

Analytical Modelling of Soccer Heading

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ABSTRACT

Heading occur frequently in soccer games and studies have shown that repetitive heading of the soccer ball could result in degeneration of brain cells and lead to mild traumatic brain injury. This study proposes a two degree-of-freedom linear mathematical model to study the impact of the soccer ball on the brain. The model consists of a mass–spring–damper system, in which the skull, the brain and the soccer ball are modelled as a mass and the neck modelled as a spring–damper system. The proposed model was compared with previous dynamic model for soccer ball-to-head impact. Moreover, it was also validated against drop ball experiment on an instrumented dummy skull and also compared with head acceleration data from previous studies. Comparison shows that our proposed model is capable of describing both the skull and brain accelerations qualitatively and quantitatively. This study shows that a simple linear mathematical model can be useful in giving a preliminary insight on the kinematics of human skull and brain during a ball-to-head impact. The model can be used to investigate the important parameters during soccer heading that affect the brain displacement and acceleration, thus providing better understanding of the mechanics behind it.

KEYWORDS: Soccer heading; head impact; brain injury; mathematical model

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