

Factors related to a large change of the pelvic sagittal inclination from supine position to standing position – standing lateral radiograph of the whole spine study

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Introduction: Generally, the pelvic sagittal inclination (PSI) does not change from supine position to standing position either preoperatively or after total hip arthroplasty (THA). However, there are some patients whose PSI changes posteriorly more than 10 degrees from supine position to standing position. Although previous studies suggested that PSI in standing position is correlated with lumbar degeneration such as degenerative disc diseases and degenerative spondylolisthesis, there have been no reports that evaluate the correlation between this atypical PSI change from supine position to standing position with whole spine alignment. The purpose of this study was to investigate factors related to a large change of PSI from supine position to standing position by using standing lateral radiographs of the whole spine.

Materials & Methods: A consecutive 163 patients who underwent primary THA in our hospital from January 2010 to December 2011 were included in this study. In all patients, a standing antero-posterior (AP) radiograph of the pelvis and a standing lateral radiograph of the whole spine were obtained preoperatively. The X-ray beam center of standing AP radiographs of the pelvis was set at the superior margin of the pubic tubercle. Computed tomography (CT) images of the pelvis were also obtained. Preoperative PSI in supine position was measured on CT images using software (3D Template, Japan Medical Materials, Osaka, Japan).

On multi-planar-reconstructed images, the pelvis was rotated to become the line between the bilateral anterior superior iliac spines (ASISs) parallel to the horizontal axis. Digitally reconstructed radiographs (DRR) of the pelvis were made on the sagittal plane and the angle between the anterior pelvic plane (APP) and the vertical axis was defined as PSI in supine position (positive angle values indicate anterior tilting of the pelvis). Preoperative PSI in standing position was calculated by a 2D-3D matching technique using CT images and the standing AP radiographs. After matching, the angle between APP and the vertical axis was measured on the sagittal DRR. When the change of PSI from supine position to standing position was more than 10 degrees posteriorly, these patients were classified as the atypical posterior tilt of the pelvis group (Group P) while the remaining patients were classified as the standard group (Group S).

On the standing lateral radiographs of the whole spine, the existence of compression fractures and lumbar spondylolisthesis were evaluated. The following radiographic spinal parameters were also measured: thoracic kyphosis, defined as the angle between lines drawn along the inferior endplate of T12 vertebrae and the superior endplate of T4; lumbar lordosis, defined as the angle between lines drawn along the superior endplate of S1 and the superior endplate of L1; S1 anterior tilt, defined as the angle between the superior endplate of S1 and the horizontal line; T4 plumb line position, defined as the distance between the anterior tip of the superior endplate of S1; and the plumb line from the centroid of T4 (a positive value indicates the T4 plumb line was located anterior to the tip of S1). Parameters including age, gender, PSI in supine position, existence of osteoarthritis, existence of osteonecrosis, existence of hip dysplasia, existence of compression fracture, existence of lumbar spondylolisthesis and the radiographic spinal parameters were compared between Group P and Group S.

Results: The average change of PSI from supine position to standing position in all patients was -6.8 ± 5.7 (-25.3 to 8.6) degrees. The characteristics of each group are shown in Table 1. There were significant differences in age, PSI in supine position, existence of compression fracture, existence of spondylolithesis, lumbar lordosis, S1 anterior tilt and T4 plumb line position. In multiple linear regression analysis, the parameters which significantly influenced the change of PSI from supine position to standing position were S1 anterior tilt (standard partial regression coefficient (β) = 0.34, p