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Appendix I. Instructions for evaluating the eight radiographic parameters in the final wrist skeletal maturity model.

R7- "Capping" at the radial 1/3rd of the distal radius radial physis
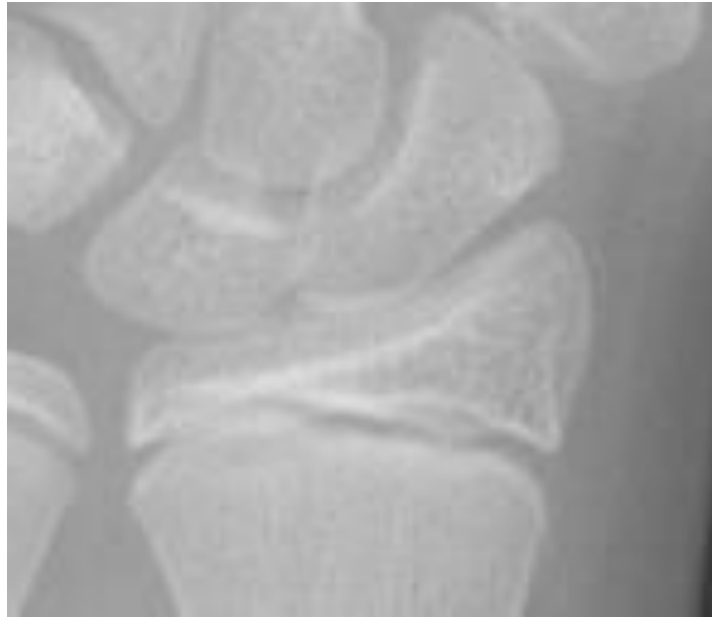
How to evaluate:

- Assessment of the proximal-radial margin of the radial epiphysis and its relation to the metaphysis.
- "Capping" occurs when a corner of the proximal-radial aspect of the epiphysis develops and points towards the metaphysis.
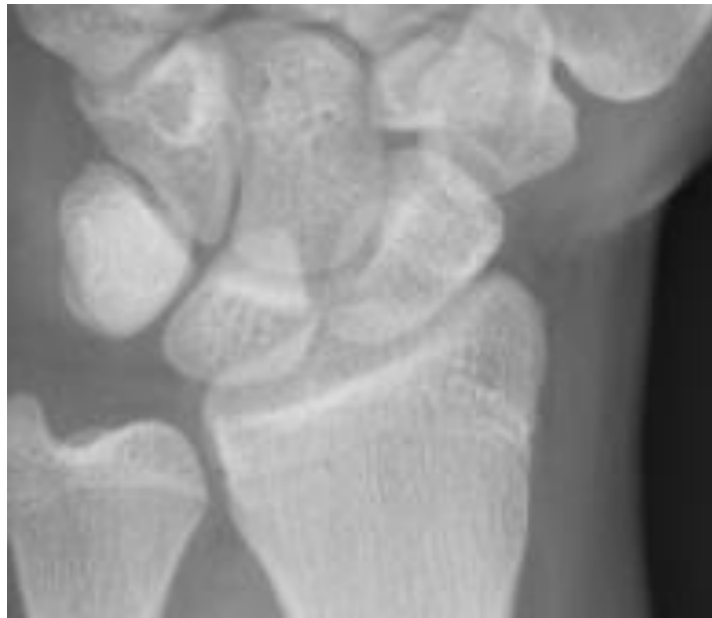
How to grade:

- Absent capping- assign value of 0
    - The proximal-radial margin of the distal radial epiphysis is blunted without a proximally-oriented projection

- Capping without fusion- assign value of 1
    - The proximal-radial margin of the distal radial epiphysis is sharp with a proximally oriented projection, but there is no fusion in the radial 1/3rd of the physis

- Capping with fusion- assign value of 2
    - Fusion has begun at the radial aspect of the physis (Figure 1C)
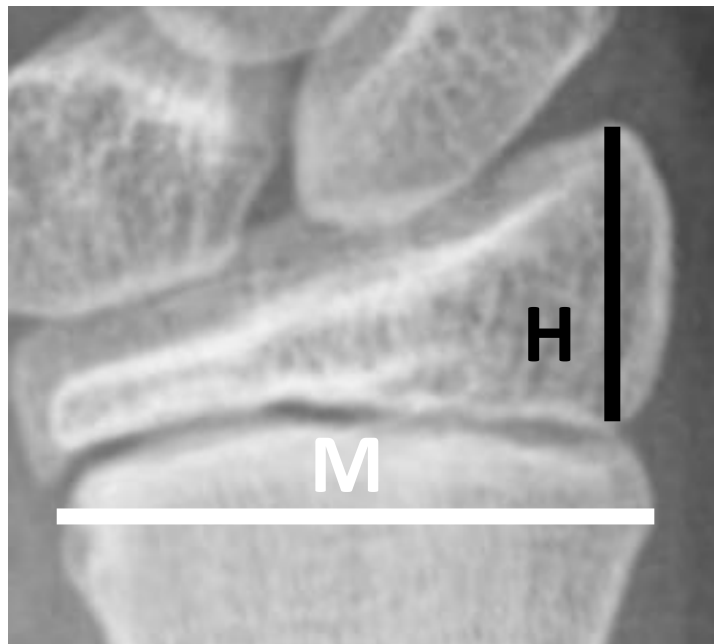
GPR1: Height of the radial styloid

How to evaluate:

- First, draw a line measuring the distal radius width at its widest point (M)
- Next, draw a line perpendicular to the first, measuring the greatest height of the radial epiphysis (H)

How to grade:

- The value for GPR1 is calculated by dividing the radial styloid height (H) by the metaphyseal width (M)

- $GPR1 = \dfrac{Radial\ Styloid\ Height\ (H)}{Radial\ Metaphyseal\ Width\ (M)}$

TPM5: Corner between the distal and radial margin of the trapezium

How to Evaluate:

- Assessment of the shape of the distal-radial trapezium

How to Grade:

- Absent- assign value of 0
    - The cortex between the distal and radial margin of the trapezium is rounded

- Present- assign value of 1
    - There is a corner between the distal and radial margins of the trapezium (Figure 3B)
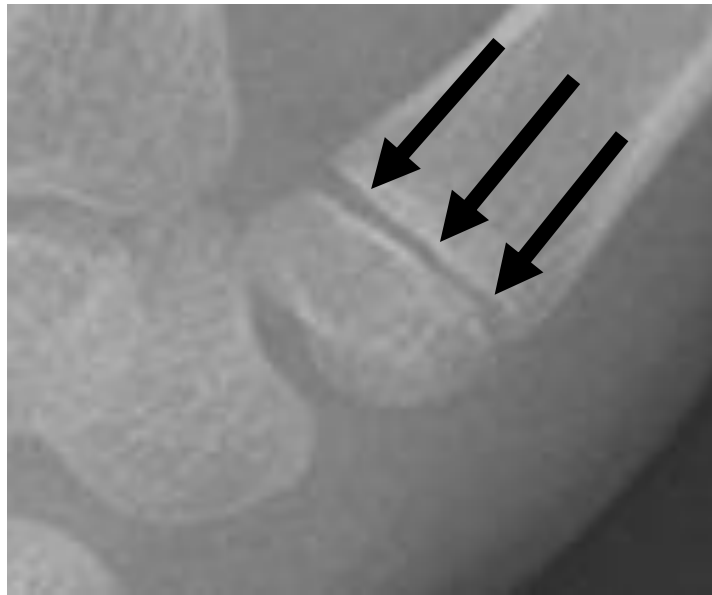
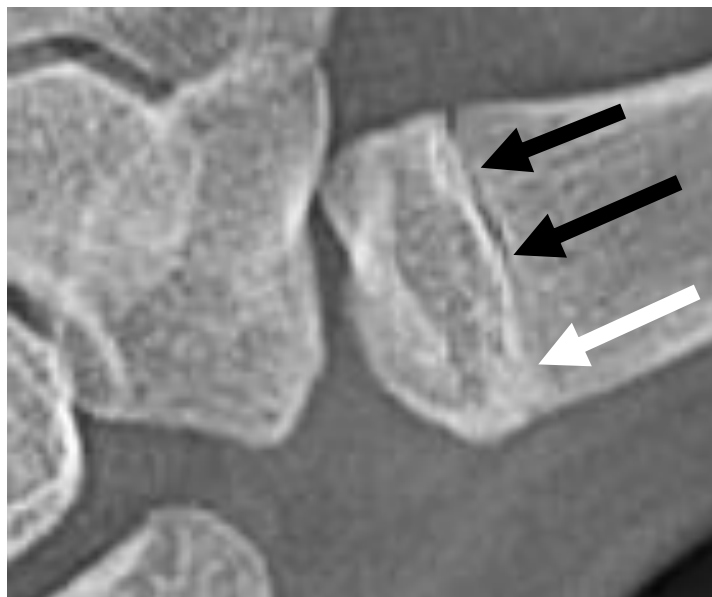Met 1-7: Metacarpal I physeal fusion

How to Evaluate:

- Assessment of physeal closure of the first metacarpal

How to Grade:

- Absent- assign value of 0
    - No fusion of the first metacarpal physis

- Partial- assign value of 1
    - Incomplete fusion of the first metacarpal physis

- Complete- assign value of 2
    - Complete fusion of the first metacarpal physis

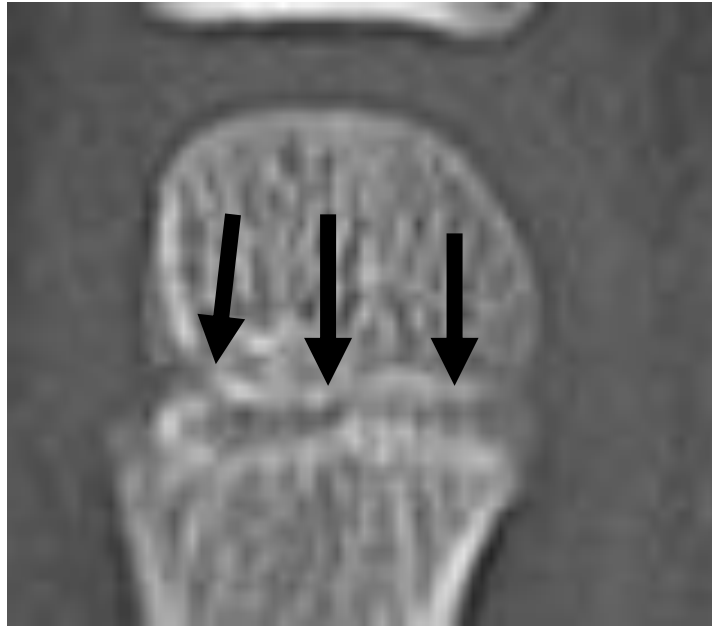Met 3-5: Metacarpal III physeal fusion

How to Evaluate:

- Assessment of physeal closure of the third metacarpal

How to Grade:
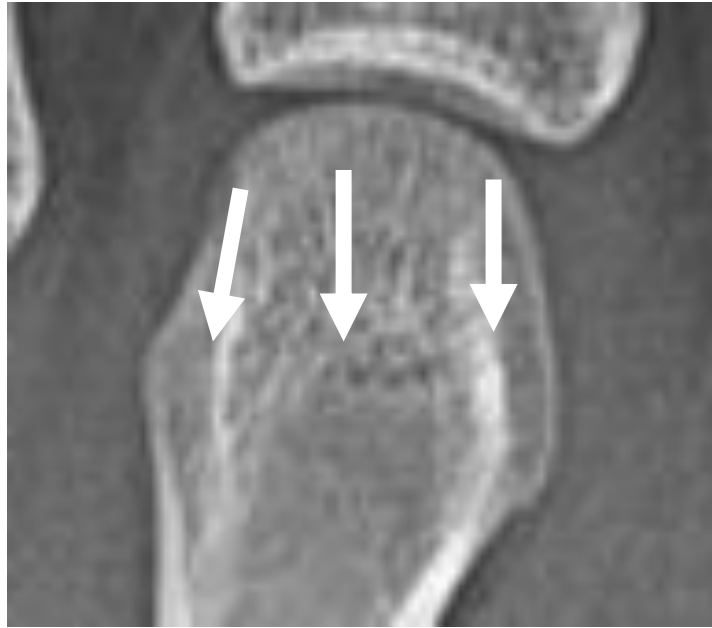
- Absent- assign value of 0

- o No fusion of the third metacarpal physis

- Partial- assign value of 1
  - o Incomplete fusion of the first metacarpal physis

- Complete- assign value of 2
  - o Complete fusion of the first metacarpal physis

Met 1-2: Epiphyseal-metaphyseal width ratio of the 1st metacarpal

How to Evaluate:

- First, measure the greatest width of the 1st metacarpal metaphysis (Figure 6- "M")
- Next, measure the greatest width of the 1st metacarpal epiphysis in a line parallel to the metaphyseal line (Figure 6- "E")

How to Grade:

- The value for Met 1-2 is calculated by dividing the 1st metacarpal epiphyseal width (E) by the 1st metacarpal metaphyseal width (M)

- Met 1-2 $= \dfrac{\text{1st Metacarpal Epiphyseal Width}}{\text{1st Metacarpal Metaphyseal Width}}$

Met 3-2: Epiphyseal-metaphyseal width ratio of 3rd metacarpal

How to Evaluate:

- First, measure the greatest width of the 3rd metacarpal metaphysis (Figure 7- "M")
- Next, measure the greatest width of the 3rd metacarpal epiphysis in a line parallel to the metaphyseal line (Figure 7- "E")

How to Grade:

- The value for Met 3-2 is calculated by dividing the 1st metacarpal epiphyseal width (E) by the 1st metacarpal metaphyseal width (M)

- Met 3-2 = $\dfrac{\text{3rd Metacarpal Epiphyseal Width}}{\text{3rd Metacarpal Metaphyseal Width}}$

Met 5-4: Proximo-ulnar projection of the 5th metacarpal epiphysis

How to Evaluate:

- Assessment of the shape of the proximo-ulnar margin of the 5th metacarpal epiphysis

How to Grade:

- Absent-assign value of 0
  - No proximo-ulnar projection of the 5th metacarpal epiphysis

- Present- assign value of 1
  - There is a proximally-pointed projection of the ulnar aspect of the 5th metacarpal epiphysis. There is typically a concave area of the epiphysis just radial to this projection.

Table 1. Example of using modified Fels wrist skeletal maturity system to estimate skeletal maturity.

Parameter	Graded Value (From evaluation of radiograph)		Multiplier (From GEE model)		Product
Constant	NA	*	-12.045	=	-12.045
Age (years)	10	*	0.458	=	4.580
Sex (male =1)	0	*	-0.755	=	-0.755
R7	1	*	0.234	=	0.234
GPR1	0.34	*	2.209	=	0.751
TPM5	0	*	0.285	=	0
Met 1-2	1.09	*	1.843	=	2.009
Met 1-7	0	*	0.184	=	0
Met 3-2	0.96	*	3.283	=	3.152

Met 3-5	0	*	0.154	=	0
Met 5-4	1	*	0.323	=	0.323

SUM -1.00 years

Based on this model, this 10-year-old female is -1.00 years away from reaching 90% of her final height. Mean age at 90% final height is 11.40 years in females and 13.20 years in males. In this example, the estimated skeletal maturity is 11.40 years -1.00 years = 10.40 years. The "What's the Skeletal Maturity?" mobile application simplifies use of the Modified Fels wrist skeletal maturity system by handling all mathematical processes and outputting a bone age directly. It is available for free on the Apple App store (iOS) and the Google Play Store (Android).