H36 The Rorschach Butterfly: The Use of Nomenclature in Lieu of Understanding the Effects and Components of Kinetic Energy in Bone Trauma Interpretations

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After attending this presentation, participants will gain knowledge related to current limitations of bone trauma classifications and terminology used in forensic anthropology with particular reference to blunt and ballistic butterfly fractures.

This presentation impacts the forensic science community by contributing to knowledge of bone trauma classifications and use of misleading or misdirected nomenclature associated with fracture pattern recognition. Blunt, sharp, and ballistic (contra "projectile" in much of anthropology) trauma categories are used to distinguish and interpret fracture characteristics in clinical settings and for description in a court of law. Bone trauma categories must convey bones' response to overall absorption of kinetic energy (KE =mv2/2) in which velocity may be a recognizable feature. However, anthropologists continually use the term "butterfly" to explain fracture shape and propagation as well as extrapolate external loading conditions in both blunt and ballistic long bones injuries.

In 1885, Messerer noticed that bending stresses on a tibia caused distinct wedged-shaped fracture patterns that at the time was also considered useful in defining direction and location of the externally applied force. More recently, a *Messerer fracture* primarily appears in forensic pathology literature and is applied to very specific injury-producing events, particularly pedestrian-vehicle accidents.[1] Yet his pioneering work on fracture pattern recognition in bending bone is ubiquitous in biomedical and forensic literature and is commonly referred to as butterfly fracture/fragments, tension wedge-fracture, and bending wedge-fractures. With an extensive research history of fracture propagation and bending bone, the association of "a bending butterfly pattern" in ballistic injuries is incorrect and is apparently associated with a dual-meaning for a butterfly fracture in the academic literature. For example, in 1915, La Garde described a perpendicular gunshot wound to a tibia (plug and spall and associated radiating fractures) as a butterfly fracture; his observations brought forth the use of current terminology such as ballistic, false, and/or double-butterflies.[2]

Biomechanically, blunt and ballistic butterfly fractures are not interchangeable in recognition or interpretation. Since the biomechanical response and fracture mechanics of bone are dependent on the external loading conditions (load-rate, contact area, impact location), butterfly descriptors are different for each situation and are essentially opposite patterns. The important question to answer with these various butterfly configurations is whether the morphological descriptors are useful in understanding fracture propagation and subsequent interpretations of fracture etiology as well as direction of failure.

The purpose of this presentation is to redirect anthropologists from relying on terminology to describe energy and focus on interpreting, at least at the basic level, the biomechanics behind bone fracture. To achieve this goal, lesion characteristics of blunt and ballistic butterfly fractures are described and contextualized, related to soft tissues and within a basic biomechanical framework. Case studies are used to illustrate the need for forensic specialists to examine external loading conditions through closer examinations of all fractured surfaces (macro and microscopically) as well as the entire pattern of trauma on a body, including the associated damage on skin and soft tissues whenever possible, prior to presenting specific fracture interpretations.[3]

Academics are urged to go beyond comfortable pedagogical practice and to explain modes of failure, tension, compression, and shear, along with varied nomenclature as a means to improve understanding and facilitate the maturation of bone trauma as a scientific discipline. A butterfly fracture is often an anthropology student's first exposure to the biomechanics of bone trauma but merely recognizing a butterfly fractures does not lead to success in bone trauma interpretations, as the biomechanical response of bone to an external loading condition is far more important than the various names used to describe a broken bone or for a bone to be thrown into a generic category.

References:

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Classification of Bone Trauma, Biomechanics, Butterfly Fractures

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