加速度計測による高齢者歩行の安定性評価と転倒予防に関する研究

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Study on Stability Assessment of Elderly Walking Utilizing Portable Accelerometry Aimed at Fall Prevention

by

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ABSTRACT

Falls due to locomotive impairment cause a serious hazard to elderly people. Impaired mobility due to injuries or a fear of falling can diminish a person's ability to perform activities of daily living. Aging effects on the sensory feedback has been hypothesized to be a key factor in adjusting posture to maintain balance against unpredictable external or internal irregularities during walking. Conventionally, clinicians perform posture balance assessments using subjective or quantitative testing, which are mostly focused on quantifying regional amount of kinetic parameters, i.e. region of body sway, variability or geometrical characteristics of motion.However, a measure of variability does not

correspond to the sensitivity of the neuromuscular control. This study addresses a quantitative evaluation of personal locomotive ability in terms of stability employing on-linear dynamical analysis. Main objective of this study is to present a reliable technique to assess dynamic stability of walking utilizing a portable accelerometer. Straight level walking of young and elderly subjects was investigated in the experimental study. Elderly subjects generally tended to exhibit higher value suggesting they were less dynamically stable. Significant individual variations were also observed among the elderly subjects, which in part could be explained by their physical conditions. Subjects with higher value were suffering knee pain or had histories of leg fracture, while the subjects with lower value had frequent exercise habit in daily life. Similar tendencies were also found with other direction of acceleration, but not as remarkable as with lateral direction. The experimental results suggested that the present technique might be useful in estimating walking stability and personal risk of falls. This method is easily applicable and reliable in daily living environments and situations. Further application of the present technique may help predicting personal risk of falls.

要　約

高齢者の歩行の特徴として運動の不規則性が報告されている．運動の不規則性は神経筋骨格系の協調の不具合を反映していると考えられるが，そこに内在する制御メカニズムの動的な性質を評価できれば，歩行安定性や転倒のリスクを評価するうえで有効である．われわれは，検診の現場でも容易に使用可能であり，歩行の安定性をより解析的に評価するための新しい方法を提案した．小型の加速度計測装置を腰部に装着し，歩行中の体幹動揺を計測した．得られた加速度時系列データに対して非線形時系列解析を行い，リャプノフ指数の推定を行って歩行の動的安定性を評価した．若年者と高齢者を被験者として実験を行い，運動習慣や関節痛の有無により比較を行った．全体的傾向として，高齢者は若年者よりも動的安定性が低いことを示したが，高齢者でも高い運動習慣を持つ被験者は若年者と同程度の高い安定性を有していた．また，関節痛の有無によっても安定性に差を生ずる結果を得た．以上の結果から，高齢者個人ごとの歩行安定性の診断や運動訓練等介入の効果の定量化に有効な手段となり得ることが示唆された．