H36 Understanding Rib Fracture Patterns

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During this presentation the dynamics of rib fractures will be discussed while introducing a new method for accurately describing the location of rib fractures. The ultimate goal is to test the predictive value of blunt force rib fractures.

Anthropologists face three challenges when analyzing blunt force rib fractures: first, understanding the mechanics of rib fractures; second, describing the location of the fracture; and third, estimating the direction of the impact force. Galloway[1] states that rib fractures rarely occur at the point of compression. This behavior is seen because the rib is a single component in a closed system, which includes the paired ribs, vertebra, sternum, and costal cartilage. Force applied at any position or direction to the system is transmitted throughout the system. As the stresses are distributed through the system the weakest point fractures, which is not necessarily the point of impact.

Structural variation found within the rib further complicates rib fracture mechanics. The head of the rib is formed by relatively thick cortical bone. By comparison the sternal end is primarily composed of trabecular bone bound by a very thin shell of cortical bone. As a result the head of the rib fractures in both oblique and butterfly patterns, failing in tension before compression, while the sternal end of the rib often buckles, failing in compression before tension. Furthermore, the medial portion of the shaft often fractures in a transverse pattern that fails to indicate the direction of tension and compression forces. The first goal of this study is to understand the vast variation of rib fracture morphology and organize this variation into standardized categories.

White[2] identifies eight landmarks on the rib: head, neck, tubercle, angle, shaft, sternal end, costal groove, and cranial edge. Most of these landmarks are located in the posterior region of the rib enabling precise description of fracture location. However, the majority of the rib is identified as the shaft, creating a large wasteland of nondescript area. This lack of features makes communicating the location of a fracture difficult. In light of this, the second goal is to develop a method to accurately locate fracture lines throughout the rib. Conceptualizing the rib as one segment of a circle lends to viewing the system as a clock face. This enables breaking the cross sectioned thorax into twelve segments. Several numbers of the clock are assigned to landmarks and the nondescript areas between are divided in to segments by the numbers between those assigned. The method can be used to quickly and relatively accurately describe the fracture location.

The ultimate goal of the study is to determine the predictability of rib fracture patterns. This is accomplished through a database using the fracture patterns of victims when the direction of the traumatic force was known. The fracture patterns are coded and statistically compared for regularity. The final step of the study is a blind comparison of rib fracture patterns to the database in order to estimate the direction of force.

The extensive bone trauma evidence archived at the Regional Forensic Center, Memphis is used in this study. The bone is harvested during autopsy and retained for medico-legal purposes. The evidence includes males and females of all ages.

1. Galloway, A fracture pattern and skeletal morphology: the axial skeleton. In: Alison Galloway editor Broken Bones: Anthropological Analysis of Blunt Force Trauma. Illinois. Charles C Thomas 2000, 81-112. 2. White TD. Human Osteology. New York. Academic Press. 2000.

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