# The Tolerance and Response of the Frontal Bone to Blunt Impact

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## ABSTRACT

*The current understanding of the response of the frontal bone to blunt impact is limited. Previous studies have utilized vastly different methods which prevents statistical analyses to determine the tolerance of the frontal bone. The purpose of this study is to determine the tolerance of the frontal bone to blunt impact and to define corridors describing its force-displacement response. The response corridors were used to evaluate the biofidelity of the Facial and Ocular CountermeasUre Safety (FOCUS) headform, a sophisticated headform capable of measuring forces imposed on eight separate facial regions.*

*A total of 46 impacts were performed on 25 male cadaver subjects ranging in age from 43 to 76 years. The thickness of the frontal bone, overlying skin thickness and head size was measured for 22 of the subjects using CT imaging. The impacts were performed using the flat surface of a free-falling cylindrical impactor. Impactor force was measured using accelerometers and an imbedded load cell. Contact pressure was estimated using Fuji-film. An acoustic emission sensor attached to the frontal bone was used to determine the force at which fracture initiated.*

*Risk functions for fracture were developed using parametric and non-parametric techniques suggesting that 2,500 N represents a 50% risk of fracture. The use of acoustic emission is essential due to the increase in impactor force after fracture onset. The force-displacement response of the frontal bone was found to vary by the type of fracture sustained by the subject. Subjects that were found to have a frontal sinus present within the impacted region had a statistically higher risk of sustaining a fracture. The response of the FOCUS headform was within the force-displacement corridors defined for the cadaveric response.*