D11 A Computer Simulation for Use in Impact Force Evaluations: Studies on the Correlation Between Impact Force and Finger Bone Fracture

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After attending this presentation, attendees will better understand the relationship between impact force and finger bone fracture to establish a safety assessment index. In addition, attendees will learn the potential use of the Finite Element Method (FEM) for evaluating human finger bone fracture risk.

This presentation will impact the forensic science community by providing an example of computer simulation for human body injury assessment and by illustrating how safety assessment can be used to prevent accidents from a variety of devices.

Establishing relationships between external force and human injury is needed to estimate intent and certify negligence in various incidents or accidents. Recent research revealed that there exists a relationship between bone density and certain types of fracture risk. Techniques that evaluate fracture risk by individual bone shape and bone density are in the process of being developed and some are being used in medical care in Japan. Non-injurious evaluation of individual bone fracture risk is important, but difficult to achieve given variations in individual physical characteristics. This is particularly important when considering finger and hand injuries involving interactions with power windows in motor vehicles. Accurate estimates regarding the relationships between external force magnitude and finger injury risk are needed, but few studies address even the basic biomechanics of this issue due to the low risk to human life and perceived relative unimportance.

This study used a pig tail model of human finger bones during static compression and dynamic drop tests to determine the relationships between external force and injury level. Varying edge shapes were used to consider this covariate in the injury risk determinations. Furthermore, Finite Element Methods (FEM) were also employed to estimate bone fracture risk so relationships between human fingers and pig tail bones could be developed.

The results demonstrated that actual fracture loads (approximately 1,100N to 1,400N) varied significantly with impact velocity, contacting edge shape, and the amount of soft tissue present. FEM simulation demonstrated estimated finger failure loads of approximately 870N to 980N. The role of these finger fracture parameters was confirmed in addition to the usefulness of computer simulation as an effective tool for the evaluation of finger bone fracture risk.

Human Injury, FEM Analysis, Finger Fracture

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