

# Predicting brain acceleration during heading of soccer ball

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**Abstract.** There has been a long debate whether purposeful heading could cause harm to the brain. Studies have shown that repetitive heading could lead to degeneration of brain cells, which is similarly found in patients with mild traumatic brain injury. A two-degree of freedom linear mathematical model was developed to study the impact of soccer ball to the brain during ball-to-head impact in soccer. From the model, the acceleration of the brain upon impact can be obtained. The model is a mass-spring-damper system, in which the skull is modelled as a mass and the neck is modelled as a spring-damper system. The brain is a mass with suspension characteristics that are also defined by a spring and a damper. The model was validated by experiment, in which a ball was dropped from different heights onto an instrumented dummy skull. The validation shows that the results obtained from the model are in a good agreement with the brain acceleration measured from the experiment. This findings show that a simple linear mathematical model can be useful in giving a preliminary insight on what human brain endures during a ball-to-head impact.

DOI:10.1088/1757-899X/50/1/012023