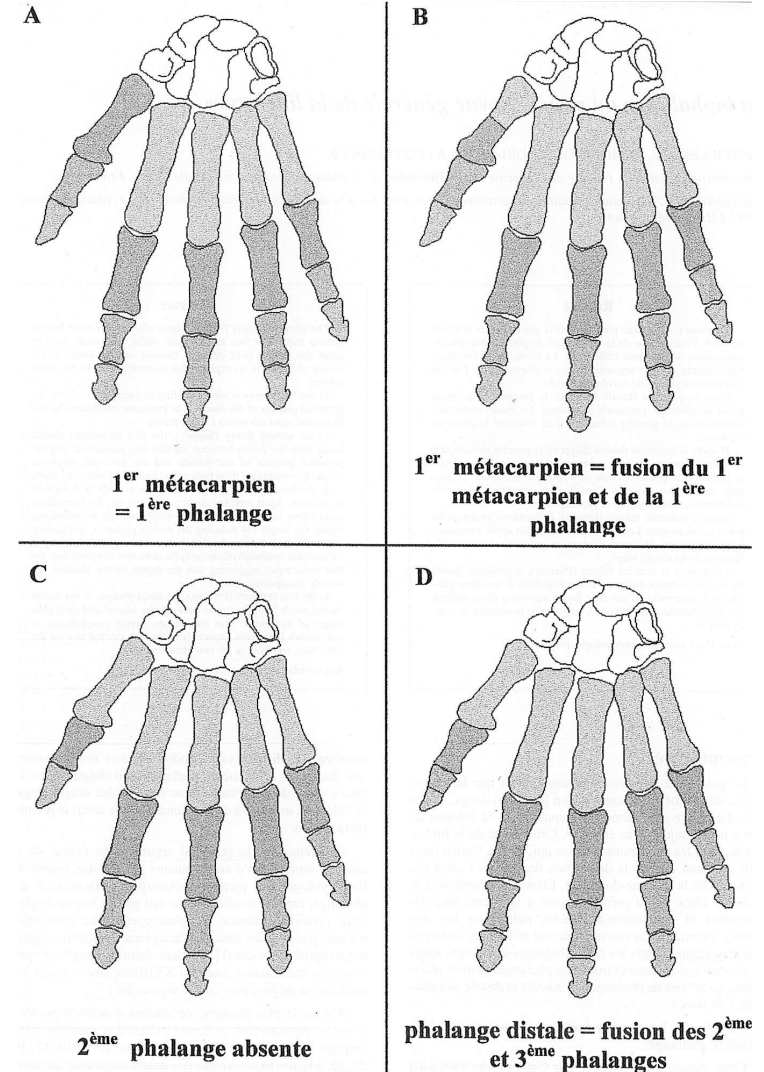


Thumb biphalangy

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(Lille)

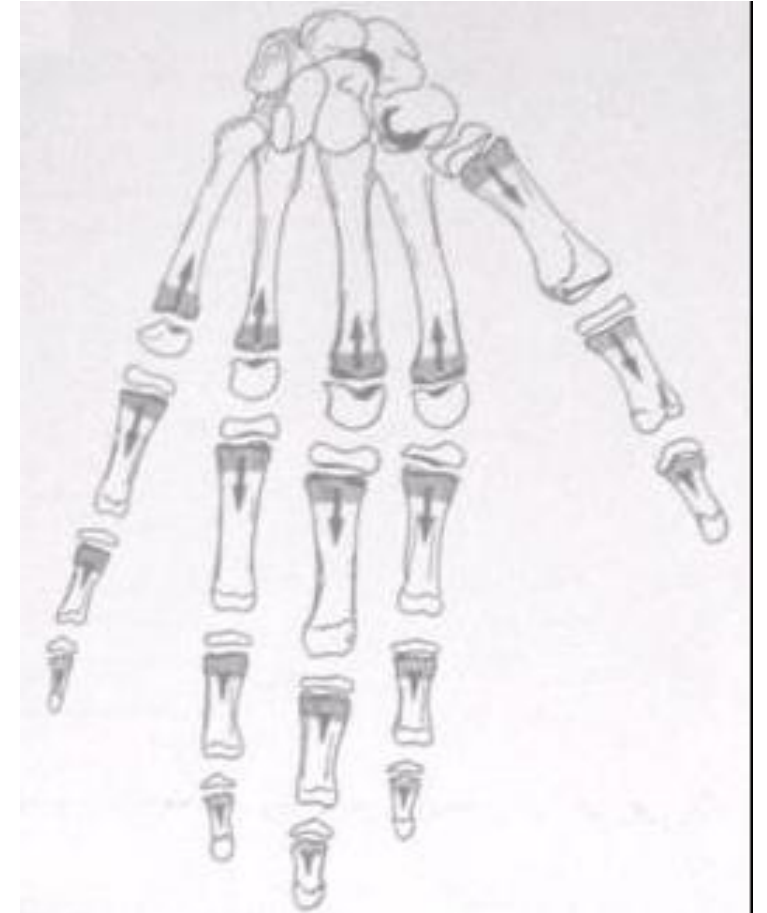
Conflicts of interest and introduction

- None of the authors has conflict of interest to declare in relation to this presentation
- The thumb has only 2 phalanges, the fingers have 3
- What is the missing element? Metacarpal or proximal phalanx?
- Review of literature
- 4 theories
 - Original 1st metacarpal is missing, currently replaced by the original proximal phalanx
 - Current 1st metacarpal = fusion of the original metacarpal and proximal phalanx
 - Middle phalanx missing
 - Current distal phalanx = fusion of the original middle and distal phalanges



1st theory: the original 1st metacarpal is missing and currently replaced by the original proximal phalanx (Galen)

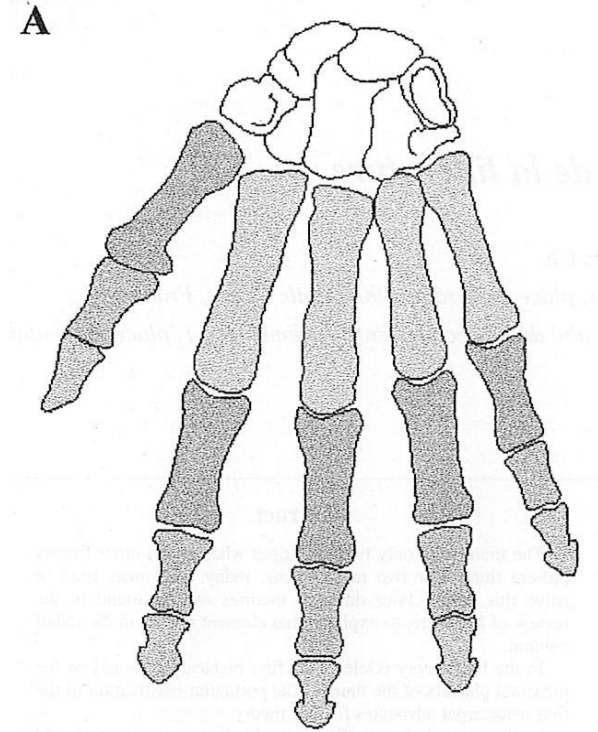
- Pros and cons 1:
 - A single proximal secondary ossification nucleus, toward that runs the nutrient artery, mimicking the typical ossification of a phalanx
 - Such an ossification pattern displays variations
 - Some 1st metacarpals and 40% of 1st metatarsals have been found with a distal ossification nucleus
 - Some finger metacarpals II-V have been found with a proximal ossification nucleus
 - Some phalanges have been found with a distal ossification nucleus



1st theory: the original 1st metacarpal is missing and currently replaced by the original proximal phalanx (Galen)

- Pros and cons 2:

- Bailleul's rule: "the ossification nucleus is the located at the most functionally important end of a long bone" (at the thumb the trapeziometacarpal joint)
- At the foot, Bailleul's rule does not act: the medial cuneometatarsal joint is not the most important (but in apes yes, the hallux moves in opposition)

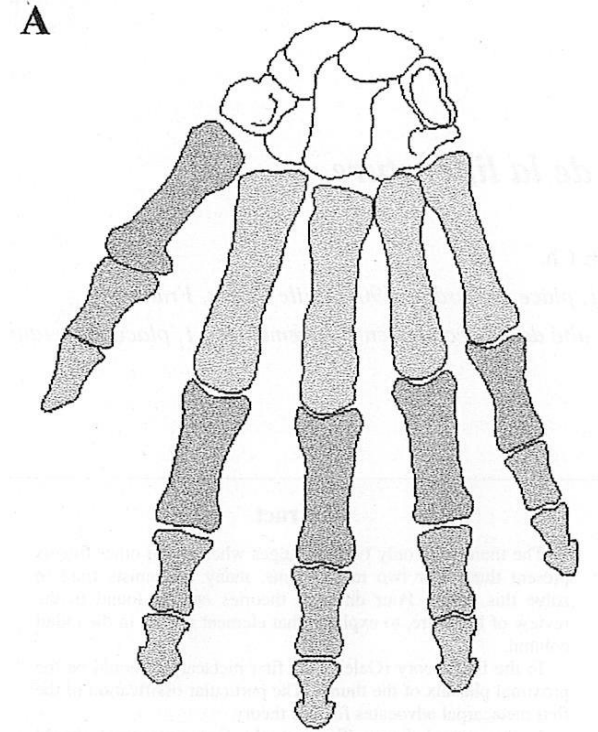


**1^{er} métacarpien
= 1^{ère} phalange**

1st theory: the original 1st metacarpal is missing and currently replaced by the original proximal phalanx (Galen)

- Pros and cons 3:

- The 1st metacarpal's nutrient foramen (NF) is located on its ulnar aspect, as in phalanges whereas that of the fingers' metacarpal is located on their radial aspect
- This is not the case at the hallux
- 2nd metacarpal may have a NF located ulnarly
- 4th and 5th metatarsal may have a NF located laterally

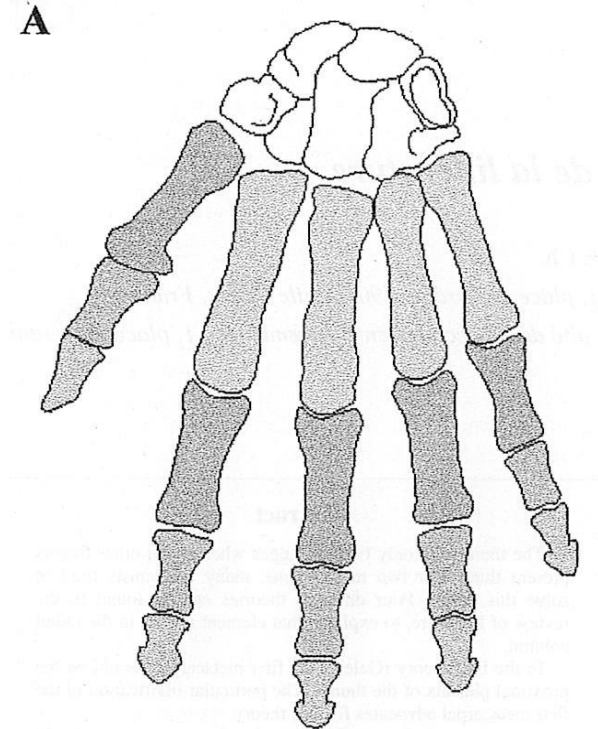


**1^{er} métacarpien
= 1^{ère} phalange**

1st theory: the original 1st metacarpal is missing and currently replaced by the original proximal phalanx (Galen)

- Pros and cons 4:

- The thumb metacarpophalangeal (MCP) joints mainly acts as a hinge joint in flexion-extension, such as the interphalangeal joints
- 1st metacarpal head has really a biconvex shape
- Thumb MCP has some movements of abduction-adduction limited by the capsuloligamentous apparatus

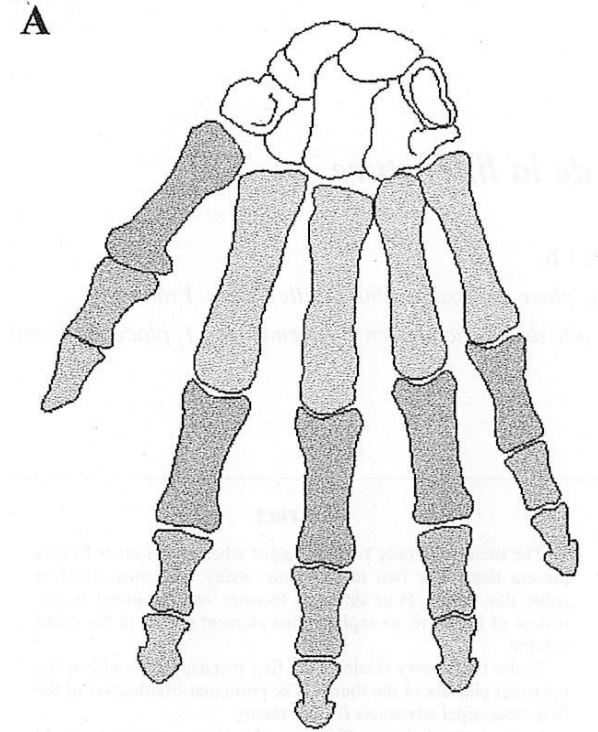


1^{er} métacarpien
= 1^{ère} phalange

1st theory: the original 1st metacarpal is missing and currently replaced by the original proximal phalanx (Galen)

- Pros and cons 5:

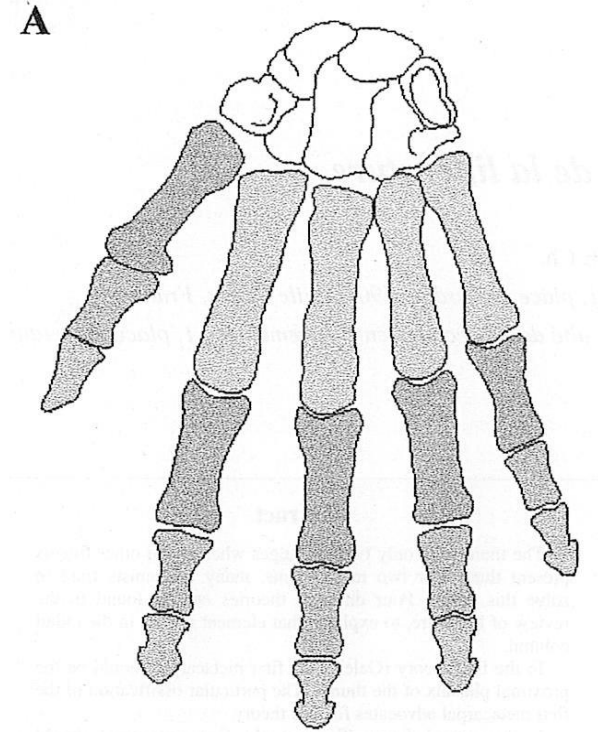
- EPL, such as the terminal slip of the EDC and EPB inserts on the base of the middle phalanx, such as the central slip of the EDC; the middle phalanx of the finger could correspond to the proximal phalanx of the thumb
- In the majority (95%) of Bantus (a so-called “primitive” ethnicity) the EPB inserts on the base of the distal phalanx; this could indicate that the EPB insertion migrated proximally during the evolution...



1^{er} métacarpien
= 1^{ère} phalange

1st theory: the original 1st metacarpal is missing and currently replaced by the original proximal phalanx (Galen)

- Pros and cons 6 (Volkow, Testut & Latarjet):
 - The original 1st metacarpal (and the original 1st metatarsal) has not disappeared, but still exists as the trapezium!
 - But when looking to the intrinsic muscles of the hand and foot
 - 1st metacarpal = main axis of the thenar compartment and gives insertion to the opponens pollicis
 - 1st metatarsal = main axis of the medial plantar compartment and gives insertion to the opponens hallucis

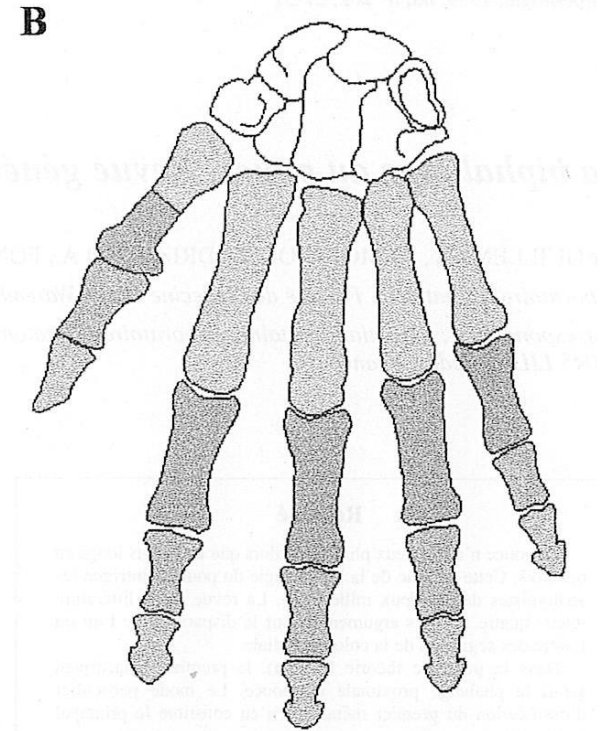


**1^{er} métacarpien
= 1^{ère} phalange**

2nd theory: the current 1st metacarpal results from a fusion of the original metacarpal and proximal phalanx (Sappey)

- Pros:

- 1st metacarpal's base looks like a metacarpal base
- 1st metacarpal's body is flattened dorsovolarly, such as phalanges
- 1st metacarpal's head has two palmar "condyles" as phalanges
- Some 1st metacarpals and 40% of 1st metatarsals have been found with a distal ossification nucleus
- Some mammals (Bradypus) show a fusion of the metacarpal and proximal phalanx in thumb and fingers
- Some human thumbs have 3 phalanges (triphalangic thumb)

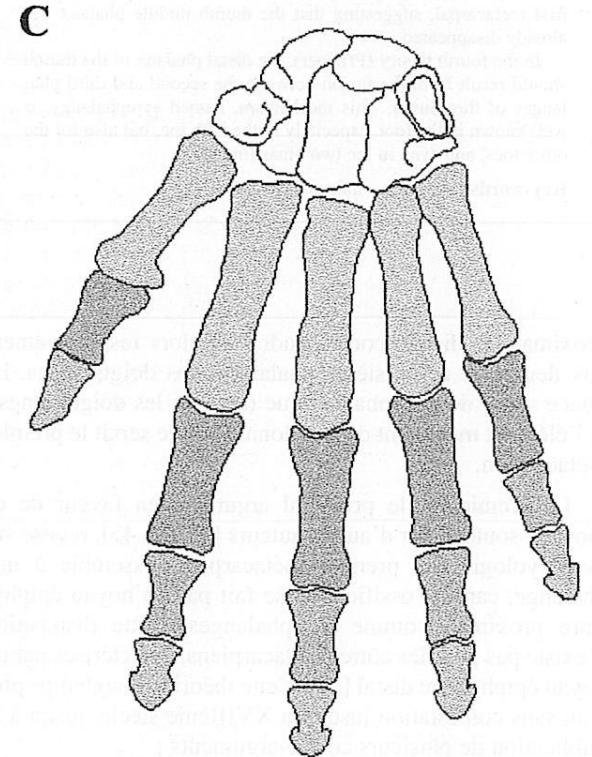


1^{er} métacarpien = fusion du 1^{er} métacarpien et de la 1^{ère} phalange

3rd theory: the middle phalanx is missing (Paturet)

- Pros:

- Harris: the order of appearance of the ossification nuclei of the phalanges allows considering the “middle” phalanx missing in the thumb
- In symbrachydactyly, the middle phalanx shortens, even disappears; the thumb is the last ray involved by the disease and there, the shortening concerns the metacarpal

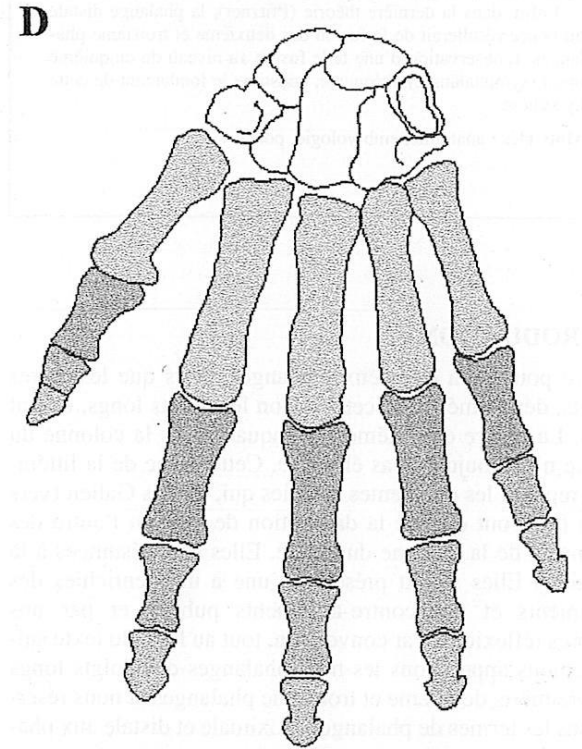


2^{ème} phalange absente

4th theory: the current distal phalanx results from the fusion of the original middle and distal phalanges (Pfitzner)

- Pros:

- Some symphalangies are due to fusion of the middle and distal phalanges
- Thumb distal phalanx is longer than that of fingers
- In triphalangeal thumb, the middle and distal phalanges are short, and the distal phalanx is shorter than that of the fingers
- Physiological (evolutionary) fusion of the middle and distal phalanges of the 5th toe in 40-80% of the Humans, already present in fetus (beginning trend in the 4th toe)
- Fusion of the middle and distal phalanges of the 4th and 5th fingers has been reported in some humans and some mammals (edentates)



phalange distale = fusion des 2^{ème}
et 3^{ème} phalanges

Conclusion

- 4 theories with pros (and cons for the 1st one, allowing its elimination)
- Some functional reasons:
 - 2 phalanges are sufficient to allow thumb's function (Kapandji, quoting Occam's rule of universal economy)
 - Counterpart of the acquisition of thumb's opposition?
- Some avenues of research:
 - Phylogeny: has one discover a vertebrate with a triphalangic thumb? Not at the moment
 - Genetics ?
 - Congenital anomalies of the hand: comparison of muscular insertions. It's your turn to play 😊 !