



## A51 A Survey of Peri-Mortem Vertebral Trauma in Historic Cases

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**Learning Overview:** After attending this presentation, attendees will be aware of: (1) the value of incorporating vertebrae in trauma analysis; (2) how analysts typically describe and interpret peri-mortem vertebral trauma; and (3) the importance of standardization in descriptions of vertebral skeletal trauma.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by: (1) facilitating analysis of vertebral trauma in skeletonized remains; (2) highlighting the importance of reconstruction and articulation of fragmented remains for trauma analysis; and (3) improving standardization of vertebral trauma analysis by presenting illustrative examples.

Vertebrae present challenges in trauma analysis because of their unique morphology and articulations within the thorax. Additionally, due to the complex structure of vertebrae, expectations based on biomechanics are of limited value. The forensic anthropological literature presents conflicting opinions regarding the importance and analytical potential of vertebral trauma. Experimental and retrospective trauma research primarily focus on the skull, long bones, and ribs. Several published case studies demonstrate that analysis of vertebral trauma can contribute significantly to overall trauma interpretation. However, in other cases, analysts cite fragmentation of the vertebral remains as precluding any useful interpretative analysis to be undertaken. The foremost objective of this study is to clarify discrepancies in the literature by assessing the value of vertebral trauma analysis in a sample of skeletal trauma analyses of various mechanisms.

Trauma analyses of historic cases associated with United States servicemen and civilians lost during World War II and the Korean War from the Defense POW/MIA Accounting Agency Laboratory are reviewed ( $n=51$ ). Analyses were completed in the blind, and unknown individuals have since been identified and associated with air ( $n=18$ ), ground ( $n=31$ ), and sea losses ( $n=2$ ). These cases display blunt force ( $n=10$ ), projectile ( $n=18$ ), extensive (e.g., deceleration or blast) ( $n=18$ ), or indeterminate ( $n=5$ ) trauma.

Overall, analyses of affected vertebrae are highly variable. The degree of fragmentation is rarely quantified. Most analysts include photographs of vertebral trauma (65%) and incorporate adjacent skeletal regions in their analysis (63%). However, reconstruction or articulation are undertaken in less than half of cases (41%). Vertebral trauma contributes to directionality interpretations in approximately half of cases (51%).

When these results are assessed by mechanism, photographs of vertebral trauma are included more frequently in blunt-force (70%) and projectile (100%) trauma cases than extensive trauma cases (33%). More often than not, analysts incorporate adjacent skeletal regions in vertebral trauma analysis no matter the mechanism (blunt force=60%, projectile=67%, extensive=72%). Vertebrae are reconstructed more commonly in projectile (78%) than blunt force (30%) or extensive (17%) trauma cases, and directionality is interpreted more often in projectile (67%) and extensive (56%) cases than in blunt force (20%) cases. These trends may reflect factors such as the condition (e.g., fragmentation) of vertebrae or the absence of standardized language and guidance for analysis of vertebral skeletal trauma. Additionally, in extensive trauma cases, analysts may not directly address vertebral trauma in an attempt to synthesize observations.

Results indicate that analyses of vertebral trauma are highly variable. Analysts are likely to consider the relationship between trauma observed on vertebrae and adjacent elements regardless of traumatic mechanism. Further, vertebral trauma analysis is underused in blunt force trauma cases, and analysts more often reconstruct vertebrae and infer directionality in projectile trauma cases.

Although vertebrae have received less attention than other elements in the trauma literature, preliminary results suggest that vertebrae are valuable in the interpretation of skeletal trauma regardless of the mechanism of injury. Reconstruction of fragmented vertebral remains and consideration of adjacent elements has the potential to improve analyses and result in more robust descriptions. Though many of the cases reviewed here present relatively complete sets of skeletal remains, these results suggest that vertebrae are valuable in cases with incomplete and fragmented remains as well. These findings facilitate a more comprehensive and standardized interpretation of injury patterns in skeletal remains and direct future research on vertebral trauma in forensic cases.

### Peri-Mortem Trauma Analysis, Vertebral Injury, Mechanism of Trauma