



## Physical Anthropology Section – 2011

### H7 Analysis of Primary Blast Rib Fractures

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After attending this presentation, attendees will understand the results of an analysis of rib fractures associated with primary blast trauma.

This presentation will impact the forensic science community by providing a more comprehensive understanding of the mechanisms and effects of blast trauma, specifically those involving the ribs, resulting in more accurate interpretations of skeletal trauma.

Worldwide, the prevalence of terrorist attacks employing the use of explosive devices has served to shift counterterrorism focus from wide-scale weapons of mass destruction to conventional explosive attacks. In 2008, bombings alone accounted for more than one-third of all terrorist attacks, with explosives, vehicle bombs, and improvised-explosive devices resulting in the majority of injuries. Forensic anthropologists have become increasingly involved in the identification of blast victims as well as the interpretation of skeletal trauma caused by exploding ordinance. Understanding rib fracture patterns associated with such explosive events would provide significant medical and forensic lead information. This study investigates the rib fractures associated with primary blast trauma (i.e., resulting from the blast wave).

Rib fractures are associated with the majority of traumatic thoracic events and can be important indicators of soft tissue and organ injury. Despite this, rib fractures have historically received little attention in medical and anthropological literature. The relatively small amount of rib fracture research could be due to the habit of viewing ribs as

individual bones rather than a protective system for the thoracic cavity, the cumbersome nature of processing the torso, and the medical practice of often overlooking rib injuries due to the potential for more severe injury to the vital thoracic organs. The majority of literature on the broader topic of blast trauma is in medical journals and focus on treatment of injuries rather than conducting controlled, empirical studies. Some researchers have examined the mechanisms of rib fracture in order to understand their structural failure during different traumatic thoracic events, but have not specifically considered blast forces.

A bone's reaction to stress is affected by factors such as force and the mechanical properties of the bone. The morphology of ribs, specifically their cross-sectional shape and degree of curvature along their length, sets them apart from other human bones and suggests that they should be expected to respond uniquely to applied forces. A recent study by Christensen *et al.*<sup>1</sup> examined primary and secondary skeletal blast trauma and reported the presence of numerous butterfly fractures in ribs that were most likely caused by ventrally applied blast force. Building on these findings, the present study involves further analysis of the previous observations, as well as additional simulated (and more controlled) primary blast event forces.

Results indicate that in response to blast and blast-type forces, ribs tend to fracture in the head, neck, and shaft in a manner consistent with compression, shearing and bending forces. Butterfly fractures, which are the result of bending, tensile and compression forces, were frequently observed. This is unsurprising considering that these forces are typically associated with blast events. Rib fracture patterns differed from those normally associated with other types of trauma events such as blunt force (including deceleration), projectile, and sharp force.

These results contribute to a more comprehensive understanding of the effect of blast forces on ribs and the interpretation of rib fractures in forensic contexts and may allow forensic anthropologists to differentiate between blast trauma and trauma resulting from some other cause. Practitioners should bear in mind; however, that blast traumas involve a number of complicated variables. If blast injury is suspected, consideration should be given to bone type, injury location, and all available contextual and investigative information including the amount of explosives utilized, the placement of the explosives in relation to the victim and the presence of potential projectiles.

#### Reference:

1. Christensen AM, Ramos V, Shegogue CW, Smith VA, Whitworth WM. Primary and Secondary Skeletal Blast Trauma. Proceedings of the 62<sup>nd</sup> American Academy of Forensic Sciences 62<sup>nd</sup> Annual Scientific Meeting 2010 February 22-27; Seattle, WA.

#### Forensic Anthropology, Blast Trauma, Rib Fractures