Modes of Fracture of Flat Bone: Fracture Direction and Stress

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This study delineates the application of fractography to discern the multifaceted modes of fracture in flat bones, explicating the interplay between fracture directionality and stress states regarding the viscoelastic nature of bone. Despite the perceived brittleness, bone exhibits toughness, attributed to its intricate structure design and amalgamating properties of solid and viscous materials. This research elucidates the variegated fracture modes inherent to bone's dualistic nature by examining fracture surfaces and identifying fracture markings using stereoscopic microscopy. Our observations across seven bone specimens reveal predominant fracture patterns from top to bottom in six instances, with a singular deviation where the fracture initiated from the bottom to the top. This anomalous pattern is hypothesized to be attributable to the distinctive thinness at the center of the seventh bone, suggesting that structure variations significantly influence the direction of fracture propagation under quasistatic impacts. This insight into the structural determinants of fracture directionality, underscored by the exception in our dataset, highlights the critical role of bone morphology in dictating fracture mechanics. Focusing on the differential thicknesses of the trabecular and cortical layers, we correlate the observed fracture patterns with the underlying stress mechanisms—whether from contact damage, bending, or inherent flaws. This quasistatic impact study, eschewing dynamic and static stresses, furthers our understanding of bone fracture mechanics under controlled yet physiologically relevant conditions. Our findings offer insights into flat bones' structural vulnerabilities and mechanical behaviors under varying stress states. This research refines our comprehension of bone's biomechanical properties in treating and preventing bone injury.