A82 Age Estimation Using the Development of the Foot and Ankle

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After attending this presentation, attendees will understand the changes that have occurred in the development of the foot and ankle in subadults since the 1930s as well as a new subadult aging technique utilizing radiographs of the foot and ankle. By using the presence or absence of ossification centers in the subadult foot and ankle along with new statistical methods, a new means of subadult age estimation will be discussed.

This presentation will impact the forensic science community by providing an improved subadult aging technique of the foot and ankle that can be used in forensic anthropology and pathology. Additionally, by using only radiographs, this study presents a less intrusive age estimation method for subadults.

Age estimation in subadults can assist with narrowing missing person searches substantially. The developmental timing of multiple areas of the skeleton, such as the wrist, knee, and elbow, have been researched thoroughly in recent years in relation to subadult age estimation; however, multiple areas of the skeleton should be used for age estimation when available.[1] The goal of this study is to first test for differences in age of appearance of ossification centers in the foot and ankle between historical and modern cohorts, and, if differences are noted, to develop a model using these modern data for subadult age estimation.

A total of 1,520 radiographs (871 males, 649 females) of the right foot and ankle from White individuals aged from birth to 13 years were analyzed from the Pediatric Radiology Interactive Atlas (PATRICIA) and funded by a National Institute of Justice grant. Eleven ossification centers were chosen to be scored based on their previously published predictive value for age.[2] Each ossification center was scored as either present, absent, or not able to be scored. Data from each ossification center were analyzed using logistic regression, which removes assumptions of a normal distribution and linearity. Most importantly, a logistic regression model produces probabilities for ossification center appearances at any age. There were two goals for using logistic regression to analyze these data. The first was to test for differences in each ossification center between the modern and historical samples; the 5th and 95th probabilities produced from the logistic regressions were used for one-sided confidence intervals for age. The second goal was to test for sexual dimorphism in ossification center appearance. The regression tree method was applied to these data in order to estimate age using explicit intervals based on the scores of multiple epiphyses.[3] Inter-observer and intra-observer studies were completed on 39 individuals to test the validity and reliability of the method. All statistical analyses were completed using R software.[4]

Results of the inter-observer and intra-observer studies demonstrate that this scoring method is both reliable and valid for 9 out of the 11 ossification centers, with the ossification centers of the ankle, tarsals, and metatarsals being more reliable and valid than ossification centers of the phalanges. Two ossification centers located on the phalanges were valid for estimating age but were very often difficult to score. For this reason, these two ossification centers had a limited amount of observations because they were rarely visible enough to score in the radiographs.

Seven out of the 11 ossification centers appear earlier in the modern males than they did in the historical males. In the modern females, 9 of 11 ossification centers developed later than the historical females. Sexual dimorphism was seen in 9 of the 11 ossification centers, with 8 of the 11 ossification centers appearing statistically significantly earlier in females. Noting these observed changes in the modern sample, this study explored two different methods

for age estimation, the first being age estimates based on one-sided 5th or 95th probabilities of the ossification center scores for age, and the second being the application of regression trees. The results of this study prove that an updated age estimation method for the foot and ankle is necessary to use on modern populations, and that the application of regression trees in this type of study provides a valuable new age estimation technique.

Reference(s):

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