How much hip motion occurs in 3 degrees of freedom during activities of daily living?

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INTRODUCTION: Hip range of motion precautions are often considered a requirement for patients after total hip replacement. Few studies have estimated hip motion during activities of daily living, and have been limited to measuring hip flexion/extension only. These studies are also limited by bulky equipment, outdated technology, or testing in a lab environment. The purpose of this study is to evaluate hip range of motion in 3 planes (flex/ext, abd/add, IR/ER) during real-life activities in healthy individuals with a novel tracking wearable sensor.

METHODS: Eight healthy subjects used a hip motion tracking device during a series of tested activities. Healthy volunteers were selected, and subjects were excluded if they reported symptoms in the limb or known deviation in their gait. Activities recorded in the real-world environment included walking, stair ascent/descent, squatting, sitting to standing, getting on/off toilet, getting in/out of car, tying shoes, and getting in/out of bed.

RESULTS: Activities with over 90 degrees hip flexion and about 25 degrees abduction arc include sit to stand and on/off toilet. Getting in/out of bed and care averaged 100 degrees hip flexion with over 26 degree abduction arc, with additional over 20 degrees of hip rotation. Tying shoes while sitting had the highest hip flexion angle of 120 degrees, combined with 27 degrees abduction arc and 13 degrees rotation. Stairs and level walking had the narrowest motion arcs.

DISCUSSION AND CONCLUSION: Hip precautions are often enforced after total hip arthroplasty without knowing normal arcs of motion during real-life activities. Knowledge of hip motion during activities of daily living in healthy individuals is useful information in setting goals and in educating THA patients. At-risk activities such as sit to stand, on/off toilet, in/out bed and chair, and shoe tying have the greatest combinations of flexion, abduction, and rotation arcs potentially leading to hip instability.

	Mean Hip Flexion Extension Angle across 8 participants (deg)	Mean Hip Abduction Adduction Angle across 8 participants (deg)	Mean Hip Internal External Rotation across 8 participants (deg)
Sit to Stand	94.76	25.37	12.48
Get on/off toilet	91.84	22.72	12.36
Stairs ascent	53.91	17.44	6.53
Stairs descent	29.39	12.47	4.15
Level walk	34.72	13.51	5.59
Hip flexion/extension dominant movement	126.98	29.15	10.85
Hip abduction/adduction dominant movement	38.24	70.64	18.48
Hip internal/external rotation dominant movement	34.09	21.50	66.40
Tying shoes standing	107.50	14.07	11.97
Tying shoes sitting	120.45	27.42	13.32
Squats	109.59	19.83	14.12
Get in/out of bed	100.31	26.97	26.01
Get in/out of car	105.30	29.04	20.27