Sagittal Pelvic Tilt in the Standing, Supine and Flexed Seated Positions

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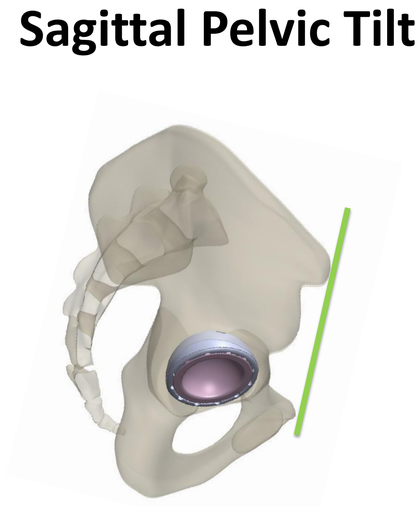
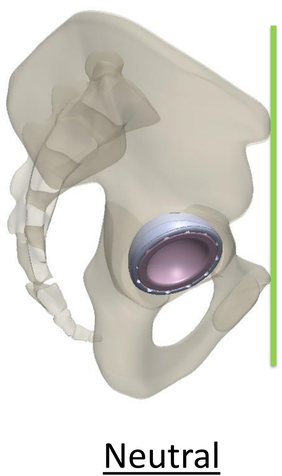
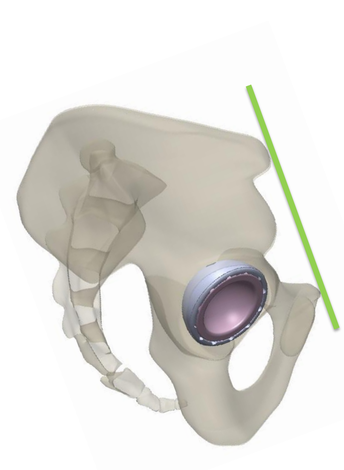
Sagittal Pelvic Tilt



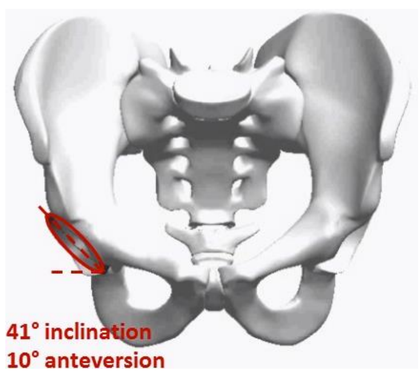
Anterior Pelvic Tilt (positive)
Protective in hip extension (standing), but not in hip flexion (sitting)

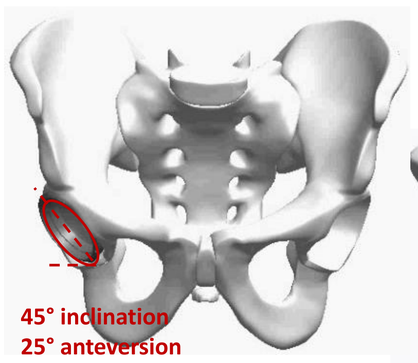


Neutral



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





Neutral

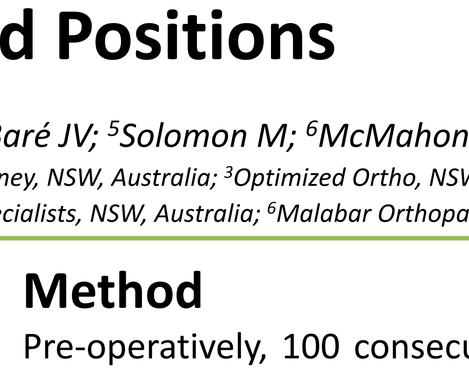
Anterior Pelvic Tilt
Causes the acetabulum to be less inclined and less anteverted

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

Method

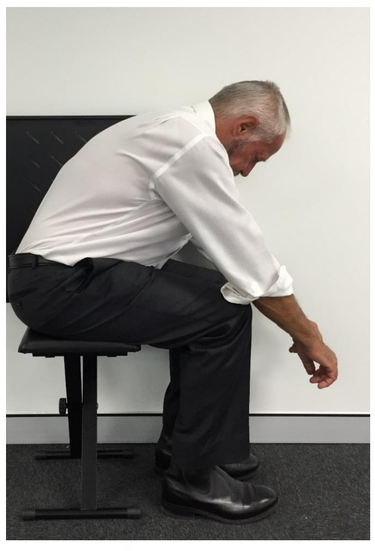
Pre-operatively, 100 consecutive total hip replacement patients had their pelvic tilt measured in three positions to assess functional flexion and functional extension:

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



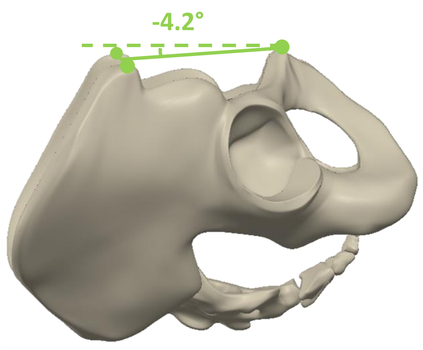
Supine

Standing

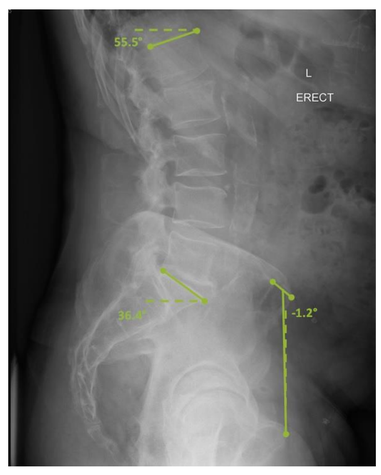


Flexed Seated

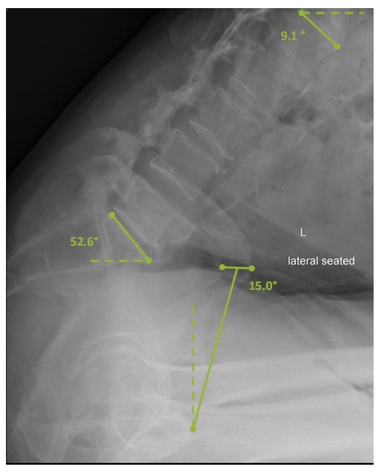
Sagittal pelvic tilt was measured from the Anterior Pelvic Plane (ASIS and pubic symphysis) to the vertical when standing and horizontal when supine.



Supine



Standing



Flexed Seated

Results

Table 1. Pelvic Tilt in Supine, Standing and Flexed Seated Positions

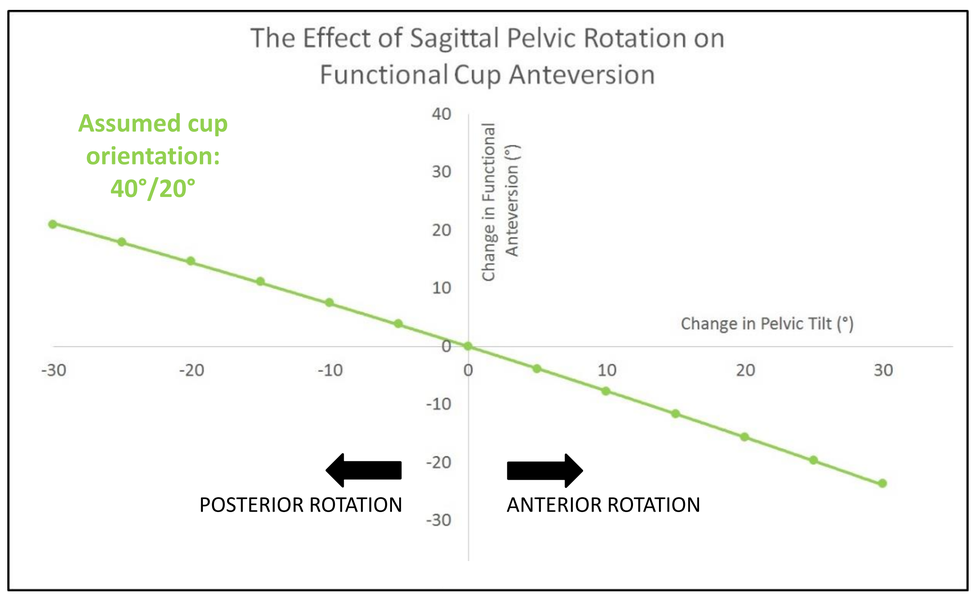
	Supine	Standing	Flexed Seated
Mean Pelvic Tilt	4.3°	-1.6°	2.2°
Range	-9.6° to 19.2°	-20.4° to 16.4°	-36.1° to 30.4°

Table 2. Changes in Pelvic Tilt

	Supine to Standing	Standing to Flexed Seated
Mean Pelvic Tilt	-5.9°	3.9°
Range	-17.7° to 5.6°	-25.9° to 32.0°

The mean values of pelvic tilt presented in Table 1 are small, or close to neutral. More importantly, the respective ranges are very large, suggesting a wide variation across the population.

In Table 2, 92% of patients rotated posteriorly from Supine to Standing. This rotation increases functional anteversion in extension. 58% of the patients rotated anteriorly from Standing to Flexed Seated. This rotation decreases functional anteversion in flexion. A 32° increase in pelvic tilt (anterior rotation) from Standing to Flexed Seated will decrease the functional anteversion of the acetabulum by more than 20° [1].



Conclusions

- The position of the pelvis in the sagittal plane changes significantly between functional activities. The extent of change is specific to each patient.
- As a result of the functional changes in pelvic position, cup orientations during dislocation and edge-loading events are likely to be significantly different to those measured from standard CT and radiographs.
- Planning and measurement of cup placement in the supine position can lead to large discrepancies in orientation during more functionally relevant postures.
- 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.

References

1. Lembeck, B. et al., *Pelvic tilt makes acetabular cup nagivation inaccurate*. Acta Orthopaedica, 2005. **76**(4): p. 517-23.

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