A140 Assessing the Impact of High- Versus Low-Velocity Thoracic Trauma: A Study of Experimental Rib Fracturing Using Juvenile Pigs (Sus Scrofa)

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Learning Overview: After attending this presentation, attendees will better understand how juvenile porcine torsos behave under conditions of high-velocity versus low-velocity impact.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing experimental data that informs how the juvenile torso as a structure, rather than bone as a localized material, behaves under different impact velocities.

Forensic anthropologists are often unable to use the same techniques they use on adults to assess trauma on juveniles, due to several differences in bone properties (e.g., structure, elasticity). Rib fractures are one of the most common injuries sustained due to both accidental and non-accidental trauma. When injuries occur from a fall or a motor vehicle collision, the impact will likely result in distinct fracture patterns. However, there has been little experimental data that focuses on the type and pattern of fractures that occur from high-velocity versus low-velocity impact to the juvenile torso. Through an analysis that compares the differences between velocities and anatomical position, forensic specialists will be able to use the findings of this study on bone fracture characteristics to further understand the mechanisms of injury.

This study uses a juvenile porcine model to examine the effects of experimental impact to the torso at two different loading rates: (1) static loading (at a rate of 0.01m/s); and (2) dynamic loading (at a rate of 0.4m/s). Additionally, the torsos will be tested in two distinct starting positions (anterior and lateral) under the two loading rates. A total sample of 12 ungutted juvenile pigs (*Sus scrofa*) aged approximately one week and weighing between 1.5 and 2.4 kilograms were purchased from a local supplier. The total sample was separated into four sub-sample groups, each with three specimens, to assess for differing velocities and different impact positions. The first sub-sample assessed the effects of static loading with impact occurring in an anterior-to-posterior direction. The next sub-sample assessed static loading with the torso being impacted in a lateral position. The remaining two sub-samples assessed the effects of impact in the same two starting positions under dynamic loading. All the specimens were mechanically compressed to 60% of the specimens' torso thickness using the Instron ElectroPlus™ E10000 biomechanical tester. Once compression tests were completed, each specimen was defleshed and the torso was macerated for macroscopic analysis. The sub-samples comprised a total sample of 363 individual ribs.

Macroscopic analysis revealed that of the 363 ribs, only 29 (7.9%) were fractured. Of these 29 fractured ribs, 23 (79.31%) occurred on the right side of the ribcage, while 6 (20.68%) occurred on the left side. Additionally, 17 (58.62%) of the fractures were incomplete and 12 (41.37%) were complete fractures. When comparing fractures that resulted from static loading versus dynamic loading, the results illustrate that 15 fractures (51.72%) were the result of static loading, and 14 fractures (48.27%) were due to dynamic loading. When comparing the two different anatomical positions, 22 (75.86%) fractures occurred when the specimen was impacted anteriorly, while 7 (2.41%) fractures occurred from testing in the lateral position. Further analysis, including the documentation of the specific fracture location on the rib shaft, as well as a thorough characterization of the fracture morphology (macro and microscopically), will enhance the current knowledge the forensic community has on the effects of compressive trauma to the juvenile thorax.

Velocity Trauma, Fracture Patterns, Force Velocity Impact