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The Pediatric Orthopaedic Society of North America

Timing of Ossification Centers

Objectives

1. List ossification centers present at birth
2. Discuss the order of ossification centers about the elbow
3. Describe age at appearance of the ossification center of the proximal femoral epiphysis; of the medial clavicular epiphysis
4. Discuss the relationship of the Risser sign to skeletal maturity

Discussion points

1. What eponym helps in remembering the order of appearance of ossification centers about the elbow?
2. What methods are available for estimating bone age? Upon what population are the data for these standards based?

Discussion

Ossification centers for the distal femur, proximal tibia, calcaneus, talus, and cuboid are often present at term birth. The distal femur, calcaneus, and talus are most constantly present, the proximal tibial epiphysis usually appears within 2 months. The proximal femoral epiphyseal ossification center appears at about age 6 months.

The ossification center for the capitellum appears by about 8 months, the radial head at about age 3-4, the medial epicondyle at about age 5, the trochlea at about age 7, the olecranon at about age 9, and the lateral epicondyle at about age 11. The eponym for remembering these ossification centers is CRITOE, designating the order of appearance is Capitellum, Radial head, Internal (medial) epicondyle, Trochlea, Olecranon, and

External (lateral) epicondyle. If one calculates the capitellum ossifies by age 1; and adds 2 years for the appearance of each successive ossification center, the scheme is not too far from accurate.

The medial clavicular epiphysis is the last ossification center to appear, at about age 17 and fuses by age 25.

Skeletal maturity may be assessed by analysis of the ossification centers of the hand, foot, knee, elbow, or pelvis. The hand is most often used. There are two systems of evaluating wrist bone age in use at present, the Greulich-Pyle and the Tanner-Whitehouse. The Greulich-Pyle has been used more by orthopaedists and was used by Green and Anderson in compiling their data for growth remaining in children nearing skeletal maturity. Since the Moseley straight line graph was based on the Green-Anderson data, the Greulich-Pyle system is correlated with that graph also. The two methods do not give equivalent bone ages. The Tanner-Whitehouse with computer assistance may be more reproducible, but it is more cumbersome to use. For the present, the Greulich-Pyle method is still standard for orthopaedic use, even though it was derived more than a half century ago on an exclusively white upper-middle class population.

The Risser sign, which evaluates the size and configuration of the iliac apophysis, is often used to determine skeletal maturity in patients with scoliosis. It is convenient, as another film is not required for analysis. Several studies have evaluated the reliability of the Risser sign. Most, but emphatically not all, have been favorable in their assessment of reliability of the Risser sign. Posterior-anterior spinal radiographs apparently negate the value of the Risser sign.

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