APPROXIMATION OF RANGE OF MOTION LIMITS DURING THE SIT-TO-STAND ACTIVITY: IMPLICATIONS FOR PATIENTS FOLLOWING THR

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INTRODUCTION:
While a concerted effort is being made to decrease the prevalence of dislocation following total hip replacement, dislocation continues to occur in relatively high numbers [1] costing the healthcare system millions annually. It is commonly accepted that dislocation is a multifactorial event with impingement and levering out believed to be the leading mechanism of dislocation. Following total hip replacement a majority of patients are believed to approximate problematic ranges that lead to impingement between the prosthetic components [2-4]. Minimizing such impingement events would likely serve to decrease the occurrence of dislocation as well as garnering other potential benefits such as decreased wear and component loosening.

Though much attention has been placed on component interaction and development it was not until relatively recently that information on activity kinematics, soft tissue restraint and other physiologic data had been taken into consideration regarding the prevention of impingement and dislocation. A greater focus on the physiologic system into which these components are placed including activity kinematics and soft tissue tension will likely provide greater insight into how best to minimize impingement and its untoward effects. The goals of this study are to quantify normal three-dimensional hip range of motion (ROM) and evaluate the degree to which individuals approximate hip end ranges of motion during the sit-to-stand activity.

METHODS:
Ten subjects (7 female, 3 male) ages 50-72 with no history of lower extremity musculoskeletal pathology were recruited and informed consent was obtained in accordance with university institutional review board procedures. The 3-D position of the lower limb and pelvis were recorded using an Optotrak motion analysis system. Three-dimensional hip passive range of motion was determined for three cycles of seven motions performed using varied levels of flexion adduction and internal rotation to capture ROM limits. All subjects performed five trials of the sit-to-stand maneuver at low (39 cm) and normal (46 cm) chair heights. Filtered marker data were used to calculate 3-D joint displacements (KinGait 3, Mishac, Inc.) (Fig. 1). For each individual the ROM limits (Fig. 2) and activity kinematics were compared. The difference between maximal ROM values during the sit-to-stand activities and the respective passive ROM limits were calculated for both the low and normal chair heights. Between groups comparisons were evaluated using a paired t-test (α = 0.05).

RESULTS:
While the envelope representing hip passive range of motion limits has a characteristic shape, the maximal limits varied between subjects predominantly in adduction and internal rotation (Fig. 3). When comparing the sit to stand activity at the two chair heights, individuals utilized greater flexion (p< .01) and internal rotation (p< .05) at the low chair height condition. During the sit-to-stand activity subjects tended to more closely approximate their hip end ranges of motion at the low chair height as compared to normal chair height both in flexion (5.9 vs. 12.5 degrees, p< .001) and internal rotation (22.5 vs. 30.8 degrees, p< .001).

DISCUSSION:
During the sit-to-stand activity healthy individuals regularly approximate their hip flexion passive range of motion limit. Though the range of motion envelope has a characteristic shape for all individuals the variable interaction between adduction and internal rotation results in notable inter-individual differences. Such variability should be taken into consideration when evaluating a patient’s dislocation risk, and used to guide surgical component placement and efforts to restore soft tissue tension.

Due to the disruption of hip musculature and capsule during THR surgery patients have the potential for decreased soft tissue constraint. A focus on restoring soft tissue tension both surgically and via postoperative rehabilitation likely plays a role in preventing total hip replacement patients from reaching problematic ranges, serving to decrease dislocation prevalence.

REFERENCES:

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