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Basic Science

Comparison of Gait Motion Including Postoperative Trunk Deflection Between Direct Lateral and Anterolateral Approaches in Supine Total Hip Arthroplasty

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ABSTRACT

Background: A prospective study was conducted to compare the effect of an anterolateral approach in the supine position (ALS) with that of a direct lateral (DL) approach on gait motion, including trunk deflection, in walking after total hip arthroplasty. We hypothesized that trunk deflection in walking after ALS would be significantly improved in comparison with use of the DL approach.
Methods: The subjects were 15 patients, with 7 in the ALS group and 8 in the DL group. Walking before and 9 and 28 weeks after surgery was analyzed using 3-dimensional motion analysis.
Results: Walking velocity, stride length, hip joint range of motion in the sagittal plane in walking, and locomotion range of trunk inclination were significantly improved 28 weeks after surgery in both groups. In gait analysis, there were no significant differences between the 2 groups.
Conclusion: This study was conducted to compare the effect of ALS with that of a DL approach on locomotion in walking after total hip arthroplasty. Hip pain at 9 weeks after surgery was significantly improved using ALS compared to the DL approach, but there were no significant differences in gait function at 28 weeks after surgery using ALS or DL approach. Further long-term studies are required to examine differences between these procedures.

Total hip arthroplasty (THA) is an excellent procedure for treating degenerative hip diseases, including hip osteoarthritis, and enhances quality of life with postoperative pain relief and improved physical function [1-3]. However, complications of THA include postoperative dislocation, decreased force of the abductor muscles of the hip, reduced hip joint range of motion (ROM), and claudication [4-8]. There are various surgical approaches for THA, including anterior, anterolateral (AL), lateral, and posterior approaches, and these are selected on a case-by-case basis by surgeons based on the advantages and disadvantages of each approach and the effects on surgical outcomes.

The direct lateral (DL) approach involves entry around the central part of the gluteus medius and thus has a higher risk for dysfunction of the abductor muscles of the hip compared to other approaches [9]. The AL approach in the supine position (ALS) has been proposed as a method that is less invasive for the abductor muscles of the hip [10]. Owing to this reduced invasiveness, ALS is likely to cause less postoperative pain, to improve the function of the abductor muscles, and to decrease the length of stay [10,11].

Gait analysis is commonly performed to examine gait function of patients after THA. Postoperative gait has been widely compared among surgical approaches: Pospischill et al [12] found no difference in postoperative functional recovery between DL and AL approaches, and Queen et al [13] found no significant difference in gait performance at 1-year after surgery with AL, DL, or posterior approaches, with the conclusion that the approach had no effect on the rate of gait recovery. However, these studies focused only on locomotion of the lower extremities under the pelvis and not on trunk locomotion.

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Patients with hip disorder, including hip osteoarthritis, have a characteristic waddling gait associated with lateral inclination of the trunk in walking (Duchenne claudication) [14,15]. Furthermore, lateral trunk deflection decreases walking efficacy in forward propulsion in walking and causes secondary deformation of the hip and foot joints [16,17]. Lateral inclination of the trunk is caused by coxalgia and decreased force of the abductor muscles [15,18,19]. It is important to evaluate lateral inclination of the trunk in walking as an indicator for improvement of pain and function of the abductor muscles of the hip during postoperative gait recovery. This indicator also allows comparison of recovery of gait motion after surgery. The present study was conducted prospectively to compare the effects of ALS with those of the DL approach on gait motion, including trunk deflection, in walking after THA. We hypothesized that trunk deflection in walking would be improved after surgery with ALS compared with the DL approach.

Materials and Methods

The subjects were chosen from patients with hip osteoarthritis who underwent THA at our University Hospital from 2010 to 2012. Surgery was performed by one orthopedic surgeon. The study contents were explained in writing and orally to all patients for whom THA was scheduled during the specified period, and 15 patients who gave informed consent were enrolled in the study. These subjects included 7 patients treated with ALS (ALS group) and 8 patients treated with the DL method (DL group). The exclusion criteria were narrowing of the hip joint on the opposite side, patients who had previously undergone surgery for musculoskeletal disease other than total hip arthroplasty, those who had rheumatoid arthritis and deformity in limb joints other than the hip joint, and those who had neuromuscular disease. All the subjects underwent the first joint arthroplasty owing to unilateral hip osteoarthritis of terminal stage.

Evaluations were conducted on the day before surgery and at means of 9 and 28 weeks after surgery. The clinical end points were body composition, Japanese Orthopaedic Association (JOA) Hip Score, and coxalgia evaluated using a visual analog scale (VAS). The JOA Hip Score is commonly used for evaluation of hip joint disease in Japan and includes 4 items: pain (40 points), joint ROM (20 points), walking ability (20 points), and activities of daily living (ADL; 20 points) [20].

Gait analysis was performed using a breastband for the trunk, a pelvic belt for the pelvis, and a supporter for the femur to measure the ROM of the trunk, pelvis, and femur, respectively, during walking. Twelve reflecting markers (3/device) were placed, and the rigid body was defined by markers on the trunk, pelvis, and femur. The definitions of the rigid body and the attachment points of markers were established as in previous studies [21,22] as follows: the trunk was defined by markers attached on lines between the right and left scapular spine terminal parts and the right and left scapular inferior horns; the pelvis was defined by markers attached on the right and left posterior superior iliac spines and the coccyx; and the femur was defined by markers attached on the inferior ischial tuberosity, inferior greater trochanter, and central posterior femur. Subjects walked 6 m in a normal gait at their own speed. The trajectories of reflecting markers in walking were measured with 6 infrared cameras and converted to 3-dimensional coordinates using the OptiTrack Motion Capture system (NaturalPoint, Inc, Corvallis, OR). The joint angle was estimated from the coordinate data using Matlab 7.0.1 (MathWorks, Natick, MA). Based on these data, walking velocity and stride length as spatiotemporal scales, hip joint ROM in the sagittal plane, locomotion range of the trunk, and pelvis inclination in the frontal plane as kinematical scales were evaluated. Subject walked 3 times as a trial before measurement. Walking was measured 5 times and the mean was evaluated.

Surgery was performed in the supine position in both groups. The surgical approach was through the tensor muscle of the fascia lata and gluteus medius in the ALS group [10]. The ALS method did not need repair because of the absence of separation in the muscles on insertion. The Bauer [23] method was used as an approach through the AL hip joint by dividing the upper third of the gluteus medius and the part approximately 3 cm from the vastus lateralis muscle in the DL group. The split part in the gluteus medius and vastus lateralis was anatomically repaired. All patients had uncemented hip implants, which included an acetabular component with a radiated polyethylene liner and femoral stem and metal head component. A femoral stem type was used with tapering proximal or distal to fixation. All the subjects underwent similar rehabilitation protocols, left their bed on the day of surgery, and began walking training with weight bearing within 3 postoperative days. Discharge occurred on the day a subject could walk with a single cane and go up and down stairs.

Comparison between the ALS and DL groups was performed by an unpaired t test. Data before and after surgery in each group were compared by a paired t test. All analyses were performed using SPSS16.0J, and $P < .05$ was considered to be significant. This study was conducted after approval by the institutional ethics committee (No. 09-535).

Results

Body composition for each surgical procedure is shown in Table 1. There were no significant differences in age, height, weight, body mass index, length of stay, disease duration, and differences in the leg before and after surgery between the ALS and DL groups. JOA Hip Scores for pain, walking ability, daily living activities, and the total score significantly improved at 9 and 28 weeks after surgery compared to those before surgery in both groups (Table 2), but there was no significant improvement in the joint ROM in either group.

In comparison of JOA Hip Scores between the groups before surgery and 9 and 28 weeks after surgery, the only significant difference was for pain at 9 weeks after surgery ($P < .05$; Table 2). VAS scores for pain significantly improved at 9 and 28 weeks after surgery in both groups, in comparison with before surgery. VAS scores for pain did not differ significantly between the ALS and DL groups before surgery and at 9 and 28 weeks after surgery (Table 2).

Walking velocity in the ALS and DL groups increased at 9 weeks after surgery and significantly increased at 28 weeks after surgery compared with that before surgery ($P < .05$; Fig. 1). There was no

Table 1
Demographic Data on the Patients.

	ALS (n = 7)	DL (n = 8)	*P* Value
Male:female	1:6	1:7	.92
Age at surgery	63.3 ± 12.8	67.9 ± 7.2	.44
Height (m)	1.58 ± 0.07	1.55 ± 0.09	.43
Weight (kg)	59.9 ± 7.1	58.2 ± 10.9	.75
BMI (kg/m^2)	23.9 ± 2.3	24.1 ± 2.1	.87
Condition of affective side	Terminal stage	Terminal stage	
Unilaterality:bilaterality	7:0	8:0	
Disease duration (y)	4.0 ± 4.3	4.3 ± 2.7	.90
LOS (d)	19.7 ± 7.8	22.3 ± 5.9	.52
SMD (cm)			
Before surgery	0.93 ± 0.62	0.81 ± 0.43	.70
After surgery (28 wk)	0.21 ± 0.52	0.25 ± 0.43	.90

Values are expressed as mean ± standard deviation.
ALS, anterolateral approach in the spine position; BMI, body mass index; DL, direct lateral approach; LOS, length of hospital stay; SMD, spina malleolar distance.