The effects of surgical approaches and femoral stem designs on anteversion and the stem alignment in total hip arthroplasty

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Introduction: Although there are many femoral stems for total hip arthroplasty (THA) that are available with sufficient size variations, stem alignment and anteversion could vary in the same femur due to several factors such as surgical approach and stem design. In order to elucidate the influence of the surgical approach and implant design on the postoperative femoral stem anteversion and alignment, we compared these between a direct anterior approach and a posterolateral approach, and between a cementless anatomical femoral stem and a cementless taper femoral stem, using computed tomography (CT) images.

Materials & Methods: 234 hips of 208 patients who underwent THA were the subjects of this study. 18 patients were male and 190 patients were female. The mean age was 59 years (range; 24 to 85 years). The diagnosis was osteoarthritis in 201 hips, osteonecrosis of the femoral head in 21 hips and others in 12 hips. A cementless anatomical stem (Centpillar, Stryker) was used in 188 hips. 98 hips of them were implanted through a direct anterior approach (DAA group) and the remaining 90 hips were implanted through a posterolateral approach (P group). A cementless taper stem (Versys fiber metal taper, Zimmer) was used in 46 hips which were implanted through the posterolateral approach (T group). Age and gender were matched among the three groups. Preoperative and postoperative CT images of the femur were used for this study. Anteversion and alignment of the stems were measured on CT images with 3D template software (Japan Medical Material).

We measured the preoperative and postoperative femoral anteversion at the femoral head-neck junction level by using a retrocondylar plane which included the most posterior point of both femoral condyles and the most posterior point of the proximal femur, and the femoral axis which passed through the trochanteric fossa and the knee center. The sagittal alignment of the femoral stem was measured as the angle between the proximal femoral axis and the femoral component axis. Varus or valgus alignment of the femoral stem (+:varus, -:valgus) was measured on the stem neck plane. We compared these parameters between DAA group and P group, and between P group and T group. We divided the patients according to their preoperative anteversion into low anteversion hips (30° or less) and high anteversion hips (more than 30°) to analyse the influence of the preoperative anteversion.

Result: The mean preoperative femoral anteversions were 23.8°±9.7° in DAA group, 28.6°±10.5° in P group, and 25.6°±12.1° in T group. The mean preoperative proximal femoral axis were 9.1°±1.6° in DAA group, 9.1°±1.5° in P group, 8.1°±1.3° in T group (Table 1).

The type of surgical approach did not show a significant difference in the increase of anteversion preoperatively to postoperatively between DAA group and P group (DAA: 4.8°±8.3°, P: 2.8°±9.3°, p=0.07). In the low anteversion hips, anteversion increased significantly compared with the high anteversion hips (Low: 5.3°±8.4°, High: 0.6°±9.0°, p=0.0001). In the high anteversion hips (100 hips), there was a significant difference in the increase of anteversion between DAA group and P group (DAA: 3.9°±8.3°, P: -0.2°±8.3°, p=0.02), but there was no difference in the low anteversion hips (88 hips). P group had a statistically significant change in stem sagittal alignment compared with DAA group (DAA: -0.7±2.3, P: 0.2±1.7, p=0.004). There was a significant difference in varus/valgus alignment between DAA group and P group (DAA: -0.1°±1.1°, P: -0.5°±1.2°, p=0.02).

The implant designs did not show a significant difference in anteversion or varus/valgus alignment, but the stem sagittal alignment revealed a significant difference between P group and T group (P: 0.2°±1.7°, T: -0.8°±1.2°, p=0.0004).

	DAA group N=98 hips	P group N=90 hips	T group N=46 hips	p value DAA vs P	p value P vs T
Background					
Gender (male/female)	7/91	6/84	7/39	0.87	0.19
Age (years)	58.7±11.8	59.1±10.3	58.2±9.8	0.93	0.52
BMI	22.9±3.7	22.5±3.5	24.0±3.1	0.55	0.004
Femoral anteversion					
Preoperative	23.8°±9.7°	28.6°±10.5°	25.6°±12.1°	0.001	0.19
Postoperative	28.6°±11.7°	31.°4±8.9°	28.1°±12.1°	0.09	0.06
Differences	4.8°±8.3°	2.8°±9.3°	2.6°±9.1°	0.07	0.89
Proximal sagittal alignment					
Proximal femoral axis	9.1°±1.6°	9.1°±1.5°	8.1°±1.3°	0.98	0.001
Femoral component axis	8.4°±2.6°	9.3°±2.6°	7.3°±1.8°	0.02	0.001
Differences	-0.7°±2.3°	0.2°±1.7°	-0.8°±1.2°	0.004	0.0004
Varus (+) / Valgus (-)	-0.1°±1.1°	-0.5°±1.2°	-0.5°±0.9°	0.02	0.76

Discussion: Some researchers have reported increased femoral anteversion after THA compared with preoperative femoral anteversion[1-3]. However, the influences of the surgical approach and implant design on the change of postoperative femoral anteversion were unknown. In the high anteversion hips, the DAA group had a significant increase of anteversion compared with P group. Although we might have intentionally reduced anteversion during THA performed through the posterolateral approach in the hips with high anteversion, it might have been difficult to reduce anteversion through DAA. Moreover, the sagittal alignment of the femoral components was more flexed in the DAA group than that in the P group. Because the femur had an anterior bowing with a mean of 9° in the proximal part of the femur, it might have been difficult to elevate the proximal femur through DAA with a resulting flexed placement of the stem in the femur. The influence of stem design on femoral anteversion and alignment was small in the present study.

When we choose the surgical approach for THA, we should be aware of its effects on the postoperative femoral anteversion and alignment.

Reference

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