生体力学手法による大腿義足ランナーの膝折れリスク評価と影響因子の解明

東 京 工 業 大 学　　久　野　元　気

（共同研究者）同　　　　　　　　中　島　　　求

産業技術総合研究所　　保　原　浩　明

Factors Associated with Prosthetic Knee Buckling during Running in Unilateral Transfemoral Amputees

by

Genki Hisano, Motomu Nakashima

Tokyo Institute of Technology

Hiroaki Hobara

National Institute of Advanced Industrial Science and Technology

ABSTRACT

Individuals with limb amputations appear to benefit both physically and psychologically from participation in sports and/or regular physical activity, leading to a healthy lifestyle. However, individuals with unilateral transfemoral amputations（UTFA）have difficulties in preventing falls due to prosthetic knee buckling, defined as the sudden loss of postural support during weight-bearing activities. Despite the risk of prosthetic knee buckling can be evaluated by the prosthetic knee angular impulse（PKAI）during the stance phase, little is known about the factors associated with PKAI in individuals with UTFA. Therefore, the aim of this study was to investigate the demographic factors associated with prosthetic knee buckling risk in runners with UTFA. Fourteen participants with UTFA performed running on a 40-m of runway, where seven force platforms and optical motion capture cameras. We quantified the risk

of knee buckling as prosthetic external knee flexion angular impulse, which is the time integral of external knee flexion moment during the stance phase of prosthetic limb. We used the Pearson's correlation coefficients to examine the relationship between the demographic data and risk of knee buckling. Only the body mass and body height had the significant negative correlation with the risk of knee buckling. These results suggest that unilateral transfemoral amputees with a smaller body height and body mass may be exposed to a higher risk of prosthetic knee buckling during running.

要　旨

　本研究の目的は，片側大腿切断者におけるランニング時の膝折れリスクを定量評価し，属性情報〔身長・体重・年齢・切断歴・義足の使用歴〕との関係を明らかにすることであった．被験者は片側大腿切断者14名とした．各被験者には40mの走路で全力疾走を行わせ，被験者に貼付した反射マーカの位置情報および地面反力のデータを三次元動作解析装置で計測した．立脚期における膝折れリスクの指標として，義足膝関節の角力積を逆動力学解析によって算出した．相関分析の結果，属性情報のうち身長と体重のみが膝関節角力積と有意な負の相関関係にあることが確認された．これらの結果は，身長がより低く，かつ，体重がより軽い大腿義足ランナーほど，より高い膝折れリスクに晒されていることを示唆している．