Pelvic Tilt in the Standing, Supine and Seated Positions

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Introduction

The pelvis is not a static structure. It rotates in the sagittal plane depending upon the activity being performed. These dynamic changes in pelvic tilt have a substantial effect on the functional orientation of the acetabulum. The aim of this study was to quantify the changes in sagittal pelvic position between three functional postures.

Methodology

Pre-operatively, 90 total hip replacement patients had their pelvic tilt measured in 3 functional positions – standing, supine and flexed seated (posture at “seat-off” from a standard chair), Fig 1

Fig 1. The flexed seated position representing the time of ‘seat off’ from a standing chair

Lateral radiographs were used to define the pelvic tilt in the standing and flexed seated positions. Pelvic tilt was defined as the angle between a vertical reference line and the anterior pelvic plane (defined by the line joining both anterior superior iliac spines and the pubic symphysis). In the supine position pelvic tilt was defined as the angle between a horizontal reference line and the anterior pelvic plane. Supine pelvic tilt was measured from computed tomography, Fig 2.

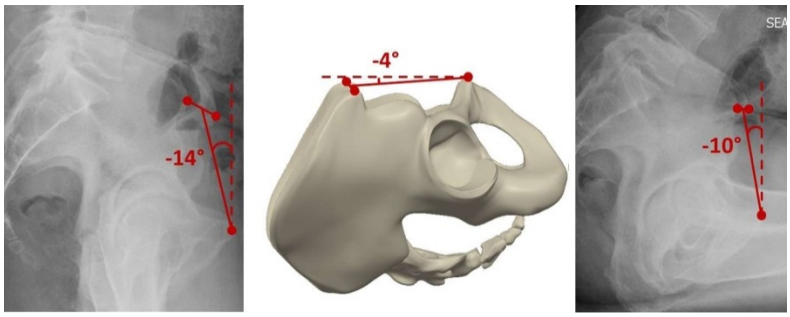

Fig 2. Pelvic tilt measurement techniques in the standing, supine and flexed seated positions

Results

The mean standing pelvic tilt was -2.1° ± 7.4°, with a range of -15.2° – 15.3°. Mean supine pelvic tilt was 4.1° ± 5.5°, with a range of -9.7° – 17.9°. Mean pelvic tilt in the flexed seated position was -1.8° ± 14.1°, with a range of -31.8° – 29.1°, Fig 3. The mean absolute change from supine to stand, and stand to flexed seated was 6.9° ± 4.1° and 11.9° ± 7.9° respectively. 86.6% of patients had a more anteriorly tilted pelvis when supine than standing. 52.2% of patients had a more anteriorly tilted pelvis when seated than standing.

	Absolute difference (stand - supine)	Absolute difference (stand - seated)
Mean Pelvic Tilt	6.9°	11.9°
Std Dev	± 4.1°	± 7.9°
Range	0.0° – 16.3°	1.1° – 30.2°
	≈13° anteversion change	≈24° anteversion change

Fig.3. Absolute difference in pelvic tilt between the functional positions

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 the supine position can lead to large discrepancies in orientation during more functionally relevant postures.
- 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 that measured from standard CT and radiographs.
- Optimal cup orientation is likely patient-specific and requires an evaluation of functional pelvic dynamics to pre-operatively determine the target angles.