Assessing Bone Growth and Development in Modern American Children

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Much of what we know about human growth and development comes from large-scale projects such as the Fels Longitudinal Study. Despite clear secular trends in greater childhood growth, earlier maturity, and greater adult stature in the 20th century, standards for age estimation in forensic anthropology are based on children born over 80 years ago. As a result, modern age estimates from unknown remains will be biased upwards. Additionally, growth data were previously collected to establish growth norms for known-age children from limited ethnic backgrounds, making the forensic application of the data, estimating age from growth and development measures, very difficult.

Radiographs from clinical and especially medical examiner settings from around the country form a unique resource because large-scale collections of subadult skeletons are virtually unheard of. The National Institute of Justice awarded a grant in October 2008 for the creation of a digital radiographic database. These data can be used to study growth and development in modern children. The project is compiling a database that is geographically and ethnically diverse (Figure 1).

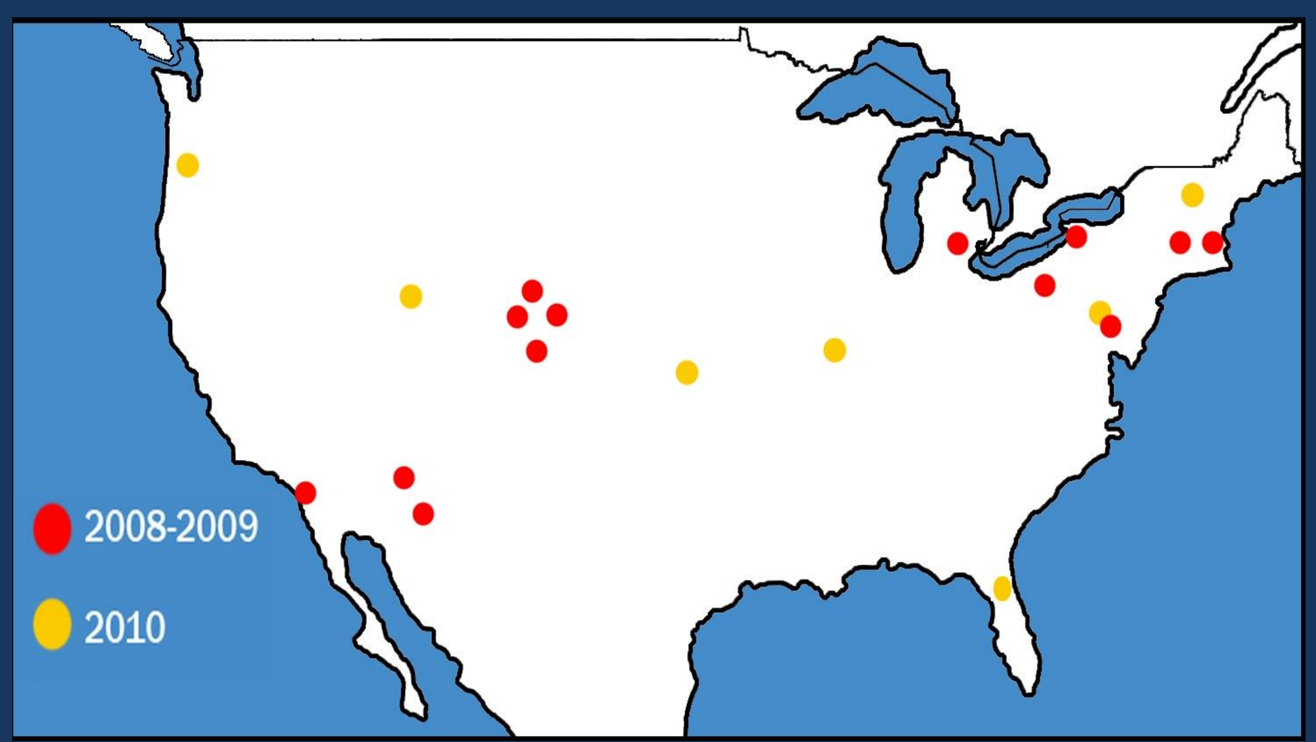

Figure 1. Visits to medical examiner and coroner offices.

As of April 1, 2010, over 12,000 radiographs had been scanned from over 4,000 children, all born after 1990 and less than 20 years old. All available demographic data are recorded, and thus far, the most numerous ancestral groups represented are "White", 49%, "Black" 27%, and "Hispanic" 16%. Epiphyseal appearance and fusion are recorded (Figure 2), and actual bone lengths will be estimated, compensating for radiographic distortion (Figure 3). To augment certain age ranges, data are also being collected from two clinical pediatric locations.

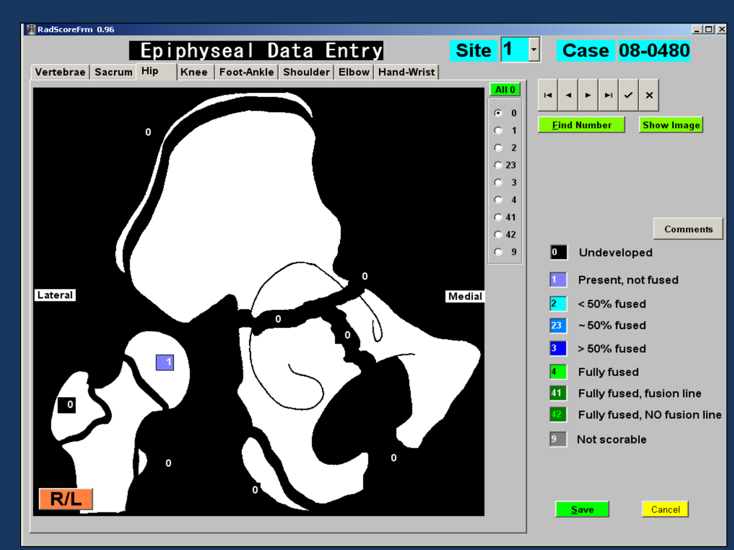

Figure 2. Epiphyseal appearance and fusion data entry program.

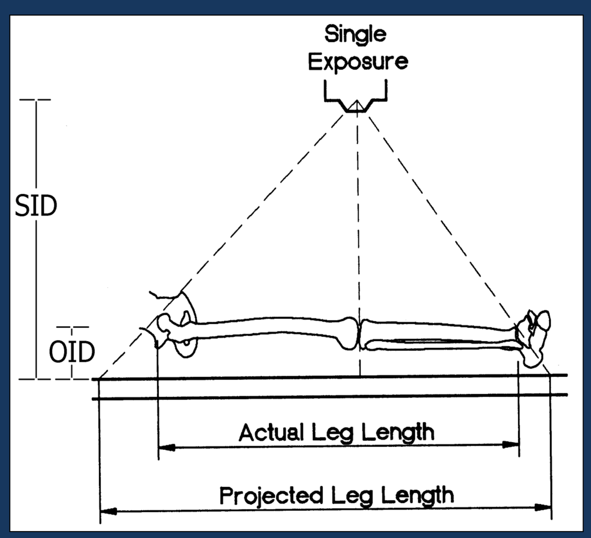

Figure 3. Factors in radiographic distortion.

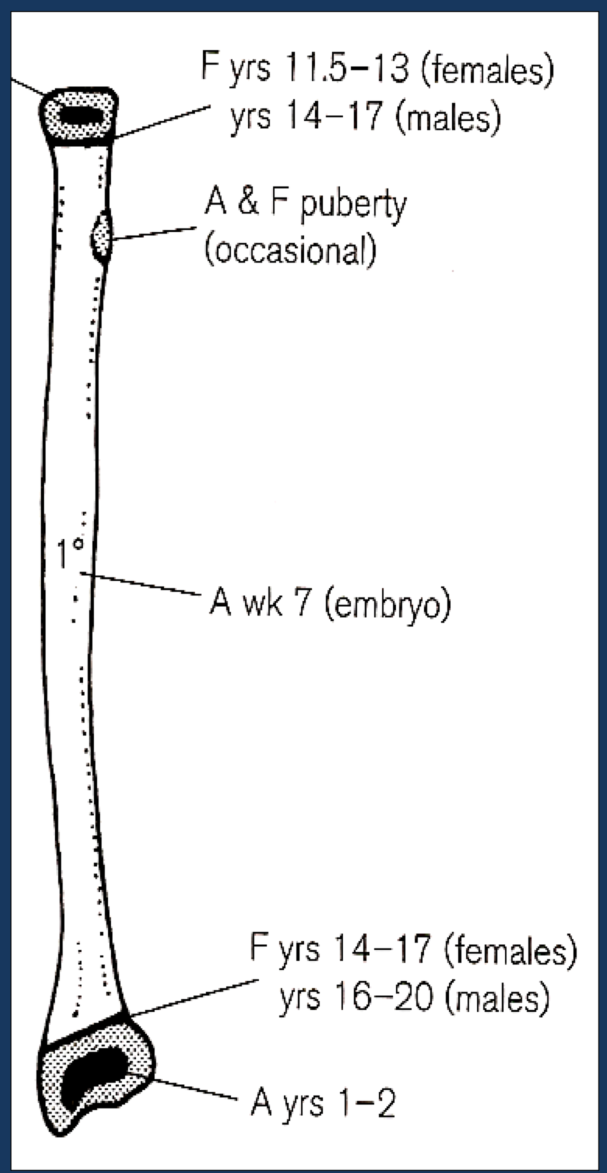

Figure 4. Ulnar epiphyseal development and age estimation (Scheuer and Black 2000).

Figure 5. Radiograph of radius and ulna showing nonunion of epiphyses in a 12 year old boy.

A preliminary study (Fojas 2009) highlights the advantages of collecting modern data and applying appropriate statistical methods to them. Scheuer and Black (2000) and Schaefer *et al*. (2009) provide an age of appearance of the distal epiphysis of the radius of one to two years (Figures 4 and 5). However, whether the age represents the minimum or modal age is unknown. When Fojas (2009) applied logistic regression to the modern data for age prediction, the presence of the epiphysis indicated a minimum age of 36 weeks old with 95% confidence, and an absence of the epiphysis indicated a maximum age of 72 weeks old. This age range is notable because it is narrower, earlier, and more explicit than other published ranges.

We are currently analyzing the data for publication of new age estimation standards using statistical methods such as logistic regression and transition analysis. The radiographic database will be available for use by interested researchers in late 2010.

References

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