A14   Age Estimation Using Osteophytic Activity on the Lumbar Vertebrae and Partial Least Squares Regression

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After attending this presentation, attendees will better understand how to estimate the age at death of adult individuals using osteophyte development on the vertebral centra and the utility of the prediction intervals presented in the methodology.

This presentation will impact the forensic science community by presenting a method that can be used to estimate the age at time of death of adult individuals when only the lumbar vertebrae are present. This presentation also shows the need to continue further studies into the utility of osteophytes for biological profile estimation, for they are an area with very little previous research.

Historically, there have been four areas that are typically used for adult age estimation.[1] These areas include the auricular surface, sternal rib ends, pubic symphysis, and cranial sutures. Other areas of the skeleton have been investigated with the same scrutiny. One area that has received very little attention is the osteophytic activity on the vertebral column. These osteophytes are frequently used to obtain general age estimations when employing the *Gestalt* method of getting a feel for the age of the decedent based upon the morphological appearance of several areas; however, there has been little work performed to develop quantitative or qualitative adult age estimation methods using osteophytosis since the work of Stewart.[2,3]

Snodgrass continued research into osteophyte development on the vertebral centra using revisions made to the Stewart scoring system.[3,4] Snodgrass used inappropriate statistics for ordinal data and his method is difficult to apply due to a lack of description and illustration.[4] It is difficult to apply the developed scoring system to osteophytic development, especially for those with a limited understanding of the developmental patterns of osteophytes on the vertebral centra.

A total of 203 White males and females of known ancestry, sex, and age were sampled from the Hamann-Todd Collection at the Cleveland Museum of Natural History. The superior and inferior rims of each lumbar vertebra were scored using the Snodgrass five-stage, ordinal scoring system.

Polychoric correlation matrixes showed there is a high degree of correlation between the superior and inferior rims of all five vertebrae. The highest correlation found between two vertebrae was 0.92 and the lowest correlation was 0.69. The polychoric correlation also found that the variables are all highly correlated and, thus, multicollinearity is an issue. Analysis of Covariance (ANCOVA) showed that the differences between the mean scores for males and females across age were not statistically significant with an F-value of 0.429. Partial least squares regression was chosen for age estimation over other methods because it eliminates the problem of multicollinearity. The partial least squares model was then used to create 95% prediction intervals using R software.[5]

The 95% prediction intervals reported in this presentation are quite large with the interval being approximately 50 years. Many forensic anthropologists argue that this method is of little use in narrowing down the missing persons list due to its large age intervals; however, the lower bounds of these intervals do provide important cut-off points. For example, if an individual scores a three on all of the vertebral rims, the observer can conclude, with 95% confidence, that he or she is more than 46 years of age. This finding can eliminate a large portion of possible identifications and would be useful when combined with other age estimation methods. Osteophytosis can be used as a method for age estimation, but it does require further research and validation. Revisions need to be made to the scoring system developed by Snodgrass.

Reference(s):

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2. Milner G., Boldsen J. Transitional analysis: a valdiation study with known-age modern American skeletons. *Am J Phys Anthropol* 2012;148:98-110.

3. Stewart T. The rate of development of vertebral osteoarthritis in American whites and its significance in skeletal age identification. *Leech* 1958;28:144-151.

4. Snodgrass J. Sex differences and aging of the vertebral column. *J Forensic Sci* 2004;49(3):1-6.

5. R Core Team. *R: A language and environment for statistical computing.* Version 3.1.3. Viennna, Austria: R Foundation for Statistical Computing, 2015.

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