

## Technical Appendix:

Key: Risser is defined as the integer value of the Risser sign, TRC is defined as closure of the triradiate cartilage where open = 0 and closed = 1, Olecranon is defined as the integer value of the olecranon stage, Humerus is defined as the integer value of the humerus stage, Sanders is defined as the integer value of the Sanders hand stage, Age is defined as the chronological age of the patients rounded to one decimal point, Sex is defined as Female = 0 and Male = 1. The average chronologic age at PHV was 11.5 years for females and 13.2 years for males.

Risser/TRC Model: Years to PHV =  $-2.656 + 0.661 * (\text{Risser}) + 3.534 * (\text{TRC})$

Humerus Model: Years to PHV =  $-5.189 + 1.525 * (\text{Humerus})$

Olecranon Model: Years to PHV =  $-4.428 + 1.042 * (\text{Olecranon})$

Sanders Model: Years to PHV =  $-4.053 + 1.103 * (\text{Sanders})$

Age/Sex/Olecranon Model: Years to PHV =  $-9.819 + 0.801 * (\text{Age}) - 1.478 * (\text{Sex}) + 0.191 * (\text{Olecranon})$

Age/Sex/Olecranon/Risser/TRC Model: Age to PGA = Years to PHV =  $-9.373 + 0.750 * (\text{Age}) - 1.409 * (\text{Sex}) + 0.173 * (\text{Olecranon}) + 0.135 * (\text{Risser}) + 0.083 * (\text{TRC})$

Age/Sex/Olecranon/Risser/TRC Model/Sanders Model: Years to PHV =  $-9.430 + 0.731 * (\text{Age}) - 1.303 * (\text{Sex}) + 0.131 * (\text{Olecranon}) + 0.005 * (\text{Risser}) - 0.059 * (\text{TRC}) + .179 * (\text{Sanders Hand})$

# Dimeglio et al Olecranon Grading Rubric Guide



*Above Olecranon apophysis grading rubric borrowed from:*

*Diméglio A, Charles YP, Daures J-P, de Rosa V, Kaboré B. Accuracy of the Sauvegrain method in determining skeletal age during puberty. J Bone Joint Surg Am. 2005;87(8): 1689-1696. (Figure 1)*

# General Tips

Olecranon  
apophysis



- Stage 0 – No ossification
- Stage 1 – One small, circular singular ossification
- Stage 2 – One small, oblong singular ossification
- Stage 3 – Two ossifications that do not overlap
- Stage 4 – Two ossifications that overlap
- Stage 5 – One fused ossification with rectangular proximal end

# General Tips



- Stage 6 – One fused ossification with pointed/rounded proximal end
- Stage 6.5 – One fused ossification that is partially fused to the volar ulna metaphysis
- Stage 7 – Completely fused ossification

# General Tips



- Stage 1 and 2 are similar
  - 1: Small, circular shape
  - 2: oblong or irregular shape
- Stage 2 and 5 are similar
  - 2: Singular ossification with a rounded top that does not reach the articular surface
  - 5: Singular ossification with a rectangular top that reaches the articular surface

# General Tips



- Stages 3 and 4 are similar (be mindful that the ossification center can be anywhere along the apophyseal line surface)
  - 3: two ossifications that do no overlap/touch
  - 4: two ossifications that overlap/touch

# General Tips



- Stage 6 and 6.5 are similar
  - 6: The complete apophyseal line is visible
  - 6.5: Unable to see the complete line indicating partial fusion
- Stage 6.5 and 7 are similar
  - 6.5: The apophysis is partially fused from volar to dorsal, so there is still a small gap on dorsal aspect of apophyseal line
  - 7: There is no gap at dorsal apophyseal line, but an apophyseal scar may be visible

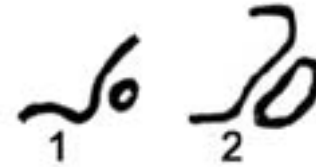
# Stage 0

- Straightforward
- No ossification at of olecranon apophysis





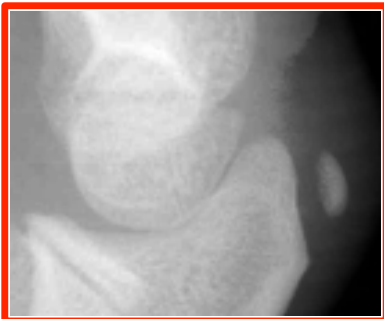
# Stage 1



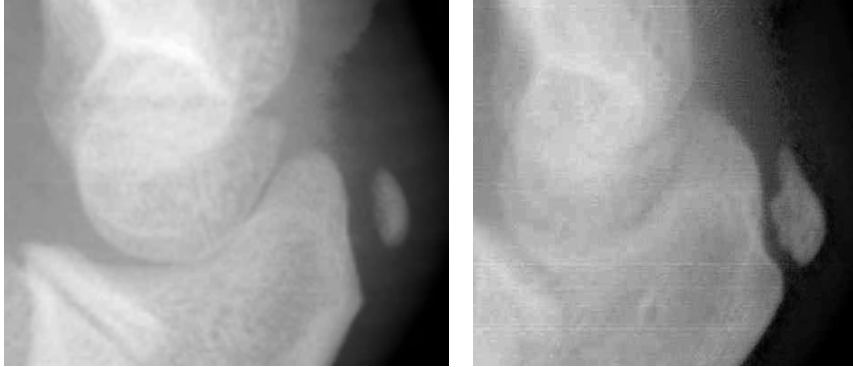
- Small circle/oval ossification

Compared to Stage 2 (Red)

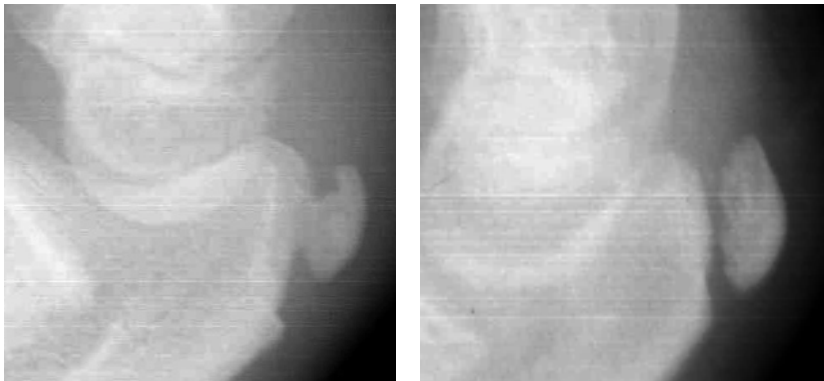
- Oblong/longer



## Stage 2

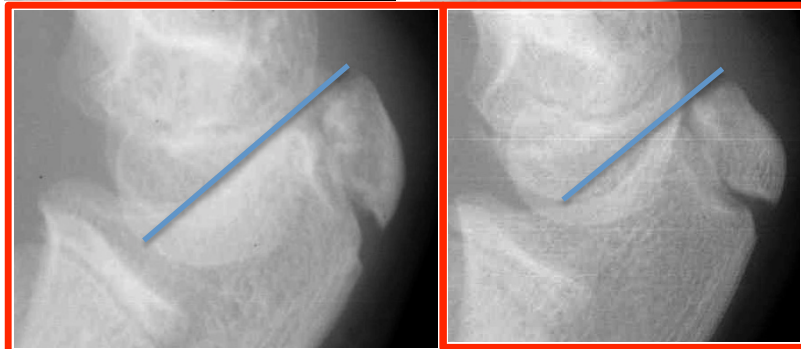


- Large range
- No 2<sup>nd</sup> ossification
- May have odd shape



Compared to Stage 5  
(Red)

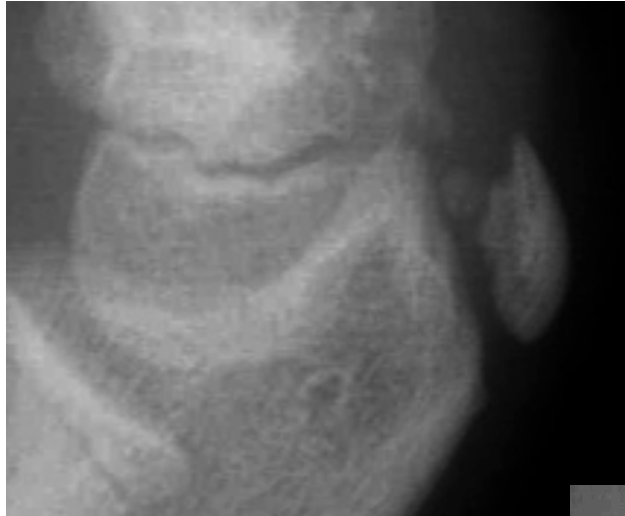
- Does not have rectangular top at level of olecranon articular surface (blue line)



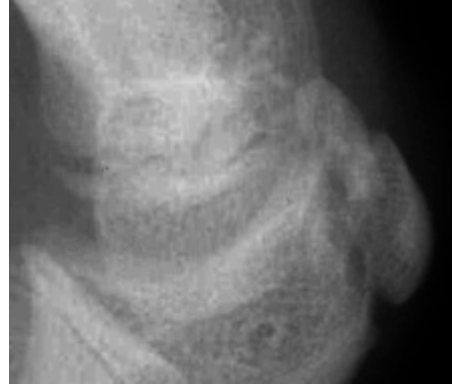
## Stage 3



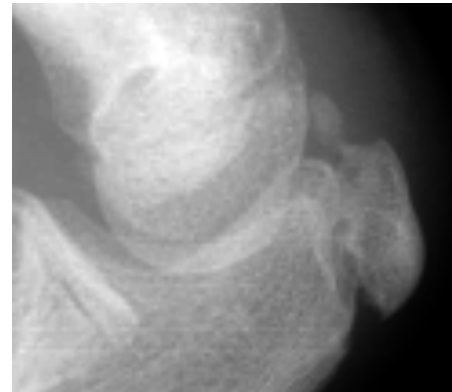
- Two ossifications that do not overlap/touch



# Stage 4



- Two ossifications that overlap/touch

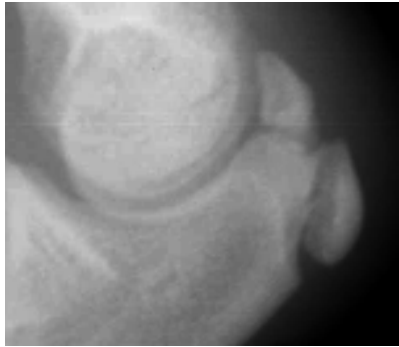


Compared to Stage 6  
(Red)

- Two distinct/fusing ossifications vs smooth single apophyseal piece



# Stage 3 vs 4 (Red)





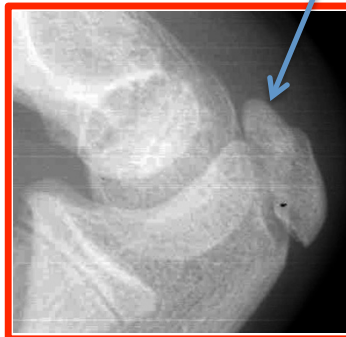
# Stage 5



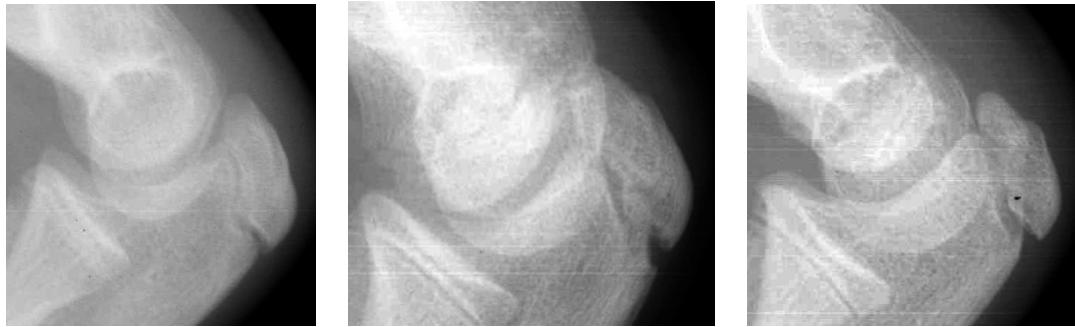
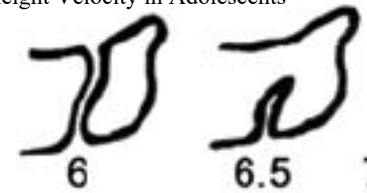
- Rectangular top at level of olecranon articular surface, no second ossification center

Compared to Stage 6 (Red)

- No rounded/peaked tip posteriorly/proximally (indicated by blue arrows)



# Stage 6



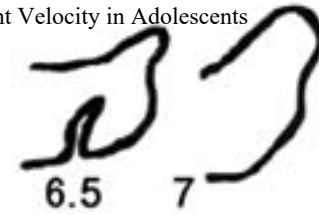
- Rounded/peaked tip of apophysis
- No evidence of fusion
- Able to visualize complete apophyseal line



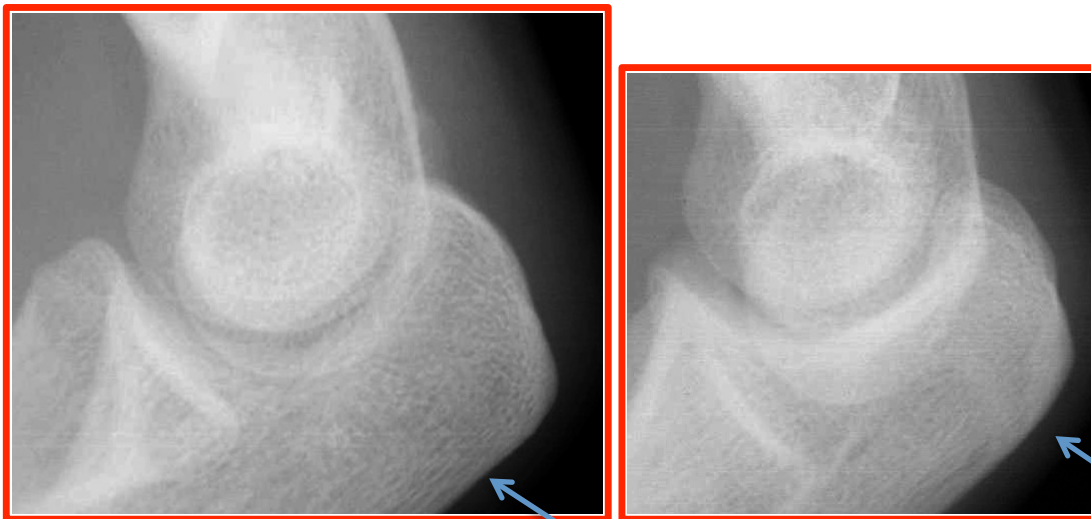
Compared to Stage 6.5 (Red)

- No partial fusion

# Stage 6.5



- Partial fusion
- If dorsal ulna is not smooth, qualifies as 6.5

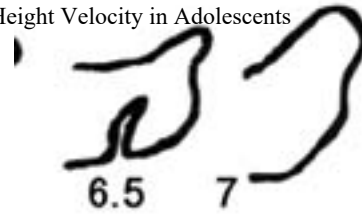


Compared to Stage 7  
(Red)

- Smooth dorsal ulna



# Stage 7



- Smooth posterior ulna
- Complete fusion
- Ok if apophyseal scar present

