H106 Dead Man's Curve: How Scoliosis Affects Rib Aging

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The goal of this presentation is to present gross and radiographic methods used in the identification of abnormal spinal curvature, e.g., scoliosis, and the possible effects this condition has on the accuracy of rib aging estimation from skeletal remains.

The presentation will impact the forensic community by elucidating the possible effects scoliosis has on rib aging criteria developed for the analysis of skeletal remains.

Abnormal lateral curvature of the vertebral column, or scoliosis, currently affects 2-3% of the United States population. Due to its fairly uncommon occurrence, the presence of the condition may help to establish a positive identification from unidentified skeletal remains when medical records or radiographs are available. In the absence of antemortem medical information, scoliosis becomes one aspect of the broader biological profile (i.e., age, sex, stature, and ancestry) used to compare the unknown individual with NCIC and NamUS missing and endangered persons profiles.

Two types of scoliosis are identified in clinical settings—adolescent scoliosis and adult degenerative scoliosis. Clinicians visually identify both types through the presence of asymmetric shoulders, scapulae, and hips. The diagnosis is then confirmed through antero-posterior radiographs. Once the displaced vertebrae are radiographically identified, the degree of the abnormal curvature is calculated using the Cobb angle. On the radiograph, one line is drawn from the superior vertebral body of the uppermost-displaced vertebrae. A second intersecting line is drawn along the inferior vertebral body of the most inferiorly displaced vertebra. The angle between these two lines as measured by a protractor is the Cobb angle. A 10° curvature is the minimum angulation required for a clinical diagnosis of scoliosis with most scoliotic spinal deformities falling between 10° and 30°.

The postmortem skeletal identification of scoliosis is typically determined through gross analysis of the ribs (e.g., asymmetrical length and shape of rib antemeres), isolated vertebrae (e.g., deflected transverse processes, lateral wedging, rotation, and/or torsion of vertebral bodies, asymmetrical presence of sclerotic bone, and/or ossified intervertebral disc spaces), as well as the abnormal appearance of the articulated vertebral column. These changes to the ribs and vertebrae may cause the analyst to over estimate the age of the individual if the scoliotic pathology is present but slight in its expression or if the analyst does not recognize the condition. It is hypothesized that the loss of rib symmetry caused by the curvatures, which is attributed to the adaptation the ribs must make to accommodate spinal deformities, as well as the potential ossification of spinal ligaments and intervertebral disc space, results in changes to the sternal rib ends that inevitably complicate age assessment.

For this study, a series of skeletons (n=44) under the jurisdiction of various medical examiners, including the offices of District 4, 17, and 20, were evaluated for scoliosis indicators. Twenty-five percent (n= 11) of the forensic skeletal sample revealed scoliotic curvatures upon reconstruction. Left and right fourth ribs were aged of each individual and assigned a phase score using the Iscan and colleagues technique. In addition, the Cobb angle was calculated for each reconstructed skeleton within our forensic sample. Lastly, five analysts were used in this study in order to account for interobserver error.

It was found that the more severe instances of spinal curvatures were caused by underlying congenital defects, the most common being hemivertebrae. Most instances of scoliosis observed presented with a double curvature and exhibited osteoarthritis; thereby, suggesting the curvature was attributed to age-related changes. In general, rib ends did not necessarily age older, but in some cases sustained such a high degree of distortion they appeared more flattened or youthful as defined by the Iscan and colleagues' technique. Therefore, we suggest that when skeletal analysts age scoliotic individuals shape criteria should be de-emphasized. Rather, features such as porosity and pitting criteria should supplant shape changes when using Iscan and colleagues aging technique on scoliotic skeletal remains.

Forensic anthropology, Scoliosis, Fourth rib end aging