A1 Quantifying and Visualizing Skeletal Thoracic Trauma

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The goal of this presentation is to introduce attendees to ongoing research in thoracic trauma and fracture pattern trends in vehicular accidents and to describe how advanced imaging techniques can act as tools in trauma research.

This presentation will impact the forensic science community by contributing statistically substantiated results, which will directly affect the interpretation of fracture patterns and ultimately further baseline knowledge of the complex interaction of variables in the thoracic region.

Trauma analysis is largely heuristic; while there have been advancements in recent years, overall statistical substantiation of findings is lacking in comparison to other research areas within forensic anthropology. Thoracic blunt trauma, in particular, is difficult because of the complexity and variation in bone morphology and muscle attachment sites. Additionally, the number and magnitude of extrinsic variables is problematic when making interpretations. The goal of this presentation is to shed light on extrinsic and intrinsic variables that should be taken into consideration when interpreting fracture patterns in the thoracic area. Specifically, this presentation will explore the relationship between rib fractures and known variables in a vehicular crash setting.

Individuals over 18 years of age that were in a motor vehicle accident, hit from the front or side, with or without the use of a seat belt were included in the study. Computed Tomography (CT) images with associated medical records of injuries to the thoracic region of 180 individuals were evaluated. The two continuous variables, age and speed, were also categorized to better observe relationships among variables. Additional variables, such as presence/absence of fractures, side (left/right) of fractures, rib number, specific location on the rib (anterior, posterior, lateral), and number of fractures were scored for each individual. Chi-squared tests and logistic regression were conducted to explore the relationship between presence/absence of fractures to the above-mentioned variables. Density plots were used in order to visualize patterns of fracture location and provide insight to overall trends.

Only one variable, age, showed a statistically significant relationship with the presence of fractures using a chi-squared test. When age category was tested against the presence of fractures, the two variables appeared to be dependent ($\chi 2(2) = 15.902$, $p < 0.05$). The null hypothesis was accepted for all other variables, suggesting no relationship ($p > 0.05$). The age category was also the only variable to demonstrate a significant relationship in the logistic regression. A middle-aged individual is 2.61 times more likely to have fractures reported than an individual in the young-age category. An older-aged individual is 5.55 times more likely to have fractures present than an individual in the middle-age category. There was a slight trend that males, on average, incurred more fractures than women; however, women in the middle-aged category were 2.6 times more likely to fracture than males in the same age category. Counterintuitively, speed was not found to be a significant variable with the presence of fractures. A slight trend appeared in the data associating a slightly higher number of fractures when hit anteriorly. The density plots displayed a lack of differentiation of number of fractures between sides but the greatest density of fractures was located laterally.

Practicing forensic anthropologists should be aware that when observing fracture patterns in the thoracic region,

age will play an important role in number of fractures, while all other recorded variables exhibited little impact on the presence and location of fractures. The current project exemplifies the evolution of forensic science because of the inter-disciplinary collaboration, the utilization of advanced imaging techniques, and the incorporation of statistical analyses, which moves us away from experience-based trauma interpretation and toward scientifically sound interpretations.

Ribs, Vehicular, Blunt Trauma