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Contribution to a better understanding of human skull bone's mechanical behaviour, subjected to various means of conservation and loading

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Statistical studies of accidents show that the head is the most vulnerable physical segment during a collision (pedestrian impacts, motorcyclist impacts and side automobile collisions). In order to enhance virtual human model and to develop a new predictive injuries tool, this thesis deals with an experimental identification of mechanical properties of the human skull (considered as a homogeneous layer).

Experimental tests on twenty skulls from fresh PMHS (Post Mortem Human Subject) have been performed. A specific protocol has been developed in order to cut 19 specimens per skull. A total of 380 specimens have been tested in three point bending test. The force/displacement curves are considered as reference for elastic modulus identification. Many relationships by zone and orientation have been obtained.

Cycling tests in the elastic zone have been performed on 105 specimens cut in 7 frozen PMHS. Loading velocity effect has also been investigated. This second study compares also specimens according to their conservation's mode. A correlation has been observed and allows to extrapolate the elastic modulus of a fresh skull, tested in the frozen state.

Thanks to these two studies, a relationship between the equivalent elastic modulus and the geometrical properties (thickness and density) of fresh PMHS has been observed.

In order to develop a new head prototype, 7 frozen PMHS skull have been tested in quasi-static compression configurations. The elastic properties of the prototype have been identified from the previous experimental studies and they differ from skull zone to another. This prototype has been validated under static and dynamic compression tests.