H51 The Relationship Between Directionality of Force and the Formation of Butterfly Fractures

Tammy S. Thomas, BS, 910 San Jacinto Street, Lockhart, TX 78644; and Tal Simmons, PhD, School of Forensic & Investigative Sciences, University of Central Lancashire, Preston, PR1 2HE, UNITED KINGDOM*

After attending this presentation, attendees will better understand the formation of butterfly fractures and the underlining factors affecting the pattern of their formation.

This presentation will impact the forensic science community by providing an understanding of the mechanisms of injury behind butterfly fractures found in relation to human skeletal remains.

Fractures are caused in a number of ways. Pathological conditions could weaken a bone to the point of breaking, or continual stress to a bone could lead to a stress fracture, but the cause of fractures most people consider first is an abrupt impact of some force that directly results in a break in the continuity of a bone. This third case is where there is a direct cause and effect to the trauma, and because of this the order of events leading up to a fracture can be traced. The location, angle, and severity of a fracture indicate the type of mechanism of injury involved. It is the variation between fractures that make it possible to determine if a person slipped and fell or if they were defending themselves.

Identifying the type of fracture being observed will aid in identifying the cause of the trauma. A butterfly fracture is a comminuted fracture that results from an abrupt impact to appendicular long bones. The butterfly fracture creates a butterfly fragment, which is a triangular piece of the bone that detaches when two main fracture lines meet forming what looks like a Y-shaped fracture. This study was conducted to focus on the formation of butterfly fractures and any influences differing blunt shapes and forces had on their formation.

Ninety-four sheep femora were broken at two force levels, one group in the 900s Newtons range and the other group in the 800s Newtons range, with either a rounded, flat, or edged blunt anvil to analyze the resulting fractures. The two force levels were measured by a force plate. The blunt anvils, connected to a metal bar and guided vertically perpendicular to the floor by a custom constructed apparatus, were dropped at consistent heights to control the force levels.

The cortical thickness of the bones and the general degree of the angle of the butterfly fragment were noted to see if an underlying pattern in the fracture's formation occurred. A high-speed camera was utilized to see the timing of the individual fractures that make up the Y-shaped characteristic of a butterfly fracture and their directionality with respect to the point of impact.

Preliminary examinations of the video revealed that the timing of when individual parts of the Y-shaped fracture began varied between bones, resulting in similar appearing fractures that had formed in different sequences. Inspection of the bones also showed that not all of the fractures exhibited the upwards Y-shaped patterning where the force was exerted from the open top of the Y; some created an inverted Y breaking initially at the point of impact in a straight line and then continuing on into two distinct fractures.

The results of this study show that many of the preconceived notions about directionality of force exerted and the formation of the Y- shaped fragment in butterfly fractures are inconsistent and may therefore be unreliable. The variations seen during this study indicate that those preconceived notions could be skewed, resulting in a distorted interpretation of the mechanism of injury. Further experimentation and data collection are needed to show conclusively if there exists a consistent pattern to the formation of these fractures and how

information that can be attained by their examination can accurately be used in the determination of mechanisms of injury.

Butterfly Fractures, Blunt Force Trauma, Mechanism of Injury

 ** Presenting Author*