Dynamic change of acetabular component alignment in total hip arthroplasty based on the spino-pelvic Classification: A Prospective Radiographic Study

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INTRODUCTION:

Dislocation after THA is a common cause of revision surgery. Recent studies reported that spinal deformity and stiffness can be risk factors for dislocation and proposed the optimal alignment of the acetabular component according to the spinal deformity and stiffness classification. However, whether the cup placement avoids the impingement leading to dislocation is still unclear. The aim of this study is to evaluate the dynamic change of cup alignment after THA based on spino-pelvic classification.

METHODS:

This was a prospective clinical and radiographic study of consecutive patients awaiting THA in our institute. Inclusion criteria of this study were adult patients with preoperative lateral spinopelvic imaging in standing and sitting positions with at least 2-year follow-up following THA. A total of 169 hips (women: 136) with an average age of 65 (range, 30 to 88) were identified (Table 1). According to the previously proposed algorithm, the patients were classified into four groups (1A – 2B) based on the preoperative spinopelvic parameters (Figure). The classification was determined by the presence of spinal deformity and spinal stiffness. Spinal deformity is defined by the difference between pelvic incidence (PI) and lumbar lordosis (LL), which is greater than 10°. Spinal stiffness is defined by a less than 10° change in sacral slope (SS) from the standing to seated positions. Then, the alignment of the cup was planned according to the group. All THA was performed via a direct anterior approach in the supine position with a fluoroscopy guide for settlement of the acetabular cup alignment.

The postoperative radiographic alignment of the acetabular component, radiographic inclination (RI), radiographic anteversion (RA), and lateral anteinclination (AI) in sitting and standing positions were also measured. AI in the sitting position was used as the surrogate variable for anterior impingement, and AI in the standing position was used for the posterior impingement. The cumulative incidence of dislocation during the follow-up period was evaluated.

RESULTS:

After radiographic classification, there were 54 (31.9%) Group 1A, 30 (17.8%) Group 1B, 43 (25.4%) Group 2A, and 42 (24.9%) Group 2B patients. Demographic and radiographic data on the patients are shown in Table 1, and radiographic data are shown in Table 2. The acetabular component was set within the safe zone in 98.8% (167/169) hips. RA in group 1B was significantly larger than in group 2A and 2B ($p = 0.012$ and $p = 0.0003$, respectively). The sitting AI in the 1B group was significantly smaller than in groups 1A and 2A ($p = 0.0064$ and 0.0024, respectively). No significant differences were found in standing AI between each group.

Except for the three dropout cases, one posterior dislocation occurred during the period (0.6%). The case was included in this study and classified in group 1B. The dislocation rate was not significant between the groups.

DISCUSSION AND CONCLUSION:

This study investigated the dynamic change of cup alignment after THA based on spino-pelvic classification and clinical effectiveness to prevent dislocation. The dislocation rate was low. In group 1B, despite the cup anteversion being the largest, the sitting AI, the surrogate variable for anterior impingement, was the smallest.

Our study suggests that patients with normal spinal alignment and stiff spine reduced cup anteversion in sitting position and may have the risk of anterior impingement. With more anteversion in normal spinal alignment and stiff spine group, the cup placement based on the spinopelvic parameters can be an appropriate guide to prevent short-term dislocation after THA.

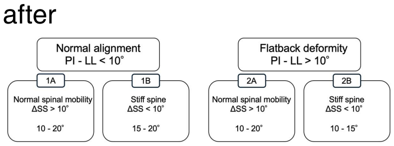

table1 Patient characteristics

	1A (n = 54)	1B (n = 30)	2A (n = 43)	2B (n = 42)	P-value
Age (years)	60.4 (11.80)	65.2 (11.75)	66.3 (12.69)	69.2 (11.17)	0.0043
Sex (female), n (%)	42 (77.8)	24 (80.0)	38 (88.4)	32 (76.2)	0.48
BMI (kg/m^2)	24.6 (4.13)	22.4 (3.24)	26.3 (4.43)	24.1 (4.56)	0.0022
Diagnosis, n (%)					0.13
OA	38 (70.4)	24 (80.0)	39 (90.7)	38 (90.5)	
ONFH	14 (25.9)	5 (16.7)	3 (7.0)	3 (7.1)	
RA	2 (3.7)	1 (3.3)	1 (2.3)	1 (2.4)	
PI – LL	-1.5 (8.00)	2.6 (5.24)	19.4 (9.18)	21.5 (9.94)	< 0.0001
ΔSS	21.5 (9.23)	3.6 (4.85)	19.8 (8.26)	3.9 (4.53)	< 0.0001

OA, osteoarthritis; ONFH, osteonecrosis of femoral head; RA, rheumatoid arthritis

PI – LL, pelvic incidence – lumbar lordosis; SS, sacral slope; ΔSS, change in SS from the standing to seated positions.

table2 radiographic evaluation

	1A (n = 54)	1B (n = 30)	2A (n = 43)	2B (n = 42)	P-value
RI	40.5 (3.80)	40.3 (3.14)	40.8 (3.65)	40.5 (3.34)	0.93
RA	14.1 (4.43)	16.0 (2.59)	13.5 (3.29)	12.6 (2.75)	0.0006
Sitting AI	48.0 (11.18)	41.2 (8.51)	49.1 (10.81)	45.3 (11.64)	0.012
Standing AI	28.2 (6.35)	30.0 (6.92)	28.1 (6.41)	30.9 (7.47)	0.15

RI, radiographic inclination; RA, radiographic anteversion; AI, anteinclination