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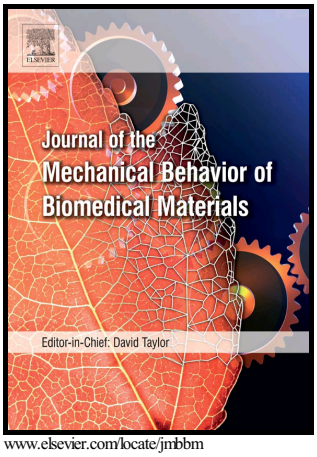

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Loading and kinematic profiles for patellofemoral durability testing

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ABSTRACT

Patellar complications after total knee replacement (TKR), such as maltracking, fracture, wear, and loosening, can lead to implant failure and revision surgery. However, few *in vitro* patellofemoral durability tests for the implanted joint have been developed. Existing standards for PF loading profiles (ISO 14243-5, draft) are generic (not implant-specific) and do not include patient variability. The goal of this study was to derive implant-specific loading profiles to simulate a motor task that reaches high knee flexion and includes patient variability. *In vivo* data, including motion capture and stereo-radiographic images at the knee, were collected for eleven rotating platform TKR patients performing a single-leg lunge activity. Quadriceps forces during the activity were estimated for each patient from marker data and ground forces with a musculoskeletal model. Patellofemoral contact forces were estimated with patient-specific finite element models of the implanted knees. Stereo-radiography patellofemoral kinematics and estimated contact loads were combined to derive seven loading profiles that span the observed inter-patient variability. The loading profiles were experimentally evaluated in a 6-degree-of-freedom testing machine and worst-case loading profiles were identified. The two profiles that generated the highest stresses in the patellar button (43% and 46% of the volume surpassed yield stress, respectively) included the largest internal (4.4°) and external (13.0°) patellar rotation, and