



A125 Buckle Rib Fractures: More Than a Pleural Surface Phenomenon

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Learning Overview: After attending this presentation, attendees will understand the need for using more precise anatomical terminology when documenting buckle rib fractures.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating a lack of consistency and precision in the definition of buckle rib fractures in the forensic science literature over the past 15 years, in terms of the underlying mechanism of fracture and/or anatomical location of fracture. Suggestions for improving the fracture terminology are made, which should help eliminate confusion and improve the quality of forensic anthropological practice.

In 2004, Love and Symes, citing engineering sources, introduced buckle rib fractures into the anthropological literature, defining them as, “a fracture wherein the bone failed at the point of compressive stress prior to failure at the point of tensile stress.”¹ Despite this straightforward and accurate definition, in the 15 years since its introduction, slight variations of this definition have been presented, leading to possible confusion as to what actually constitutes a buckle rib fracture. To explore these differences, a thorough literature review was conducted. All peer-reviewed sources in English that cited the Love and Symes article were investigated as to whether they referenced buckle rib fractures, whether they defined buckle rib fractures, and if so, how buckle rib fractures were defined.¹

Overall, 36 articles and book chapters fit the criteria for inclusion in this survey. Of these, 18 (50.0%) referenced Love and Symes for reasons other than buckle rib fractures, while 10 (27.8%) of them specifically mention buckle rib fractures, yet do not define them.¹ Only 8 of the 36 sources (22.2%) mention buckle rib fractures while also providing a definition. Of those eight sources, only five define buckle rib fractures as being the result of failure in compression prior to failure in tension; two sources fail to specify a strain mode responsible for the failure; and one source mistakenly reports that buckle rib fractures are the result of failure in tension. In addition to the loading mechanism responsible for failure, three of the eight sources that define buckle rib fractures also include mention of the rib surfaces involved. Two of the three mention that buckle rib fractures can occur on either the “inner” or “outer” cortex of the rib, while one source defines buckle rib fractures as specifically occurring on the pleural surface of the rib.

A case study will be presented that demonstrates multiple incomplete fractures on the right ribs where the cutaneous surface near the sternal end presents with a sharp disruption in the normal alignment of the cortical bone surface, having a crumpled or kinked appearance, while the pleural surface remains intact. Other trauma throughout the skeleton indicates a significant traumatic impact to the left side of the body. It is hypothesized that the load applied to the left side of the thorax transferred through the left costal cartilages to the sternum and continued through the right costal cartilages such that the sternal end of the right ribs was loaded in bending with the pleural surface in tension and the cutaneous surface in compression. As these fractures seemingly resulted from compressive forces, rather than tensile ones, they are classified as cutaneous buckle rib fractures.

In keeping with the engineering literature from which the term was taken, most authors who define buckle rib fracture define it by the loading mechanism responsible and agree that they are the result of failure in compression prior to failure in tension. However, the majority of sources that mention buckle rib fractures fail to specify the affected rib surface. As the case study presented here demonstrates, buckle rib fractures are not only a pleural surface phenomenon and should not be assumed as such. Under certain loading scenarios, the cutaneous surface of the ribs can be loaded in compression with the pleural surface in tension. Ergo, it is recommended that practitioners specify which anatomical surface is affected, notated as a pleural buckle rib fracture or cutaneous buckle rib fracture, to increase the precision of fracture description.

Reference(s):

¹ Love, J.C., Symes S.A. 2004. Understanding Rib Fracture Patterns: Incomplete and Buckle Fractures. *J Forensic Sci.* 49(6): 1153-1158.

Buckle Rib Fracture, Trauma Analysis, Fracture Analysis