LET'S TALK ABOUT

SKELETAL OSSIFICATION

IMPLICATIONS FOR CLINICAL DIAGNOSIS

NOT ALL KIDS OF THE SAME AGE ARE AT THE SAME STAGE

ANGELA JACKSON

TIMING OF BONE OSSIFICATION
Implications for clinical diagnosis

Bone ossification, or osteogenesis, is the process of bone formation. This process starts during embryonic development in the primary ossification centres. At birth, much of the skeleton is cartilaginous, but after birth, a process of secondary ossification centres develop in each end of long bones which promote both length and shape to bones.

The primary and secondary ossification centres are separated by the epiphyseal growth plate. This growth plate (physis), is split in to several layers and enables the process of elongation of the long bones. Once maximal length is achieved the growth plate fuses. Other secondary ossification centres create shape not length, providing attachments for ligaments and tendons (apophyses)

The timing of ossification is different from bone to bone, but occurs in a predictable sequence of development and progression until around the age of 25-30. In children of the same chronological age, the majority of bone maturation is approximately 2 years earlier in girls than in boys. In addition, children mature at different rates, with some children maturing as much as 3 years earlier or later than their peers.

Several factors affect maturation including:

- Gender
- Hormones
- Ethnicity
- Pathology
- Stress
- Genetics

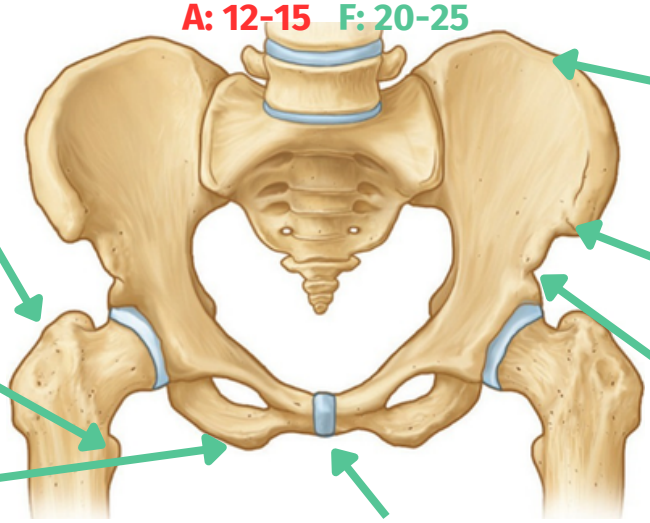
Certain conditions that affect adolescents can only occur when the physis is open. For example, Sever's is the primary cause of heel pain in sporty children aged between 8-14 when the calcaneal physis is open. Once the physis fuses post puberty, Sever's no longer is a consideration and other differential diagnoses must be sought. Knowledge and understanding of paediatric anatomy, the timing and pattern of secondary ossification centre appearance, and an assessment of maturation is therefore important to be able to assess skeletal development, and to be able to make an accurate clinical diagnosis.

The following diagrams of the timing of ossification create a summary of several research papers and are for guidance only. There is conflict across the research and it is thought that these figures may vary across population groups.

TIMING OF OSSIFICATION OF THE LOWER LIMB IN BOYS

TWO YEARS EARLIER ON AVERAGE IN GIRLS

A: APPEARANCE F: FUSION



Pars interarticularis
A: 12-15 F: 20-25

Greater trochanter
Gluteal muscles
A: 4 F: 14-18

Lesser trochanter
Iliopsoas
A: 8-12 F: 13-16

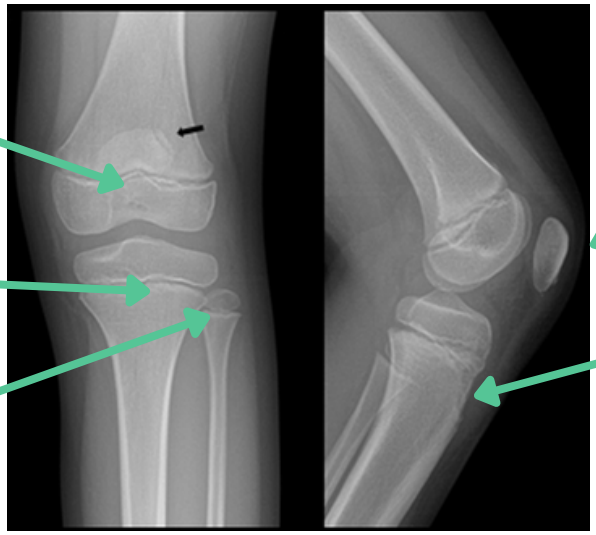
Ischial Tuberosity
Hamstring
A: 12-15 F: 16-23

Iliac crest
Abdominal muscles
A: 12-15 F: 16-23

ASIS
Sartorius, TFL
A: 12-15 F: 16-18

AIIS
Rectus femoris
A: 11-15 F:13-17

Pubic symphysis = Adductors, Gracilis
A: 16-21 F: 20-30



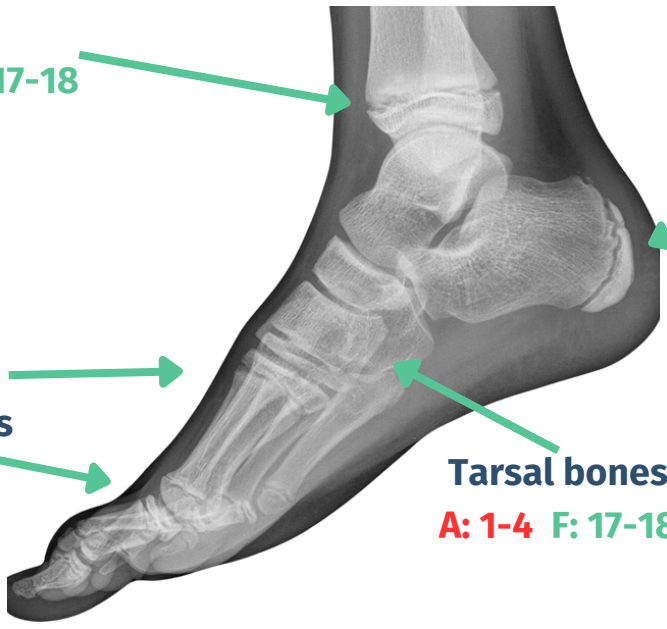
Distal femur
A: Birth F: 16-19

Proximal tibia
A: Birth F: 18-20

Proximal fibula
A: 2-4 F: 18-20

Patella
A: 2-7 F: 12-14

Tibial tuberosity
A: 10-12 F: 15-18



Distal tibia
A: 6 months F: 17-18

Calcaneum
A: 6-8 F: 12-14

Metatarsal and phalangeal epiphysis
A: 3-6 F: 17-20

Tarsal bones
A: 1-4 F: 17-18

Distal fibula
A: 1 F: 17-18

kids back 2 sport

TIMING OF OSSIFICATION OF THE UPPER LIMB IN BOYS

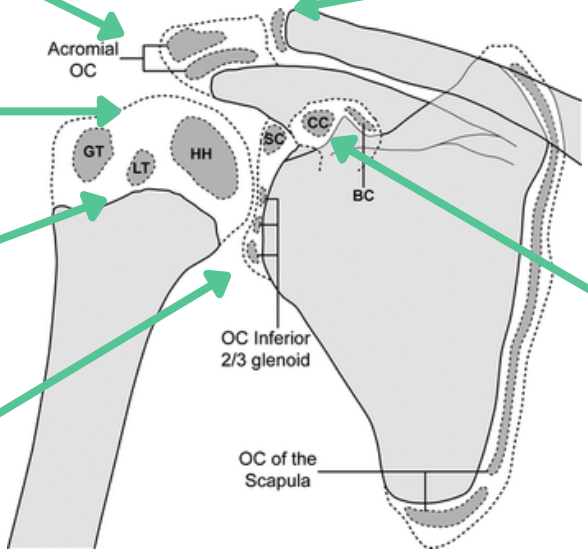
TWO YEARS EARLIER ON AVERAGE IN GIRLS

Acromion
A: 14-19 F: 20-25

Humeral head
A: Birth F: 4-6

Prox humeral physis
A: Birth F: 17-20

Glenoid
A: 10-11 F: 18-20



Lateral Clavicle
A: Birth F: 17-22

Medial Clavicle
A: 15 F: 25-29

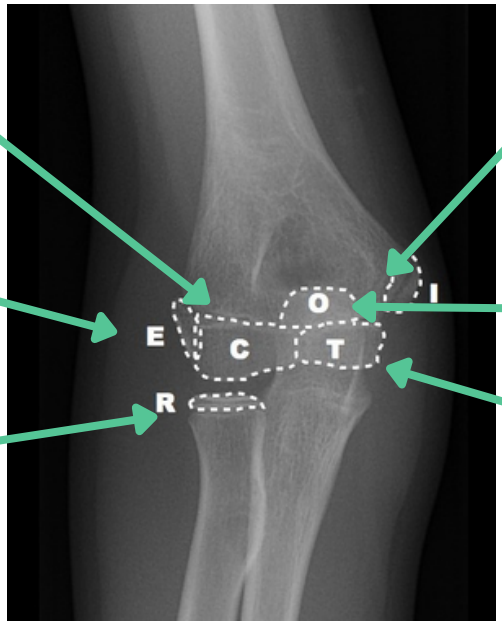
Tip of Coracoid
A: 10-16 F: 18-25

Illustration from doi.org/10.1148/rg.2016160036

Capitellum
A: 1 F: 12

External Epicondyle
A: 12 F: 12

Radius
A: 5 F: 15



Internal Epicondyle
A: 6 F: 17

Olecranon
A: 10 F: 15

Trochlea
A: 9 F: 12

Illustration from radiopedia.org

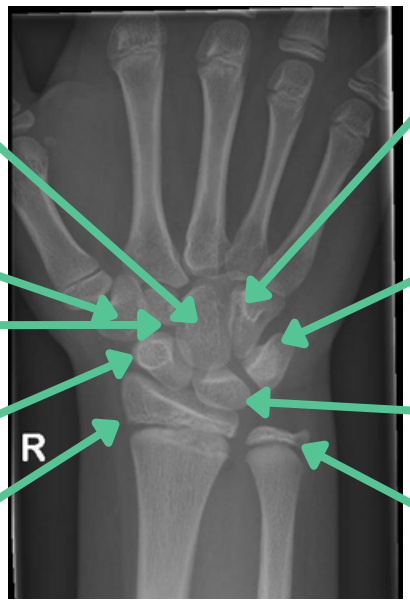
Capitate
F: 1 month

Trapezium
F: 4-6 years

Trapezoid
F: 4-6 years

Scaphoid
F: 4-6 years

Distal radius
A: 5 F: 15



Hamate
F: 2 months

Triquetral
F: 3

Pisiform
F: 12

Lunate
F: 4

Distal ulna
A: 9 F: 12

kids back 2 sport