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Estimation of Biological Age by Epiphyseal Union

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Abstract

Epiphyseal union is the secondary ossification of bone in juveniles and primary means of estimating age of subadult post-cranial remains. First an inventory was conducted of skeletal remains from a single individual, accounting for the skeletal condition as well as the presence or absence of bones. Then, using previously developed standards, the estimation of age was assessed through a system of scoring epiphyseal closure. Results will narrow the age range of the individual, which will expand our knowledge of the skeletal collection. It is also important that we respect the decedent by taking the time to know more about them.

Introduction

It is the job of the forensic anthropologist to help the medico-legal community identify unknown human remains. As a forensic anthropologist, they must be able to ascertain the many characteristics that define us as humans. Among the many approaches that a forensic anthropologist uses to assess the identity of the skeletal remains, there are those aimed at estimating the age at death. Techniques vary according to whether or not the remains belong to a subadult or an adult. In this investigation I will estimate the age at death using closure of the epiphyseal union centers.

Materials

The materials used are from the collection of the Anthropology Department under the Humanities and Social Sciences Division at Western Oregon University. The materials consist of adult postcranial skeletal remains (Figure 1).

Figure 1. Postcranial skeleton



Methods

Upon gaining access to the postcranial remains, a full and thorough inventory was conducted. Following protocols developed by Lieverse (2006) this inventory accomplished many goals. First, the assessment accounted for exactly which bones of the skeleton were present or absent. Second, the assessment took into consideration the degree of completeness of each bone present. Third, the assessment sought to account for the number of fragments for each bone. As a result, a spreadsheet was created revealing these results. By utilizing present and pertinent research methods on the epiphyseal union of human skeletal remains (Buikstra and Ubelaker 1994; Schaefer, Scheuer and Black 2009), the postcranial remains were assessed to estimate the biological age range. This was done by examining every bone that has observable epiphyseal union centers.

To estimate the biological age range of the skeletal remains, secondary centers of ossification or epiphyseal unions of each bone were combined to create an overall score for the skeletal element. The scoring system is numbered from 1 to 3: if there is no union present then it was scored a 1, if there is some union present with a noticeable gap then it was given a 2, if there was advanced union then it was scored a 2.5, and if there is complete union with no indicators such as a line then it was scored a 3. In order to account for interobserver reliability, the remains were also analyzed by Dr. Misty Weitzel using the same scoring system.

Bone	*Score	# of fragments	# of complete	**% < 100%
Costals	3	5	16	40%/98%
Manubrium	2.5	N/A	1	97%
Sternal Body	2.5	N/A	1	95%
Sacrum	2.5	N/A	1	92%
Cervical Vertebrae				
C3 (body/arch)	3	N/A	1	95%/98%
C4 (body/arch)	3	N/A	1	93%/100%
C7 (body/arch)	3	N/A	1	80%/99%
Thoracic Vertebrae				
T6 (body/arch)	3	N/A	1	95%/95%
T8 (body/arch)	3	2	0	97%/98%
T9 (body/arch)	3	2	0	75%/80%
Lumbar Vertebrae				
L4 (body/arch)	3	N/A	1	83%/97%
Left Humerus	2.5	N/A	1	95%
Right Humerus	2.5	N/A	1	98%
Left Radius	2.5	N/A	1	98%
Left Ulna	2.5	N/A	1	98%
Right Ulna	2.5	N/A	1	98%
Left Femur	2	N/A	1	93%
Right Femur	2	N/A	1	97%
Left Tibia	2.5	N/A	1	95%
Right Tibia	2.5	N/A	1	97%
Left Fibula	3	N/A	1	96%
Right Fibula	3	N/A	1	96%
Left Clavicle	2.5	N/A	1	98%
Right Clavicle	2.5	N/A	1	98%
Right Ilium	2.5	N/A	1	98%
Right Ischium	2.5	N/A	1	98%
Right Pubis	2.5	N/A	1	85%

Table 1. Only bones present were used in epiphyseal union estimations.
* Scoring: 1 - no fusion 2 - partial fusion 2.5 - advanced union 3 - complete union
** % if < 100%: Estimated completeness of cortical surface



Figure 2. Sacral epiphyseal line scored a 2.5

Figure 3. Right iliac crest epiphyseal line scored a 2.5



Figure 4. Left femoral epiphyseal line scored a 2

Results

Upon completion of the assessment using the epiphyses, it was concluded that most of the skeletal elements scored at or closer to a 3. It is believed that the postcranial remains belong to a subadult with the biological age range of 15 to 25 with a median age of 20 (Figure 5).

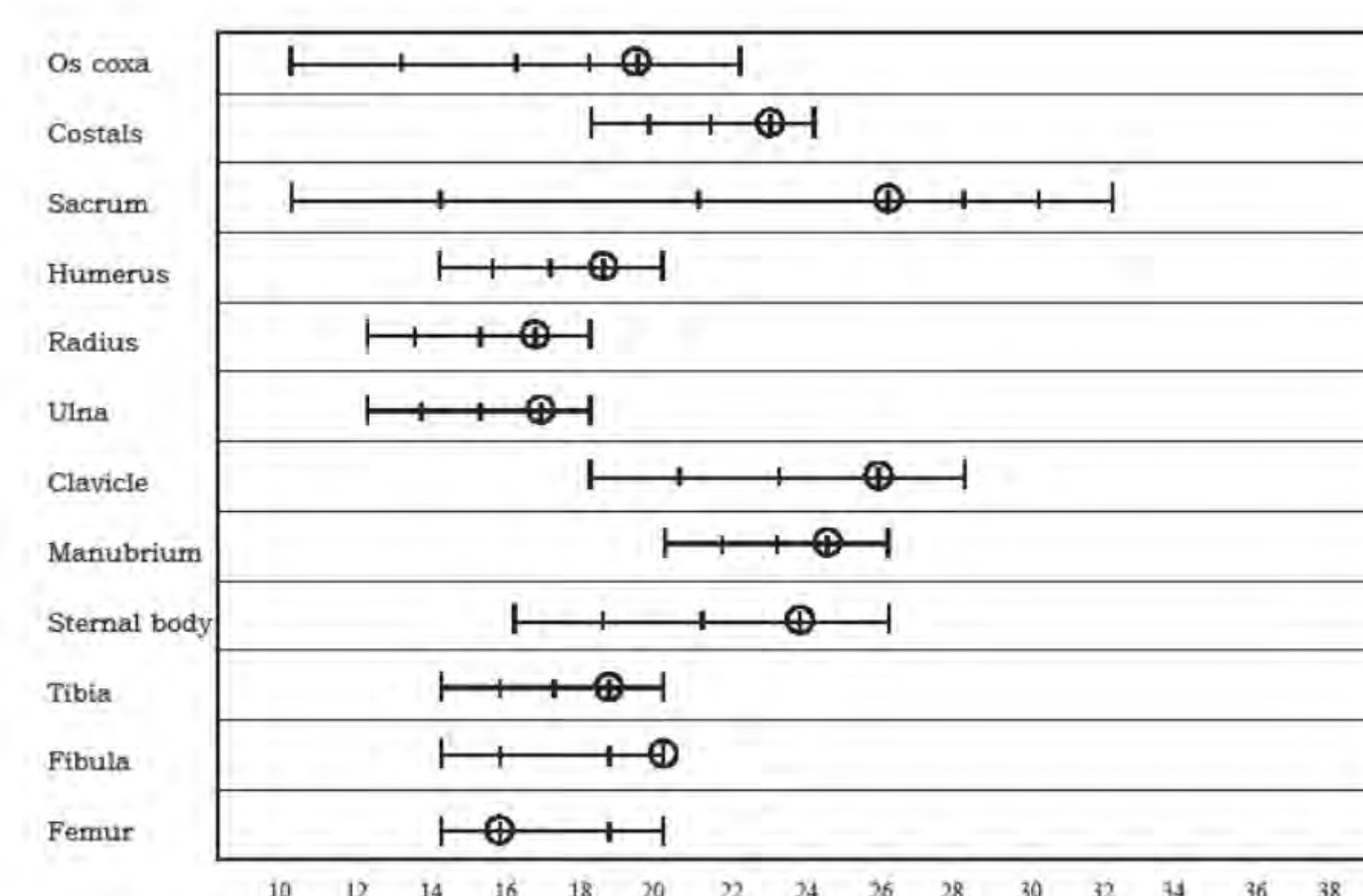


Figure 5. Estimated age range for epiphyseal union. (based on Buikstra and Ubelaker(1994), Figure 20, Page 43, traits combined for each skeletal element)



Figure 6. Right humeral epiphyseal line scored a 2.5

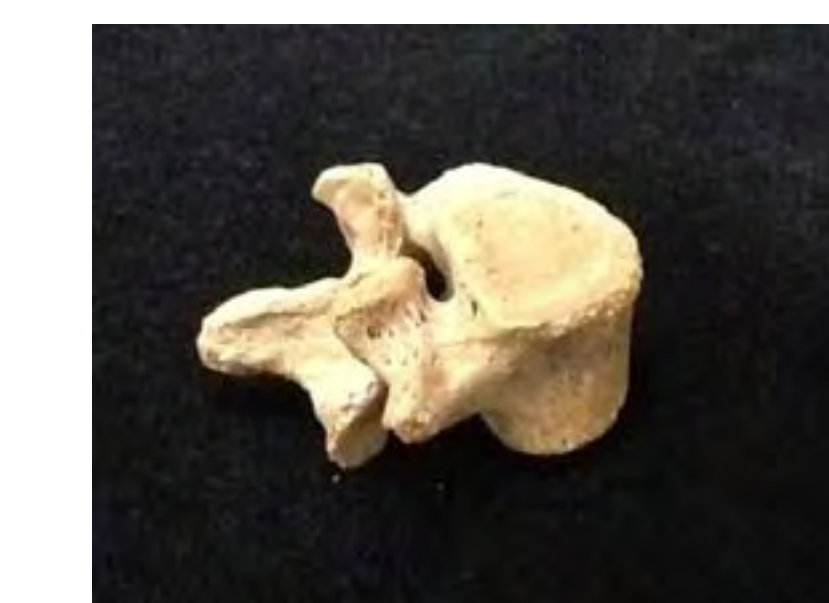


Figure 7. Lumbar 4th vertebra epiphyseal line scored a 3

Conclusions

Usually a forensic anthropologist would be able to assess the age at death more readily if given a full and complete skeleton; this is not the case here. During inventory it was discovered that some key elements were missing that have telltale signs of age. The skull for these particular remains is missing as well as the left os coxa along with the pubic symphysis for both right and left os coxae. Since there are some missing elements, it is harder to give a more definitive biological age range. Even with these missing elements, there was an abundance of epiphyseal plates to assess which could point to a general biological age range and median age. It is believed that the postcranial remains belong to a subadult with the biological age range of 15 to 25 with a median age of 20. This tells us that according to Buikstra and Ubelaker's (1994) estimated age categories that these skeletal remains belong to a young adult. In an actual case of unidentified remains, there would be additional assessments and characteristics that would be used to better confirm the age range. Some additional techniques that would be used are dentition development and eruption and postcranial long bone measurements.

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