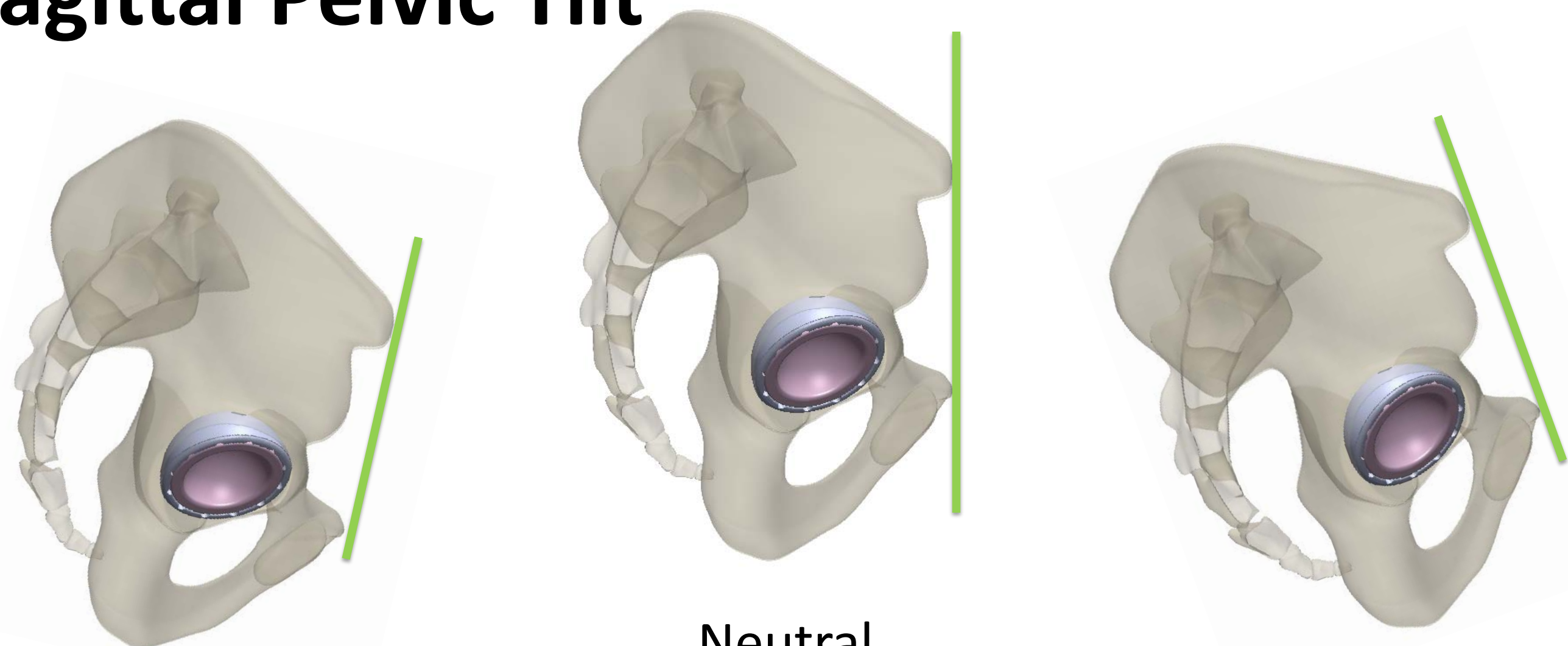


<sup>1,2</sup>Pierrepont JW; <sup>3</sup>McMahon S; <sup>4</sup>Walter LR; <sup>4</sup>Marel E; <sup>2</sup>Miles BP; <sup>5</sup>Baré JV; <sup>6</sup>Solomon M; <sup>5</sup>Shimmin AJ  
<sup>1</sup>University of Sydney, NSW, Australia; <sup>2</sup>Optimized Ortho, NSW, Australia; <sup>3</sup>Malabar Orthopaedic Clinic, VIC, Australia; <sup>4</sup>Peninsula Orthopaedics, NSW, Australia; <sup>5</sup>Melbourne Orthopaedic Group, VIC, Australia; <sup>6</sup>Sydney Orthopaedic Specialists, NSW, Australia

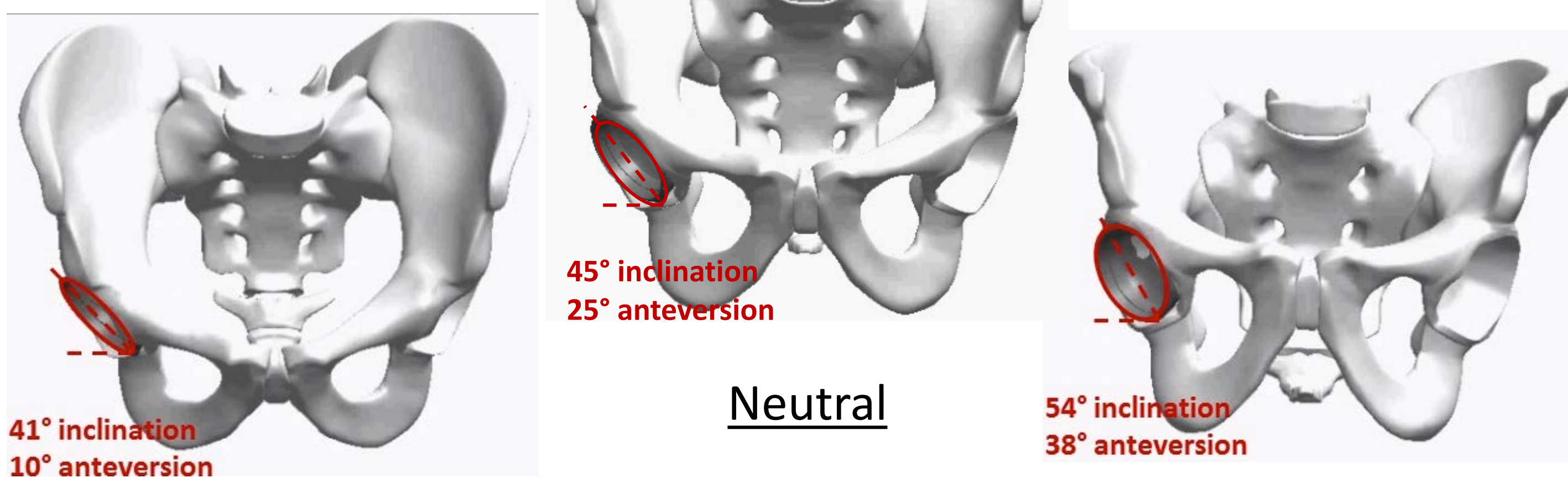
## Sagittal Pelvic Tilt



**Anterior Pelvic Tilt (positive)**  
 Protective in hip extension (standing), but not in hip flexion (sitting)

**Neutral**

**Posterior Pelvic Tilt (negative)**  
 Protective in hip flexion (sitting), but not in hip extension (standing)



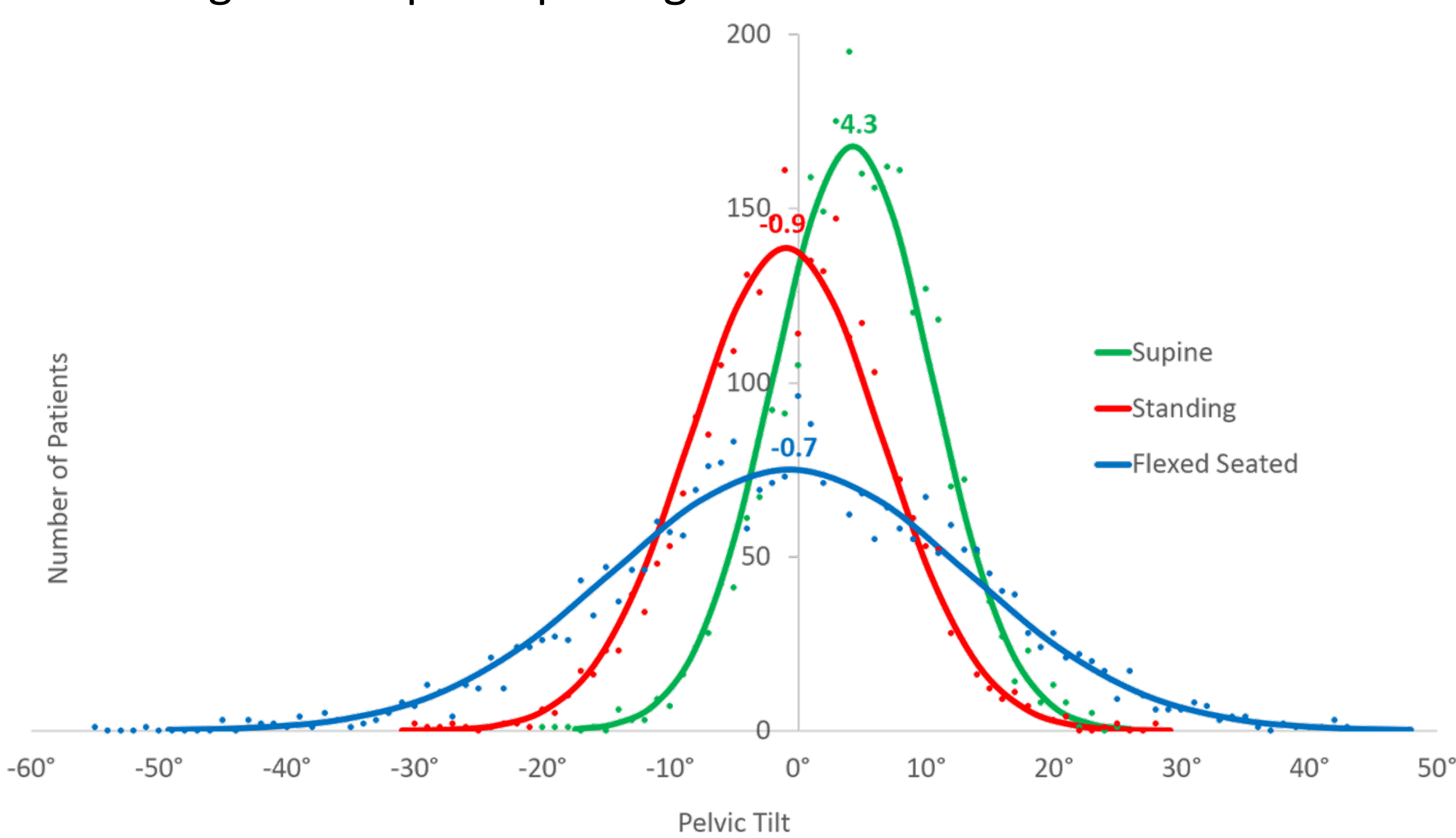
**Anterior Pelvic Tilt**  
 Causes the acetabulum to be less inclined and less anteverted

**Neutral**

**Posterior Pelvic Tilt**  
 Causes the acetabulum to be more inclined and more anteverted

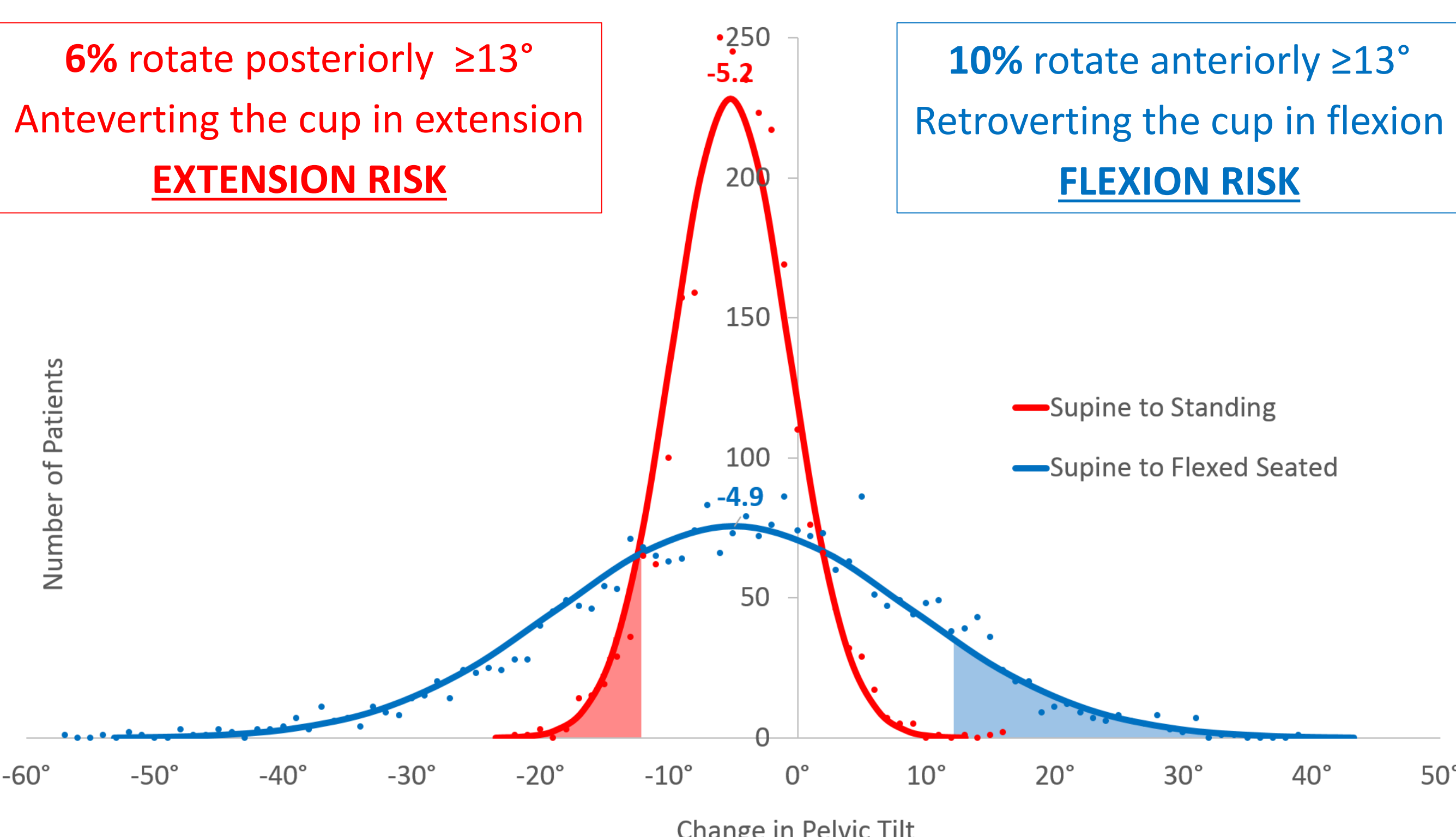
## Results

The mean supine pelvic tilt was 4.3°, with a range of -20.5° to 26.9°. The mean standing pelvic tilt was -0.9°, with a range of -30.6° to 27.9°. Mean pelvic tilt in the flexed seated position was -0.7°, with a range of -55.6° to 42.2°. 6% of patients rotated posteriorly by more than 13° from supine to stand, consequently putting them at risk of excessive functional anteversion in extension. 10% of patients rotated anteriorly by more than 13° from supine to flexed seated, consequently retroverting their cup and putting them at risk in flexion.



**6% rotate posteriorly  $\geq 13^\circ$**   
 Anteverting the cup in extension  
**EXTENSION RISK**

**10% rotate anteriorly  $\geq 13^\circ$**   
 Retroverting the cup in flexion  
**FLEXION RISK**



## Method

Pre-operatively 2612 consecutive total hip replacement patients had their pelvic tilt measured in three positions to assess functional flexion and functional extension:

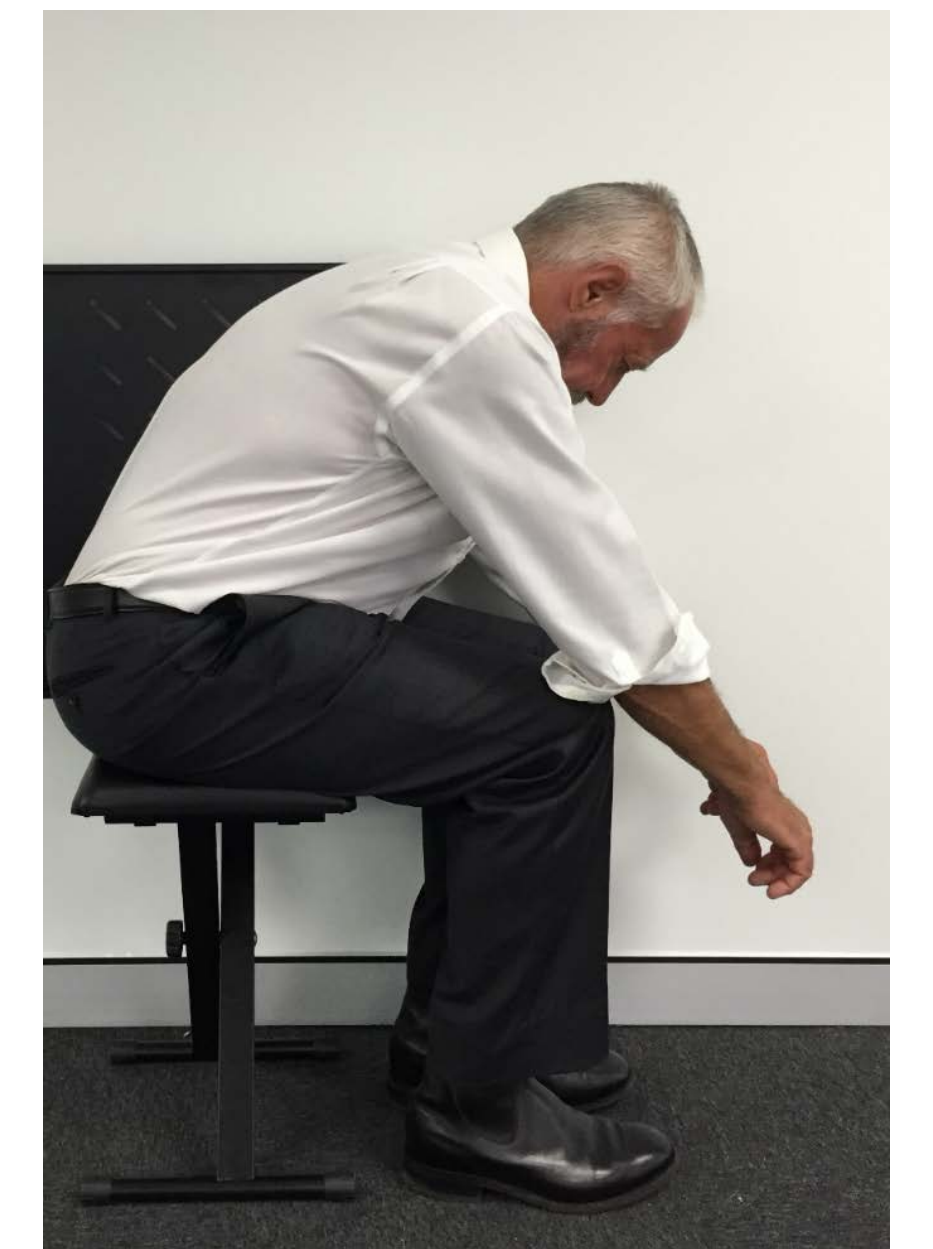
1. Supine – from CT scan
2. Standing – from lateral standing x-ray
3. Flexed Seated – from lateral x-ray at “seat off” as the centre of gravity comes over the feet to stand



Supine

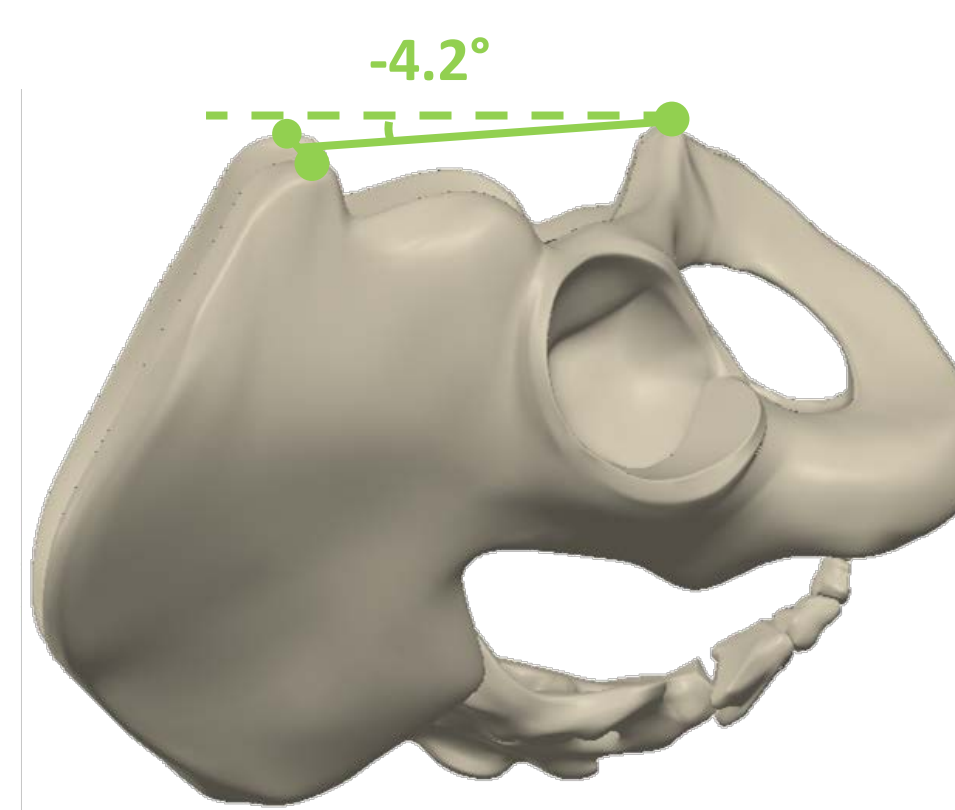


Standing

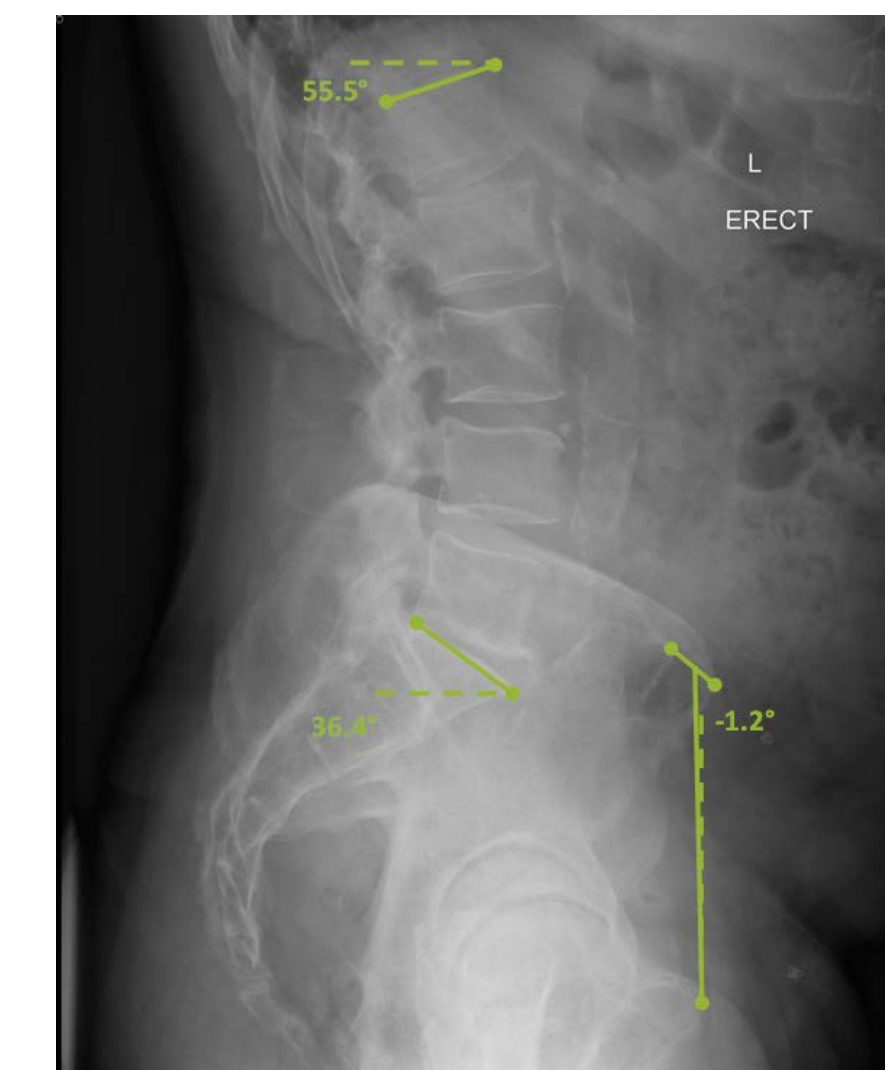


Flexed Seated

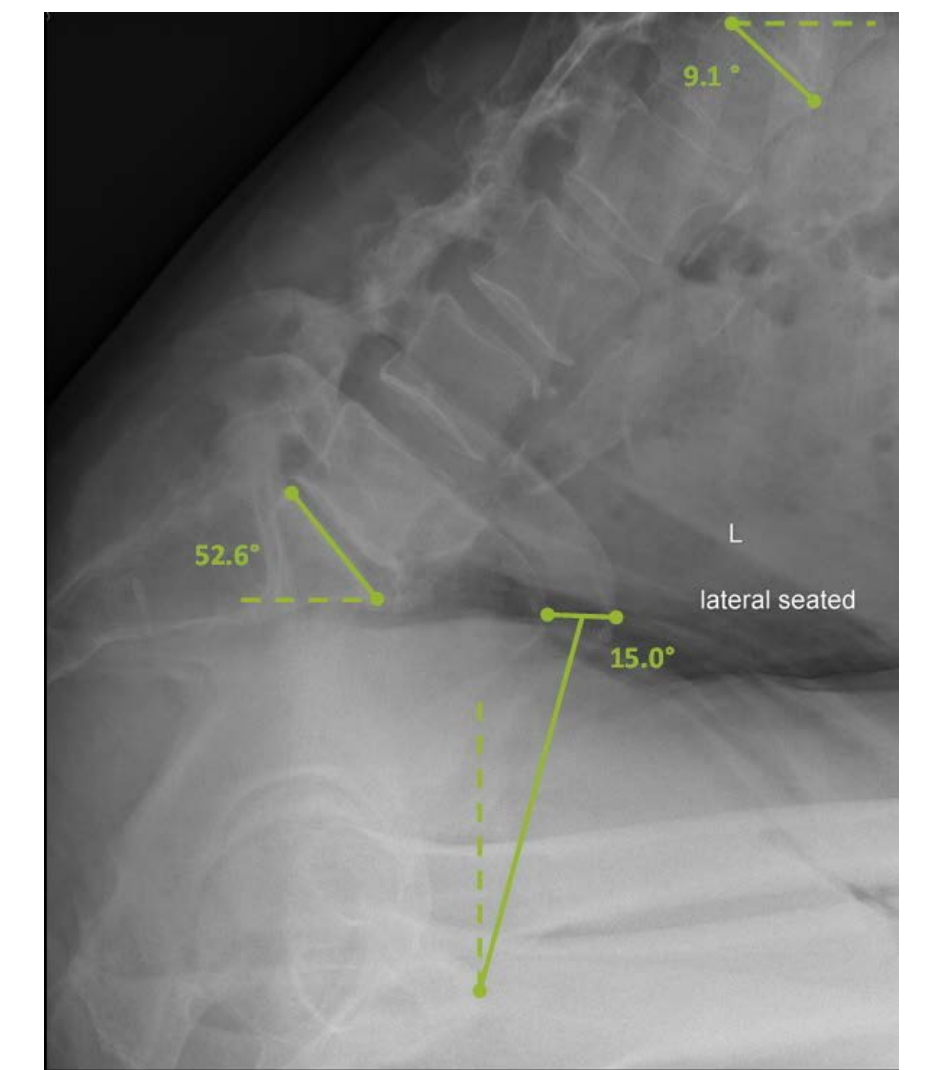
Sagittal pelvic tilt was measured from the Anterior Pelvic Plane (ASIS and pubic symphysis) to the vertical when standing and horizontal when supine.



Supine



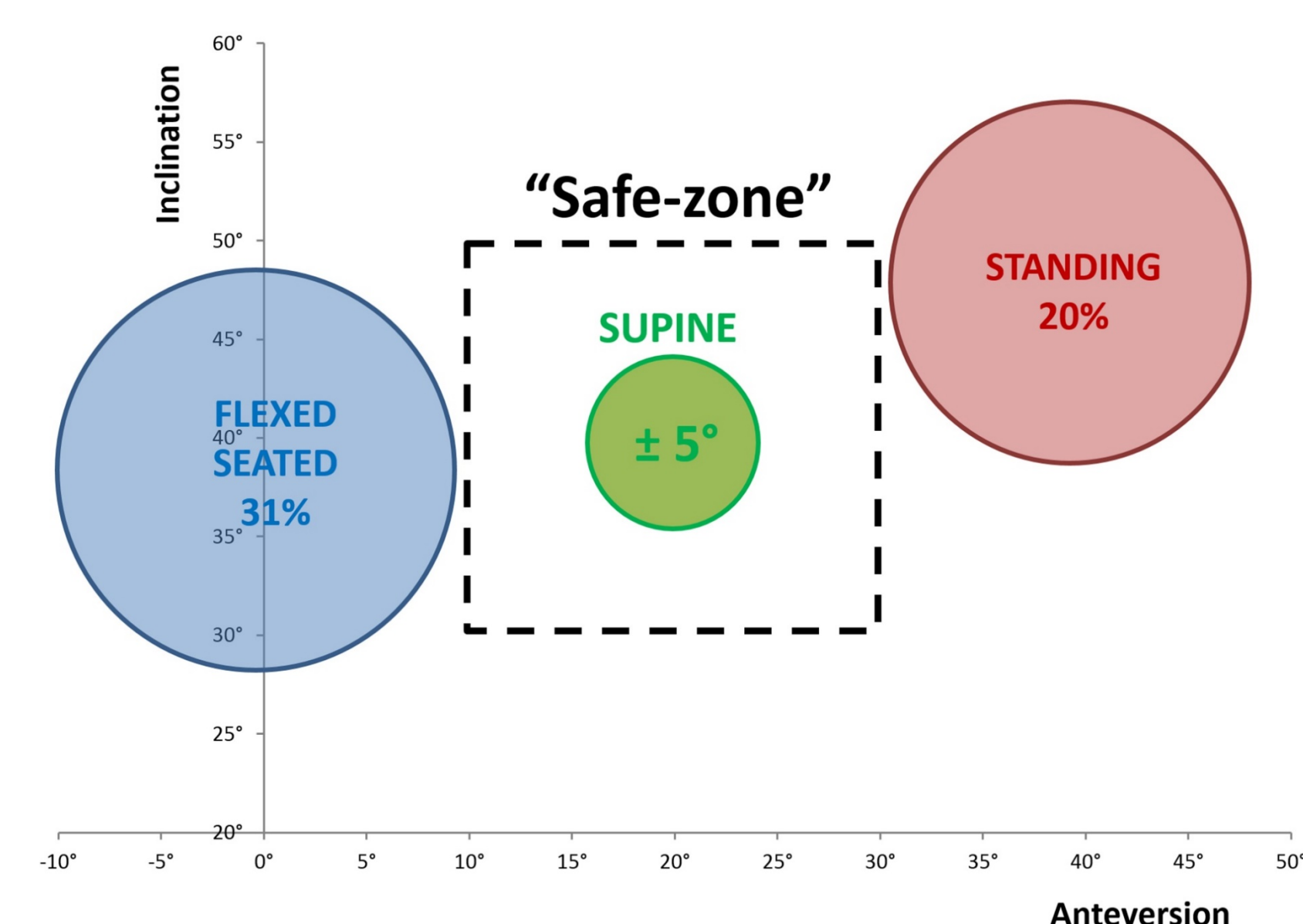
Standing



Flexed Seated

## Conclusions

- The position of the pelvis in the sagittal plane changes significantly between functional activities. The extent of change is specific to each patient.
- Planning and measurement of cup placement in only the supine position can lead to large discrepancies in orientation during more functionally relevant postures.
- One in six patients had sagittal pelvic rotations that could lead to functional cup malorientation in flexion or extension. Factoring in an intraoperative delivery error of  $\pm 5^\circ$  extends this risk to **51% of patients**.



- Previously defined “safe zones” might not be appropriate for all patients as they don’t account for the dynamic behaviour of the pelvis
- Optimal cup orientation is likely patient-specific and requires an evaluation of functional pelvic dynamics to pre-operatively determine the target angles.