00433 Biomechanical Analysis of Spiral Fracture Pattern in a Human Metacarpal Using a Chicken Humerus Model

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Aims: Spiral fracture of the metacarpal bone is common and prone to shortening and malrotation. This can limit the function of the hand and surgical fixation is often necessary. A good understanding of fracture pattern is essential to guide surgical fixation. The aim of the study is to analyze the mechanism of spiral fracture formation by biomechanically inducing a torsional force on a chicken humerus model.

Methodology: 30 fresh frozen chicken humerus bone were dissected and divided into three groups of 10. The bones were mounted onto a customized jig and subjected to torsional load using the Instron 3343 Mechanical Tester. The bones were tested at 3 torsional rates (Group A – 45° /sec,Group B – 30° /sec, Group C – 22.5° /sec). The fracture pattern, angle, length, and degree of comminution were analyzed.

Result: 24 out of 30 specimens failed in a spiral pattern along the shaft of the bone, 6 specimens that fractured through the metaphysis were excluded. All spiral fractures propagated along the same direction as the torsional force applied. Spiral fractures were observed to have two distinct components: a 'helical line' that traverses the circumference of the bone and a 'longitudinal line' that connects both ends of the helix. A linear relationship was demonstrated for the different torsional rates applied: the faster the torsion, the smaller the fracture angle (R2=0.9957) and the longer the fracture length (R2=0.9778).

Conclusion: The direction of the torsional force applied predicts the direction of the fracture propagation, forming a distinct 3-dimensional spiral fracture pattern characterized by a 'helical line' and a 'longitudinal line'. Hand surgeons should be mindful about the fracture configuration and consciously identify the two components intra-operatively.

Careful and precise screw placement can prevent catastrophic comminution.