



## Physical Anthropology Section – 2011

### H22 The Use of Vertebral Osteoarthritis and Osteophytosis in Age Estimation

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The goal of this presentation is to assess whether or not vertebral degenerative changes can be used for estimating age.

This presentation will impact the forensic science community by demonstrating that a significant but weak correlation exists between age and vertebral degenerative changes.

For more than 50 years, research has been conducted on various regions of the human skeleton to establish techniques for determining age at death; however, the accuracy of those age prediction techniques generally decreases as chronological age increases. While previous research on the vertebrae indicates that a correlation exists between age and osteophyte development (osteophytosis) (Snodgrass 2004, Stewart 1958),<sup>1,2</sup> degenerative changes (osteoarthritis) in the zygapophyses have not been assessed for patterns associated with age. Additionally, many of the past studies that assessed vertebral bodies in forensic and bioarchaeological settings were conducted on skeletal collections from more than 75 years ago.

The present study examined degenerative changes both in the bodies and zygapophyses in all 24 vertebrae using a modern forensic population from the Donated Collection at the University of Tennessee, Knoxville. Researchers independently examined and scored the superior and inferior borders of the vertebral bodies and the superior and inferior facets of each vertebra for 104 individuals aged between 30 and 90 years. Scoring techniques for osteophytosis and osteoarthritis were based on Ubelaker (1999).<sup>3</sup> Statistical analyses were used to assess relationships between age and degenerative change for the bodies and facets, both separately and in combination, for all vertebrae collectively, as well as for subcategories of vertebral types. Separate analyses also were conducted which included only the vertebrae in regions that are most commonly flexed (for osteophytosis, these regions included C5-6, T8-9, and L4-5; for osteoarthritis, C6-7, T1-5, L2-4).

Results using all 24 vertebrae indicate the following. Severity of osteophytosis is significantly correlated to age for all vertebrae collectively, as well as for each vertebral subcategory ( $p < .001$ ); however, the association is not strong ( $R^2$  values range from 0.244 for cervical vertebrae to 0.393 for lumbar vertebrae). With regard to osteoarthritis, severity is significantly correlated to age for all vertebrae collectively, as well as for the cervical and lumbar subcategories ( $p < .01$ ); however, once again, the association is not strong ( $R^2$  values range from 0.168 for all facets combined to 0.305 for cervical facets). Results do not improve when bodies and facets are considered together: severity is significantly but not strongly correlated with age in all categories ( $p < .5$ ;  $R^2$  ranges from 0.205 for thoracic vertebrae to 0.370 for cervical vertebrae).

Results of the analyses for areas of common flexion are only slightly better. Osteophytosis and osteoarthritis are significantly correlated to age for all categories of data when considered both separately and together (osteophytosis:  $p < .001$  with  $R^2$  values ranging from 0.243 in the cervical vertebrae to 0.408 for combined subtypes; osteoarthritis:  $p < .01$  with  $R^2$  values ranging from 0.116 in the thoracic facets to 0.244 in the lumbar facets; combined:  $p < .001$  with  $R^2$  values ranging from 0.217 in the thoracic vertebrae to 0.319 in the lumbar vertebrae).

The current study assessed the presence and strength of the relationship between age and vertebral degenerative changes with the hope of generating predictive models for estimating age in older individuals. To differentiate from previous research, data from multiple indicators were considered both individually and collectively and a contemporary population, composed of individuals whose deaths post-dated 1980, was used. In general, results from this study add to, but ultimately mirror, previous research. That is, both osteophytosis and osteoarthritis are significantly but not strongly correlated with age (either singularly or in combination). Therefore, though both types of degenerative change are believed to be associated with repetitive movements and stress (and, thus, exacerbated by the aging process), the relationship is not strong enough to yield predictive power for establishing age estimates.

#### References:

1. Snodgrass JJ. Sex differences and aging of the vertebral column. *J Forensic Sci* 2004;49(3):458-463.
2. Stewart TD. The rate of development of vertebral osteoarthritis in American whites and its significance in skeletal age identification. *Leech* 1958;28(3-5):144-151.
3. Ubelaker DH. *Human skeletal remains: excavation, analysis, interpretation*. 3<sup>rd</sup> edition. Washington, D.C.: Taraxacum, 1999.

#### Age Estimation, Vertebrae, Osteoarthritis