05 mm in thickness are found behind the ear and on the eyelids.



The middle layer of skin is referred to as the dermis. The dermis is the area often addressed in anti-aging treatments because it is where we find fibroblasts and collagen, factors that contribute to whether our skin looks wrinkled or more youthful in nature. The dermis contains not only collagen, and fibroblasts but hair roots, elastin, sebaceous glands, blood vessels and sensory structures.

The dermis itself is further separated into two layers: the papillary above and the reticular layer on the bottom. The dermis provides cushioning and protection and gives us our sense of touch. While epidermal thickness remains fairly constant throughout life, dermal thickness will vary with age.

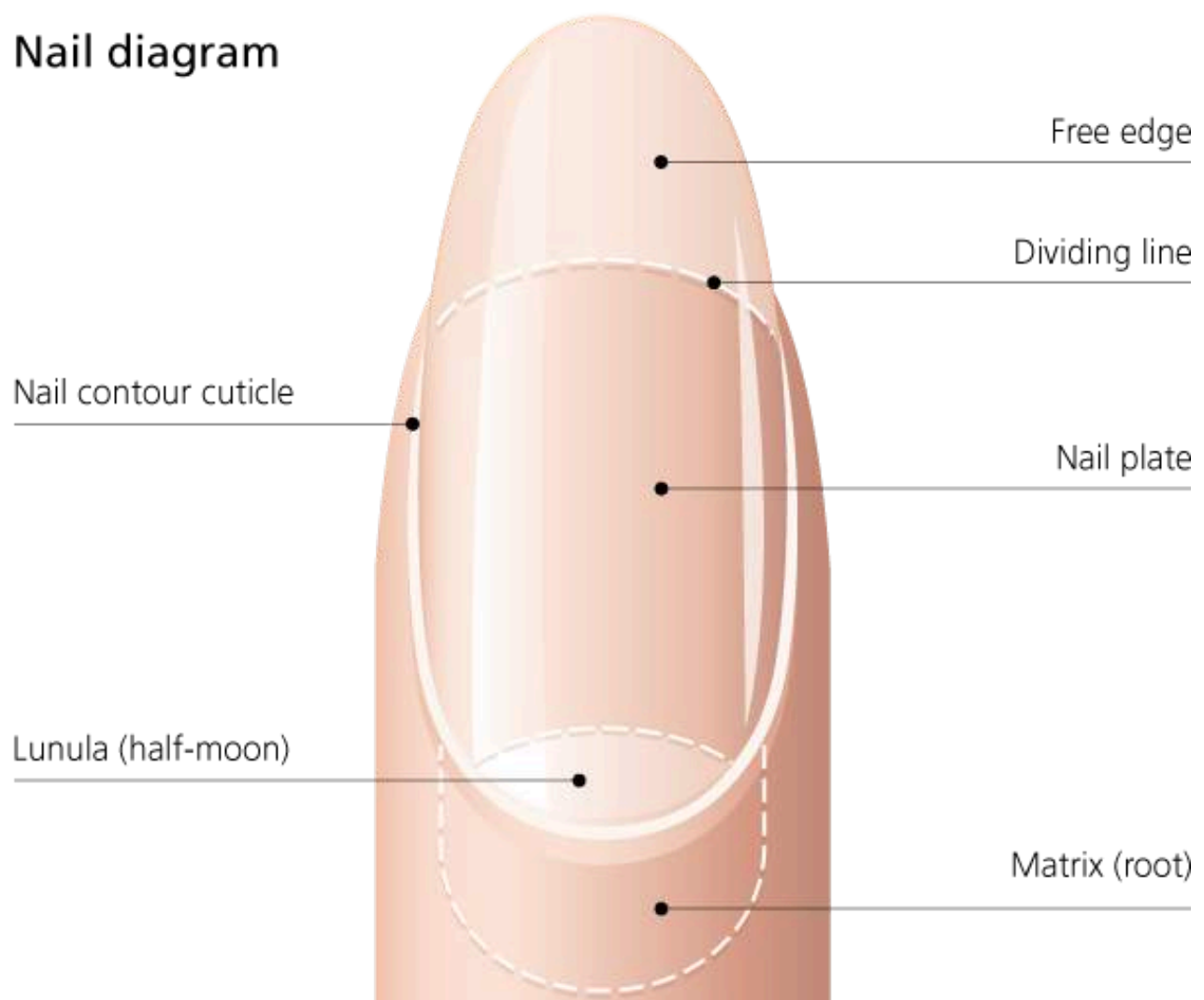
Underneath the dermis and epidermis is the deepest layer of skin, the hypodermis. The hypodermis is also known as the subcutaneous fat layer, or subcutaneous tissue. This layer of fat insulates us and helps regulate our temperature.

TIP: A gentle pinch to the skin on the backs of the hands demonstrates age and skin condition. A young and hydrated skin recovers immediately. Older and/or dehydrated skin takes longer to recover. Experiment on different ages of skin to discover the difference.

THE NAIL UNIT

A basic understanding of how the skin is structured and how it grows should help with understanding how finger and toenails are formed as a nail unit.

Nail diagram

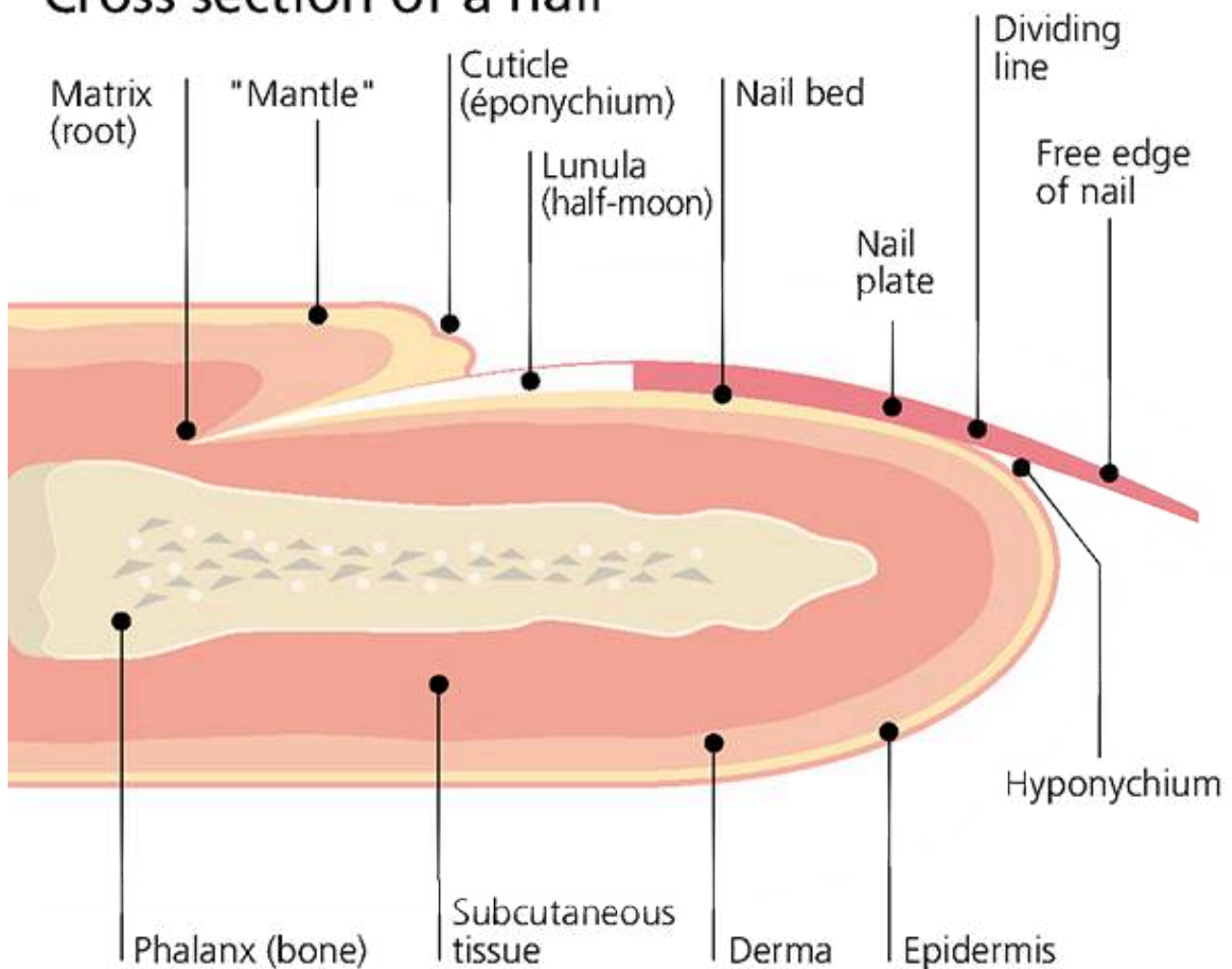


Like the hair follicle, the area where the nail starts life is a fold of the epidermal layer where skin cells are instructed by their nucleus to make certain adaptations. In the skin, they become keratinized to form the flattened cells of the stratum corneum. In a hair, they are keratinized and adapted to create a hair shaft. In a nail, they are also keratinized and form flat layers that make up a hard nail plate. Like the upper layer of the epidermis (stratum corneum) and hair, the nail is non-living.

THE FUNCTION OF THE NAIL

All species of primate have nails. They are linked to the evolution of using hands (and feet) to manipulate objects. Humans, however, are the only animals able to use the thumb and forefinger in a pincer movement. The higher primates, such as gorillas and chimpanzees, have hands that are very similar to ours with fingerprints and perfect nails, but they cannot manipulate their thumbs as we can. There is a theory that this arrangement of our thumbs gave our species the opportunity to evolve faster, as we were able to use a wider variety of tools.

Cross section of a nail



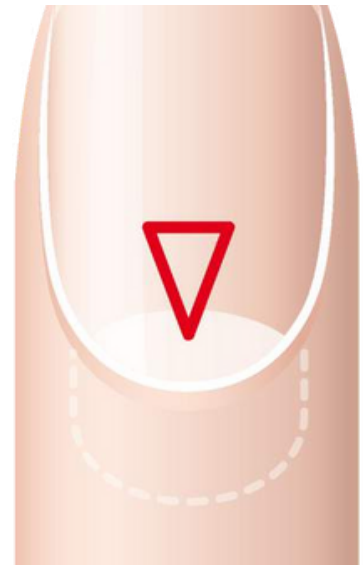
Nails are on the ends of our fingers for several reasons and are not just there to paint or chew! They provide a rigid support for the end of the finger, allowing us to pick things up more easily, and they protect the end of the finger and the last bone from countless knocks.

Nails start to form in an unborn baby very early in the gestation period and by 17–20 weeks are fully formed. Nails will even grow for a short period after death, as the cycle of adaptation of the skin cells and keratinization will continue, once it has started, without any nourishment from the blood supply.

THE STRUCTURE OF THE NAIL

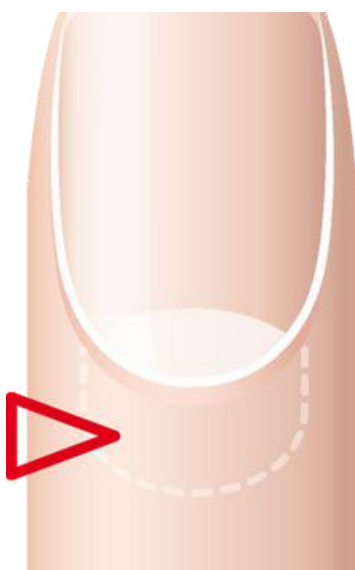
MATRIX

This is the most important area of the nail unit. It is directly under the proximal nail fold or mantle, and it is where the skin cells are adapted to form the nail plate. As the skin cells become keratinized, they bond together and lose the other cell contents. Unlike in the epidermis, where the bonds break down and the cells are shed, the bonds in a newly forming nail plate are much stronger, and the lipid content is retained. The keratinized cells form layers, or lamellar, and several of these bonds together to form the nail plate.



The shape and size of the matrix will determine the thickness and width of the nail. The matrix extends from the base of the nail down towards the first joint. The longer the matrix, the thicker the nail. Thin nails will tend to have a short matrix. The width of the nail will be determined by the width of the matrix. Naturally thin (or thick) nails are hereditary; however, a lot can happen to them once they are grown to change this characteristic.

The developing nail in the matrix is very soft until full keratinization has taken place and damage to this area can result in a permanently deformed nail. Examples can be seen in a person who has shut their finger in a door, even as a child. If the area of the matrix is damaged, the base of the nail and the nail plate may have a permanent ridge. Another example would be if someone has had a serious infection in the area. If damage to the area is temporary and heals properly in the matrix, any deformity to the nail should grow out in approximately 6 months after the damage has healed.



PROXIMAL NAIL FOLD OR MANTLE

The epidermis of the skin on the finger, above the matrix, folds back on itself and underneath. As in the hair follicle, the deeper area of the fold forms part of the germinal matrix and helps protect the area.

This area of skin can often be quite large and unsightly, for example, when it is stuck to the cuticle, the nail grows and pulls the skin with it. When the skin is overstretched it splits, usually at the sides, and appears ragged. These splits can be quite sore and, if pulled, can become infected and inflamed. The split piece of skin can be very carefully removed with cuticle nippers.

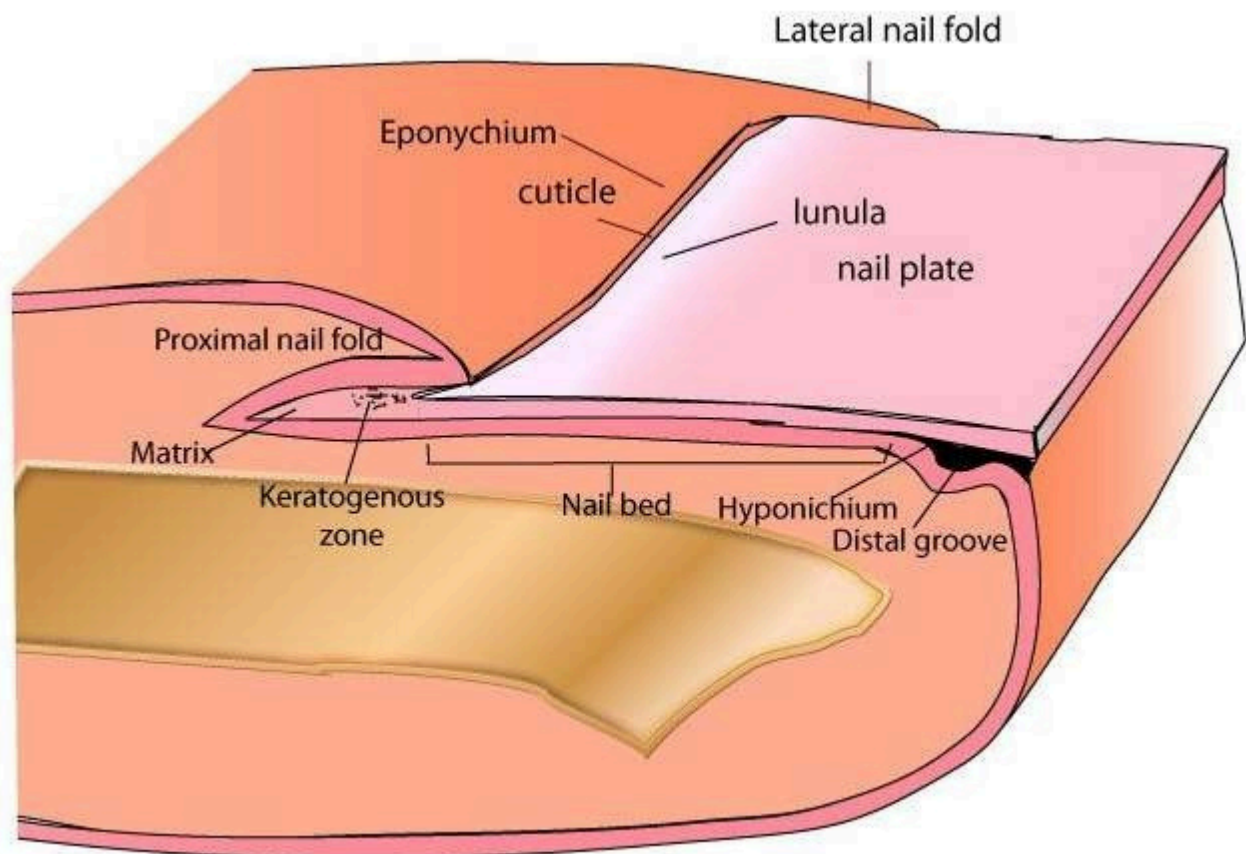
Proper care of the nails ensures that the nail fold does not stick to the nail plate as it is regularly lifted away. This area should not be pushed as this can cause damage to the underlying soft nail and matrix. The area also forms a seal around the proximal edge of the nail that prevents bacteria from entering.

When the nails are soaked in water or softened with oils, the nail fold can be lifted with ease. It is not recommended that the lifted skin is cut on a regular basis. The body is expert at protecting itself and, if an area is removed, the body will often compensate and grow thicker skin.

If the skin has been lifted for the first time and is unsightly, careful removal may be carried out with a hygienic pair of nippers, used correctly. The area should then be treated with oil or cream to keep the skin soft and prevent it from sticking to the cuticle.

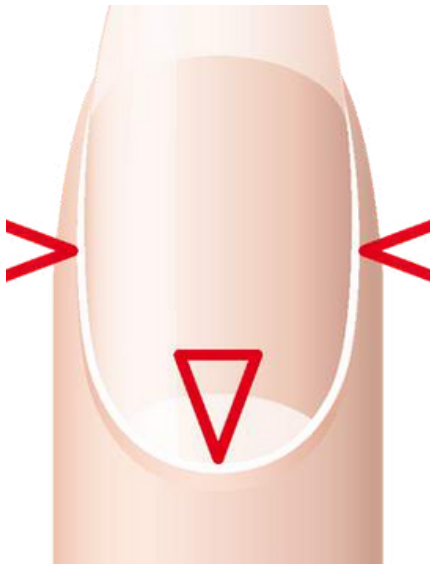
LATERAL NAIL FOLD OR SIDE WALL

The skin of the finger folds down along the side of the nail and provides the nail plate with protection and a groove to guide the growth of the nail. A seal is formed here to prevent the invasion of unwanted substances or microorganisms.



EPONYCHIUM

The eponychium is an area at the base of the nail plate where the proximal nail fold meets the nail plate. It acts as a seal for and guards against invasive bacteria. During a manicure, this area should be treated gently because, if the seal is broken, not only is it painful, but infection can occur.



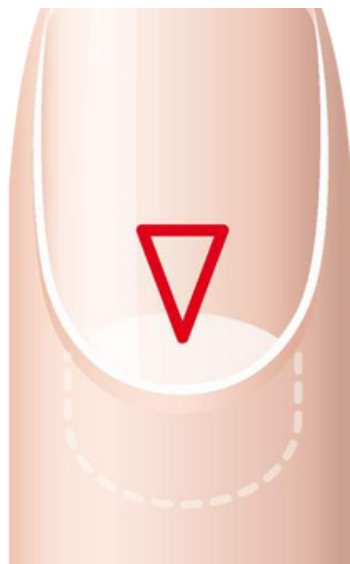
THE CUTICLE

The nail fold is often called the cuticle, but this is inaccurate. The underside of the proximal nail fold constantly sheds a layer of clear skin that sits on the nail plate and grows with it. This is the real cuticle and is not always visible until softened. This is the skin that should be removed during a manicure and always before the application of artificial nails to avoid any lifting problems, as products do not bond with skin, only with the nail plate. This skin is sometimes called the pterygium. When using a cuticle knife, it is usually possible to feel the difference between skin and hard nail even if the skin is not visible.

As the epidermis of the nail fold produces this layer continuously, there is always some to be found on the nail plate, however little.

THE ONYCHODERMAL BAND

This is the area of the hyponychium where a slight change of color in the skin can be seen. When applying a French manicure or artificial nails using a white-tip, powder or gel, it is referred to as the 'smile line' & its ideal shape should mirror the shape at the base of the nail to create a symmetrical 'top and bottom'.



THE NAIL PLATES

As previously explained, keratinized skin cells form the nail plate. These flattened cells stick together and form layers.

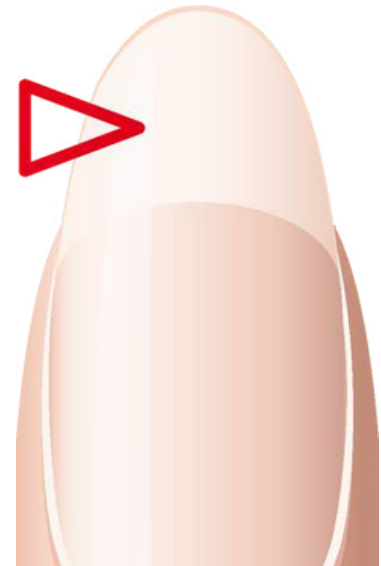
There are approximately 25 layers of keratinized skin cells. There is less concentration of lipids (fats) in the nail plate compared to the stratum corneum (1 per cent versus 20 per cent) and there are many air spaces; this allows ten times as much water to be absorbed by the nail than by the skin.

This can be seen when the nails are soaked in water, e.g., in the bath they become very transparent and flexible.

The bonds holding the cells together are tougher in the nail plate than in the stratum corneum, as the skin cells are designed to be shed, whereas the nail plate needs to be kept together. Evaporation of water soaked up by the nails can be quite damaging as it breaks down the bonds that hold the cells together causing weak & peeling nails. In fact, water is one of the most damaging substances for nails.

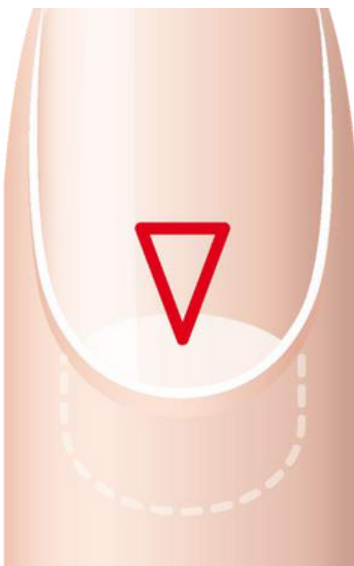
The uppermost layer of nail is formed in the deepest part of the matrix, while the lower layers are formed nearer the cuticle. This results in a very hard surface & much softer lower layer of the nail plate.

The layers of keratinized cells form themselves into three main layers of nail plate. The upper and lower layers are the thinnest with the middle layer making up approximately 75 percent of the nail plate. The upper layer is dense and hard, but thin. This is the layer that often peels, due to the damage caused to the bonds between it and the middle layer, exposing the slightly softer but thicker middle layer.



The break in these bonds allows more water to seep between the layers and causes further peeling. The lower layer of the nail plate is very thin and contains some soft keratin. This layer bonds strongly to the nail bed. When nails become too dry and peel, not only are they thinner, but also the hard-upper layer has been lost, leaving the pliable and weaker lower layers. Nails must be protected from this condition and that is why wearing gloves for washing up, etc. is always recommended. Nail varnish can also help protect the nails, as can massaging oils or cream into the cuticle area.

As the nail plate leaves the end of the finger, it forms a projection called the free edge. This appears whiter than the main body of the nail as it is not attached to the nail bed. The nail plate has a proximal and distal area, and the free edge could be described as the distal edge.



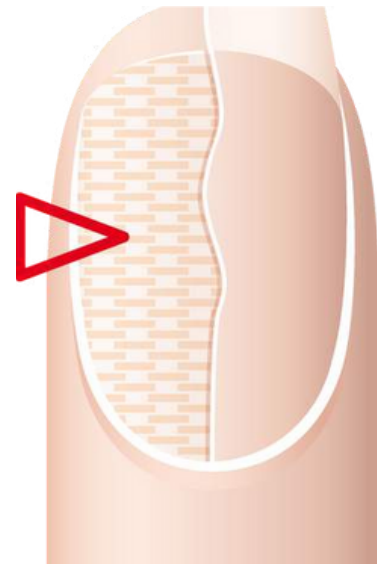
LUNULA

The lunula is also known as the half moon, an area of the nail by or under the proximal nail fold, and the front end of the matrix. It appears whiter because the cells are not yet completely keratinized and not totally transparent. Not every person has an exposed lunula and it is a misconception that the lunula (or half-moon) should be visible. The nail is still slightly soft in this area and easily damaged so, if anything, it is better that the lunula is protected by the nail fold. People who have a large exposed lunula usually have very ridged nails which is often more noticeable on the thumbs.

This is due to continual trauma to the soft nail from everyday living. During a manicure or any work done in the cuticle area, care must be taken not to press too hard on the lunula, as it will cause a ridge in the nail that will need to grow up and off the end before it disappears.

THE NAIL BED

This lies directly under the nail plate. It is skin just like on the rest of the body, but it has a very rich supply of blood and lymph vessels to keep the nail healthy. It also has a series of ridges and grooves that fit into ridges and grooves on the underside of the nail plate. These are what hold the nail onto the nail bed. If the ridges are disturbed or if the nail plate becomes too thin and flexible, this 'hold' is broken and causes the nail plate to separate from the nail bed. This is a dangerous situation as it allows bacteria in under the nail that could cause severe problems. Nail technicians must take extreme care not to over-buff the nail, as this will cause the nail to become too thin.



If this thinning occurs anywhere on the nail, it will eventually grow up to the end of the nail bed where it is most likely to result in separation. The nail plate appears pink in this area, owing to the colour of the underlying skin .

THE HYPONYCHIUM

This is the area of skin at the very end of the nail bed under the beginning of the free edge. It forms a very tight seal that prevents bacteria entering. There are many nerve endings in this area that act as a warning to this seal being broken. Sometimes, this area grows under the free edge, especially on those people with almond shaped nails, and forms an area that can be painful if pushed. It is thought to be a form of support to the free edge and care must be taken not to disturb it. It is sometimes called the solehorn. Like all areas of skin, the epidermis sheds dead skin cells continuously. These cells can often be found under the free edge, especially of the toenails, where they get trapped.

THE PROCESS OF NAIL GROWTH

Rates Of Growth

Like hair, nails grow at different rates in individuals and at different times of the year but, unlike hair, grow continually. Fingernails grow faster than toenails. As an average guide, nails grow at the rate of between 3mm per month and it takes approximately 5-6 months for a fingernail to grow from the matrix to the free edge and up to a year for a toenail. The growth rate is faster in the summer and during pregnancy and usually slows down with age. It can be speeded up or slowed down by illness. This slow growth rate complicates the treatment of nail conditions as damage caused to the nail plate takes a long time to grow out.

The speed or strength of nail growth is not linked specifically to diet, vitamin or mineral intake but can be improved, along with the condition of skin and hair if a well-balanced diet is followed.

It is quite common to be able to see the effects of systemic trauma on the nails. For example, a general anesthetic, bereavement, illness, etc. will often show up as a line or ridge on the nail plate where the growth has been affected.

Technicians and their clients will often notice an increased growth rate immediately after artificial nails have been applied. This is due to the stimulation produced by buffing during application. The nail matrix and nail bed have a concentrated supply of blood and lymph vessels that supply the area with nutrients and remove waste products. Stimulation of the circulation in this area will improve this function and assist growth.



Buffing the natural nail during a manicure is a valuable treatment, but care must be taken not to thin the nail or create too much heat through friction, as this can cause splitting.

The effect of stimulation to the circulation can be seen in the general growth of nails: nails on the dominant hand grow faster, as does the forefinger. Nail biters have faster growing nails owing to the continual nibbling.

As a technician, the growth rate of an individual's nails will affect maintenance treatments. Artificial nails must be maintained to compensate for this growth. The majority of clients will need to return every 2-3 weeks, but some clients need to return only every 4-5 weeks, as their growth rate is slower.

NAIL COMPOSITION AND STRENGTH

KERATIN AND AMINO ACIDS

The skin cells that are formed in the matrix have, in their nucleus, the 'instructions' needed to keratinize but, unlike the keratinized skin cells of the stratum corneum that form a barrier and then are lost, these cells form together to create the hard nail plate layers.

Keratin is a type of protein that is made in the body and the body has many different proteins that are essential to its functioning. Proteins are made up of certain sequences of amino acids. Amino acids are chemicals created by the body that, when linked together in various specific sequences, make the necessary proteins. The linked amino acids form long 'strands' and these strands are then linked together at intervals with another amino acid, bonding the strands together and creating a strong structure. The keratin of the nail has many more of these bonds than that of the skin and hair.

Hard and soft nails the progression of cells from the matrix to the nail plate is very similar to those making the journey in the epidermis of the skin. The cells are created by cell division deep in the matrix and, as they are pushed forward, lose the cellular fluid, and become flatter. The lunula is thought to be an area where this process has not quite finished, hence its whiter appearance. As the cells are pushed forward by the reproducing cells behind, they become completely keratinized, flat and hard. Therefore, the nail plate nearest to the nail fold is softer than the distal edge and can be easily damaged.

- A strong nail is one that can withstand breakage. This does not necessarily mean hard as 'hard' could suggest brittleness and the nail could easily snap. Many products on the market are nail 'strengtheners', and that can mean nail 'hardeners'. If a weak nail is hardened too much, it will become brittle. If a hard or brittle nail becomes too soft and flexible, it will tear. The spaces between keratinized cells are full of moisture from the nail bed beneath and from external sources. The right amount of moisture will keep the nail flexible and help absorb shocks. Too much, and the nail bends, too little and the nail becomes dry and brittle.
- The nail plate is very absorbent and too much water can cause splitting and peeling. Excessive water can cause the nail plate to soften and swell. Repeated softening and swelling can cause surface peeling. The only truly effective moisturizer for skin and nails is
- water (and natural lipids), but in the right amount. Using creams and oils is beneficial as they can seal natural moisture in and keep too much out. Solvents, such as acetone and nail varnish removers, can remove natural oils and water and can be the cause of dryness if overused. The perfect nail is a combination of strength and flexibility. A nail specialist
- should be able to diagnose the exact condition of a client's nails and be able to recommend the ideal treatment and products. It may be that a weak nail needs a hardening treatment for a period of time followed by a moisturizing treatment. A brittle nail may need moisturizing then hardening. An understanding of nail growth and structure brings with it the ability to correctly diagnose conditions.

PROTEIN, CALCIUM AND NAILS

As mentioned before, nails are keratinized skin cells. Keratin is a protein composed of amino acids formed together in long chains and linked by an amino acid bond. The vast number of these strong bonds is specific to nails and is what makes them so much harder than skin and hair. The protein, keratin, is mostly composed of carbon, oxygen, nitrogen, Sulphur, and hydrogen. The nail plate also has traces of many other chemicals, e.g., iron, zinc, sodium, calcium, titanium, even aluminum, copper, gold, and silver.

There are many myths about calcium and nails. The body's intake and absorption of calcium is essential for teeth and bones, but as calcium is only 0.07 per cent of the nail, it does not play a large part. The body needs vitamin D in order to absorb calcium and that is obtained from the sun and diet. If this vitamin is lacking, conditions such as rickets can occur.

White spots on the nail are often blamed on a lack of calcium, but this is usually incorrect (see Chapter). They are usually caused by trauma to the nail plate causing minor separation of the layers. In rare instances, the spots may be caused by lack of the trace element, zinc, in the body, but a reasonable diet and good health does not cause this condition.

THE ARTIFICIAL NAIL AND THE NATURAL NAIL

The strength of the nail can be influenced, even during the wearing of artificial nails or varnish. The nail plate is at its softest in the area of the cuticle and there should be a narrow margin of nail that is not covered.

A nourishing oil massaged into this area daily will affect the new nail growing, so weak or brittle nails can be improved while artificial nails are worn. The massaging will stimulate the area and the oil will help to reduce the moisture loss from the new nail. If the artificial nails are correctly maintained, the natural nails should be stronger when they are removed.

Can artificial nails damage natural nails? They certainly can if they are incorrectly applied, or the wearer does not understand how to look after them properly. It is usually an inexperienced or unprofessional technician or an uneducated client who causes damage to natural nails. It is really important that technicians explain what the wearer needs to do (or not do) in between treatments.

Summary

THIS MODULE HAS EXPLAINED THE BASIC ANATOMY AND PHYSIOLOGY OF SKIN, MUSCLES, BONES, BLOOD CIRCULATION, THE LYMPHATIC SYSTEM, THE NERVOUS SYSTEM AND NAILS, NAIL STRUCTURE AND GROWTH AND THE POTENTIAL PROBLEMS A TECHNICIAN MAY ENCOUNTER IN TREATING A CLIENT IF NAIL TRAUMA OR PAST ILLNESS HAS OCCURRED.