Anatomy and physiology of the nail

Christian Dumontier
Institut de la Main & hôpital saint Antoine, Paris
Anatomy of the nail

- The osteo-ligamentous support
- Nail plate
- All surrounding tissues, i.e. the perionychium
The distal phalanx

- Is reinforced laterally by the Flint’s ligament
- Which protect the neuro-vascular structures
Flint’s ligament
The ligamentous support

- The nail is fixed onto the bone through a highly vascularized dermis
• The nail is fixed onto the bone through two strong ligaments
The ligamentous structures

- All the ligaments merge together with
  - The extensor tendon
  - The flexor tendon
  - The collateral ligaments
  - Flint’s ligament
  - Guero’s dorsal ligament
  - (Hyponychial ligament)
Clinical implications

• A normal nail cannot grow on an abnormal support +++
  • Large phalanx = racket nails
  • bony malunion = nail dystrophy
  • arthrosis = Pincer nail,...
The nail plate

- Is produced by the germinal matrix

- Keratinic structure, partially transparent and curved both longitudinally and transversally

- Three different layers

- 0.5 mm thickness, 20% of water

- Its shape depends on the bony support and the integrity of the soft tissues around it
Clinical applications

- The nail plate is often intact in crushing trauma due to its flexibility.

- And must be removed in order to explore all the lesions.
The perionychium

- Include all the soft-tissues located under the nail plate
  - Nail (germinal) matrix,
  - Nail bed,
  - Hyponychium
The perionychium

- Soft-tissues around the plate (paronychium) proximal and lateral nail wall (fold) and the cuticle
The (germinal) nail matrix

- The only site of production of the nail plate
- Extend distally to the lunula
- Also extend over the nail plate
- Cannot be replaced by any other tissue +++
The nail bed

- Specialized structure responsible for:
  - Nail plate adhesion
  - Nail plate shape
- May sometimes be replaced by another tissue
Hyponychium

- Transitional zone where the nail plate lost its adhesion +++
- Acts as a barrier against microbial infection
- Its lost is responsible for a painful attachment of the plate to the pulp
Proximal nail fold

- It covers the plate and participates to its shape by molding the plate and pushing it distally
- It is fixed to the plate through the cuticle
Lateral nail folds

- Hold the nail plate and give it its shape and direction
Vascularization

- 4 origins
  - Flint’s artery
  - Arch of the proximal fold
  - Transverse arches under flint’s ligament
  - Distal arteries coming from the pulp

All those vessels are anastomotic
Flint’s a.
Proximal nail fold arch
Transverse arches
Distal vessels from the pulp
Venous drainage

- Very rich
- Non systematized
- Only around the DIP joint can we find veins that diameter is compatible with microsurgical anastomoses
To summarize!
Innervation

- Very rich
- Nerves usually follow the arteries
Physiology of the nail

- Mostly unknown +++
- Sketchy knowledge
- Little possibilities of animal experimentation
- Little surgical works
Nail growth

- The nail plate is produced by the nail matrix
- Normal growth is about 1.9 to 4.4 mm/month (0.3 mm per day)
Clinical consequences

- It needs two months for the plate to exit the proximal nail fold.
- It needs 6 months for a complete nail plate re-growth.
- The first plate is always irregular, so clinical results can only be evaluated at one year follow-up.
After a trauma

- Nail plate growth stops for 3 weeks
- The proximal part of the plate thicken
- The growth accelerates for 50 days (the nail plate gets thinner)
- Then the nail growth is slower for 30 days
After a trauma

- Apparition of a transverse line on the nail plate: the Beau’s line
- Which width is related to the duration of the trauma
- Which moves distally with time
Clinical consequences

- A matrix lesion (or a scar) cannot produce nail plate.
- The plate will appear separated or with a crack. A scar on the proximal fold will induce a pterygium.
- Maximum loss of substance without sequelae is 3 mm.
Clinical consequences

- Nail bed lesions will limit the nail plate growth and adhesion
  - Onycholysis
  - Fissure, cracking,...
  - Nail fragility (onychoschizyzy)
The nail is a complete organ

• Shape of the plate
• Depends of the folds (proximal > lateral)
• but also of the nail bed
• And of the bony structures under it