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Comparison of upper neck loading in young adult and elderly volunteers during low speed frontal impacts

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Abstract-

Cervical pain and injuries are a major health problem globally. Existing neck injury criteria are based on experimental studies that included sled tests performed with volunteers, post-mortem human surrogates and animals. However, none of these studies have addressed the differences between young adults and elderly volunteers to date. Thus, this work analyzed the estimated axial and shear forces, and the bending moment at the craniocervical junction of nine young volunteers (18-30 years old) and four elderly volunteers (>65 years old) in a low-speed frontal deceleration. The study proposed new methods to estimate the inertial properties of the head of the volunteers based on external measurements that reduced the error of previously published methods. The estimated mean peak axial force (Fz) was -164.38 ±35.04 N in the young group and -170.62±49.82 N in the elderly group. The average maximum shear force (Fx) was -224.42±54.39 N and -232.41±19.23 N in the young and elderly group, respectively. Last, the estimated peak bending moment (My) was 13.63±1.09 Nm in the young group and 14.81±1.36 Nm in the elderly group. The neck loads experienced by the elderly group were within the highest values in the present study. Nevertheless, for the group of volunteers included in this study, no substantial differences with age were observed.

Index Terms- Head inertial properties, inverse dynamics, Volunteer testing, Occipital condyle loads, frontal impact

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