

# Does Hip Resurfacing Restore Normal Range of Motion and Provide Better Joint Motion Than THR?

†\*Sean D Doherty; \*\*Matthew T Thompson; \*\*Molly M Usrey; ††Sarah Muirhead-Allwood; \*\*Philip C Noble

†\*Baylor College of Medicine, Houston, TX

\*\*Institute of Orthopedic Research and Education, Houston, TX

††Biomedical Engineering Institute of Orthopaedics, RNOH, UCL, Stanmore, Middlesex, HA7 4LP, UK

**Introduction:** Hip resurfacing is becoming a popular alternative to THR because it is perceived as being more physiologic and bone-sparing. One of the perceived benefits of hip resurfacing is increased range of motion (ROM) compared to THR because of the larger diameter of the resurfaced femoral head. However, as the head/neck ratio of the resurfaced femur is substantially smaller than that of a hip prosthesis, it is not clear whether resurfacing really provides increased ROM. This study was performed to compare normal ROM, ROM after resurfacing, and ROM after THR using 3D computer simulation of the same femora and pelvis.

**Materials and Methods:** 3D computer models of the pelvis and femur were generated from CT scans of six individuals with a mean age of 73 years (range: 54–85). CAD models of standard resurfacing and THR components were virtually implanted in each hip. Femoral resurfacing components were implanted in 5 degrees more valgus than the native neck shaft angle and positioned without notching of the neck (Fig. 1). For both resurfacing and THR, acetabular components were implanted at 45 degrees of inclination and 20 degrees of anteversion. The anteversion of each femur and the head to neck ratio for each resurfacing, THR, and intact hip was calculated.

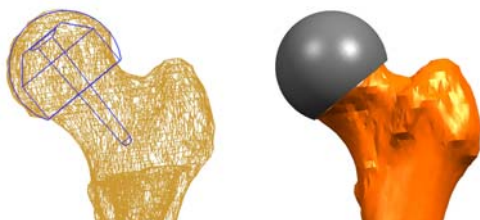


Fig 1: Virtual implantation of hip resurfacing

Normal hips, resurfaced hips, and THR's were simulated in pure flexion and extension as well as six different ROM activities at risk for total hip dislocation<sup>1</sup> (Fig. 2). Four maneuvers were at risk for posterior dislocation: (a) "sit to standing" – 5° abduction / 15° internal rotation / max flexion, (b) "stooping" – 10° adduction / 25° internal rotation / max flexion, (c) "shoe tying" – 15° adduction / 15° internal rotation / max flexion, and (d) "crossing legs" – 15° adduction / 15° external rotation / max flexion, while two maneuvers were at risk for anterior dislocation: (e) "pivoting" – 15° extension / 5° abduction / max external rotation and (f) "rolling over in bed" – 5° extension / 5° adduction / max external rotation.

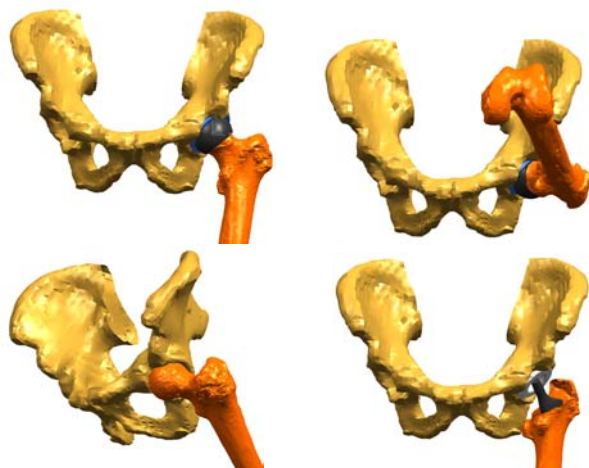


Fig 2: Range of motion simulations until collision. Clockwise from upper left: initial position of hip resurfacing, maximum flexion in hip resurfacing, maximum external rotation in "roll over in bed" simulation of THR, and maximum extension in intact hip.

**Results:** The measured ranges of motion are shown in Table 1. Hip resurfacing resulted in a decrease in pure extension secondary to impingement between the posterior neck of the femur and the rim of the acetabular shell and decrease in the ROM of the entire flexion-extension arc. ROM of "pivoting" and "rolling over in bed" also significantly decreased after hip resurfacing.

**Table 1: Ranges of motion**

	Intact (avg. ± σ)	Resurfacing (avg. ± σ)	THR (avg. ± σ)
Flexion	119° ± 4°	109° ± 9°	125° ± 6°
Extension	47° ± 7°	13° ± 8°	34° ± 5°
F/E Arc	166° ± 10°	122° ± 15°	165° ± 8°
Sit to Stand	113° ± 9°	103° ± 12°	121° ± 7°
Stoop	89° ± 10°	84° ± 9°	102° ± 4°
Shoe Tying	96° ± 7°	89° ± 10°	106° ± 3°
Cross Legs	115° ± 4°	104° ± 9°	118° ± 4°
Pivot	22° ± 5°	-1° ± 6°	25° ± 6°
Roll Over	23° ± 3°	6° ± 8°	26° ± 8°

Hip ROM was significantly lower after resurfacing compared to THR in all of the dislocation activities studied. Resurfacing also significantly decreased both flexion and extension compared to THR. Differences in ROM between resurfacing and intact and between resurfacing and THR are shown in Table 2.

**Table 2: Comparison of ranges of motion (bold = significant)**

	HR - Intact	p-value	HR - THR	p-value
Flexion	-9°	0.087	<b>-16°</b>	0.030
Extension	<b>-35°</b>	0.000	<b>-22°</b>	0.000
F/E arc	<b>-44°</b>	0.001	<b>-37°</b>	0.031
Sit to Stand	-10°	0.085	<b>-19°</b>	0.013
Stoop	-6°	0.251	<b>-18°</b>	0.018
Shoe Tying	-8°	0.159	<b>-17°</b>	0.009
Cross Legs	-11°	0.067	<b>-14°</b>	0.000
Pivot	<b>-24°</b>	0.001	<b>-26°</b>	0.000
Roll Over	<b>-18°</b>	0.006	<b>-20°</b>	0.002

The head to neck ratio was significantly lower after hip resurfacing compared to THR (1.38 vs. 2.33,  $p < 0.001$ ). Maximum hip extension after resurfacing directly correlated with the head to neck ratio ( $R^2 = 0.76$ ,  $p = 0.02$ ). After resurfacing, there was also a significant correlation between hip extension and anteversion of the femur ( $R^2 = 0.94$ ,  $p < 0.001$ ) (Fig.3).

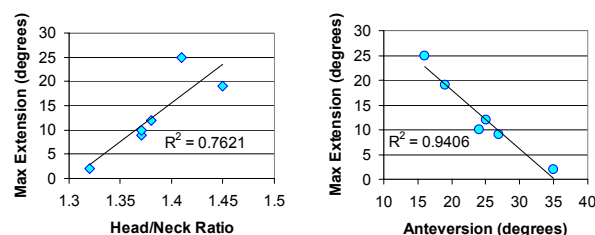


Fig 3: Correlation of max extension with head/neck ratio and anteversion

**Discussion:** Hip resurfacing significantly decreases the ROM of the entire flexion-extension arc compared to intact hips. This decrease in ROM is most profound in extension and anterior dislocation activities, most likely due to a large prosthetic posterior wall not seen in the intact acetabulum.

In comparison with THR, hip resurfacing significantly decreases ROM in all dislocation activities as well as flexion and extension. Not surprisingly, the lower head to neck ratio of resurfacing is the major contributing factor in the decrease in ROM.

## References:

1. Nadzadi et al (2003), *J Biomech* 36: 577.