The Journal of Arthroplasty 29 (2014) 1261–1264

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Similar Improvement in Gait Parameters Following Direct Anterior & Posterior Approach Total Hip Arthroplasty

Parthiv A. Rathod, MD [a], Karl F. Orishimo, MS [b], Ian J. Kremenic, MEng [b], Ajit J. Deshmukh, MD [a], José A. Rodriguez, MD [a]

[a] Center For Joint Preservation and Reconstruction, North Shore LIJ/Lenox Hill Hospital, New York, New York
[b] Nicholas Institute of Sports Medicine and Athletic Trauma (NISMAT), North Shore LIJ/Lenox Hill Hospital, New York, New York

ARTICLE INFO

Article history:
Received 21 August 2013
Accepted 26 November 2013

Keywords:
gait analysis
direct anterior
posterior
hip arthroplasty

ABSTRACT

We compared gait parameters prior to, at 6 months and 1 year following total hip arthroplasty (THA) performed via direct anterior approach (DAA) and posterior approach (PA) by a single surgeon in 22 patients. A gait analysis system involving reflective markers, infrared cameras and a multicomponent force plate was utilized. Postoperatively, the study cohort demonstrated improvement in flexion/extension range of motion (ROM) ($P = 0.001$), peak flexion ($P = 0.005$) and extension ($P = 0.002$) moments with no differences between groups. Internal/external ROM improved significantly in the DAA group ($P = 0.04$) with no change in the PA group. THA performed via DAA and PA offers similar improvement in gait parameters with the exception of internal/external ROM which might be related to the release and repair of external rotators during PA THA.

Gait analysis is an objective, established method for analyzing the effect of various surgical procedures for coxarthrosis including total hip arthroplasty (THA) [1]. Despite the improvement in clinical function and quality of life after THA, some studies have shown persistent gait anomalies in patients up to 10 years after THA [1–3]. It has also been used to quantify differences in postoperative recovery with minimally invasive and conventional THA as well as THA performed with different approaches [4–6]. This is based on the understanding that different approaches alter the function of different groups of muscles to a varying extent due to trauma incurred during the surgical approach.

The direct anterior approach (DAA) to THA uses the interval between the gluteal and tensor muscles laterally and the sartorius and rectus femoris muscles medially. There is an increased interest in this approach recently as 1) it is thought to be a muscle sparing procedure, 2) with lower dislocation rate which mitigates the need for postoperative hip precautions [7,8] and 3) the ability to confirm component positioning with fluoroscopy intra-operatively. Meneghini et al, in a cadaveric study, however, demonstrated similar overall muscle damage with the DAA and the conventional posterior approach (PA) [9]. There was less damage to the gluteus minimus with the DAA (a mean of 8% with DAA vs 18% via the PA); but, the tensor fascia lata muscle as well as the direct head of the rectus femoris incurred greater damage with the DAA (a mean of 31% and 12% respectively). The piriformis or conjoined tendon was transected in 50% of the anterior approach hips whereas all external rotators were intentionally detached and subsequently repaired in the PA.

Prospective longitudinal studies have shown significant improvements in a number of time–distance (spatiotemporal) and kinematic variables [10,11] as well as improvement in gait symmetry [12] after DAA THA as compared to anterolateral THA. However, a limited number of studies have compared the differences in the recovery of gait parameters after DAA and PA THA. Ward et al [4] and Mafflueiti et al [13] couldn't demonstrate any significant differences in spatiotemporal gait parameters with these two approaches; however both of these were cross-sectional studies with no data on preoperative gait parameters. A recent study comparing computer navigated DAA THA and conventional PA THA reported similar recovery of spatiotemporal gait parameters and frontal plane angular movements of the pelvis and thorax [14].

The aim of our prospective, non-randomized study was to investigate and compare changes in 3-dimensional kinematics and kinetics of the hip joint in addition to the spatiotemporal gait parameters after THA performed via the DAA and PA. We hypothesized that there would be differences between groups corresponding to the damage subjected to the abductors and external rotators during PA THA and to the rectus femoris and tensor fascia lata during DAA THA.

Methods

All patients undergoing primary THA by a single fellowship trained arthroplasty surgeon at a single center who qualified according to prespecified inclusion and exclusion criteria were invited to participate. The inclusion criteria were age of 45–70 years, cementless, unilateral

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2013.11.021.

Reprint requests: Parthiv A. Rathod, MD, Center For Joint Preservation & Reconstruction, New York, NY 10075.

http://dx.doi.org/10.1016/j.arth.2013.11.021
0883-5403/

THA and a diagnosis of primary osteoarthritis of the hip. Patients with a diagnosis other than primary degenerative hip arthrosis, history of previous orthopedic surgery on the ipsilateral lower extremity, patients with polyarthritis, neurological disorder known to affect gait, Crowe type 3 or 4 dysplasia, inability to walk without a cane or a walker and patients who were not willing to comply with the study protocol were excluded from participation in the study. Patients in the PA group consisted of patients who underwent PA THA by the senior surgeon from June 2008 through June 2009; whereas the DAA group consisted of patients operated by the same surgeon from April 2010 to June 2011. The PA was the only approach utilized for THA by the senior surgeon up to June 2009 with greater than 2000 PA THAs performed by him at the time of commencement of the study. DAA was utilized for all patients in the time period while recruiting patients of the DAA group except on 3 occasions; two involving a hip with presence of hardware which was removed at the time of THA and the third patient had a large gluteus medius tear which was repaired during the procedure. Patients in the DAA group were recruited after 100 DAA THAs were performed by the senior surgeon to minimize the influence of the learning curve. A written, informed consent was taken from all patients participating in the study and an IRB approval was obtained prior to commencement of the study.

22 patients participated in the study; 11 in PA group (6 males and 5 females) and 11 in the DAA group (6 males and 5 females). Within the DAA group, two patients did not complete the 6 month assessment in time but followed up for the 1 year assessment. Three other patients completed their 6 month assessments but didn't complete their 1 year assessments. Thus, 9 patients were available at 6 months and 8 patients at 1 year follow-up in the DAA group for analysis. Mean patient age in the PA group was 61.8 years (SD 9.1) and it was 58 years (SD 6.7) in the DAA group. Mean BMI values were 25.43 kg/m^2 (SD 3.08) in the PA group and 25.9 kg/m^2 (SD 2.23) in the DAA group. There were no significant differences between the groups in these demographic features.

Cementless acetabular components (Trident PSL, Stryker, Mahwah, New Jersey in PA THA; R3, Smith & Nephew, Memphis, Tennessee in DAA THA), a tapered wedge design of the femoral component (Accolade, Stryker, Mahwah, New Jersey in PA THA; Anthology, Smith & Nephew, Memphis, Tennessee in DAA THA) with a ceramic on polyethylene bearing were utilized for THA in both the groups. Head sizes were selected based on the cup size (a head size of 36 mm was used when the cup size was 54 mm or greater and 32 mm when the cup size was less than 54 mm). There was a similar distribution of 32 and 36 mm head sizes in the two groups (PA group, 32 mm–4 hips, 36 mm–7 hips; DAA group, 32 mm–4 hips, 36 mm–7 hips; $P = 0.67$). DAA cases were performed with a slight modification of the technique described by Lovell [15], with anterior capsulotomy and subsequent repair, the use of a standard operating table with a table mounted femoral elevator (Omni-Tract Surgical, St. Paul, Minnesota), selective soft tissue releases based on the mobility of the femur (conjoined tendon was released in most cases and piriformis was released in some), and the use of fluoroscopy in every case for assessing component positioning and limb-lengths. Stability was assessed with provocative testing in extension and external rotation, and leg length and socket position were adjusted to achieve stability. Leg length was determined by a direct comparison between the legs and using the C-arm. PA THAs were performed as previously reported [16], with a repair of the capsule and all muscular structures (piriformis, conjoined tendon, quadratus and gluteus maximus tendon) through trochanteric drill holes and/or direct repair. Stability was assessed with provocative testing in flexion and internal rotation. Leg length and socket position were adjusted to achieve stability. Leg length was determined using a Steinman pin in the infracotyloid groove as previously described [17].

All patients were managed with the same multi-modal anesthesia and analgesia protocol. Patients were first seen by a physical therapist on the morning after surgery and received 2 sessions of physical therapy daily until discharge from the hospital. Patients were encouraged to move from bed to chair on the first postoperative day with weight bearing as tolerated. No hip precautions were imposed on patients receiving the DAA, whereas patients who received THA through the PA were advised to use an abduction pillow, high chair and avoid a combination of flexion of more than 90° with adduction and internal rotation until 6 weeks postoperatively. Upon discharge, patients were advised to resume activities as they could tolerate, with hip comfort being their guide. Patients were also encouraged to progress to a cane as tolerated. Apart from the difference in hip precautions, standardized rehabilitation instructions were issued to physical therapists taking care of patients at home or at outpatient physical therapy facilities.

Gait testing for patients undergoing THA occurred before surgery, at 6 months and 1 year after surgery. Kinematic and ground reaction force data were recorded as subjects walked at self-selected pace across a six-meter walkway. Reflective markers were placed over the calcaneous, first and fifth metatarsals, medial and lateral malleoli, anterior shank, medial and lateral femoral condyles, anterior thigh, greater trochanter, sacrum and anterior superior iliac spine of the involved leg and the greater trochanter and anterior superior iliac spine of the contralateral leg. Marker positions were collected at 60 Hz using five infrared cameras (Qtrac, Qualisys, Gothenburg, Sweden). The motion data were then filtered with a fourth-order Butterworth low-pass filter with a cutoff frequency of 10 Hz in order to eliminate any high frequency noise. Ground reaction forces (GRF) were recorded at 960 Hz with a multi-component force plate (Kistler Instrument Corp., Anherst, NY, USA) incorporated into the walkway. Subjects preformed five gait trials and were instructed to walk as naturally as possible contacting the force plate with only the involved limb. Trials in which the foot did not land completely on the force plate or the subject altered his or her gait pattern to target the force plate were discarded and the trial was repeated.

Spatiotemporal parameters analyzed were gait velocity and single-leg stance time. Joint kinetic and kinematic variables were calculated during the stance phase. Sagittal (flexion/extension), frontal (adduction/abduction) and transverse [internal/external rotation; IR/ER] plane hip angles and moments were calculated using specialized computer software (Visual 3D, C-Motion, Inc., Rockville, MD, USA). Hip flexion, adduction and internal rotation angles and moments were defined as positive values and all moments were reported as internal moments.

Table 1
Mean Values & Standard Deviations for Hip Range of Motion (Degrees).

	DAA	PA	Group[a]	Group by Time[b]	Time[c]
Sagittal plane (Flexion/extension)					
Presurgery	30 (12)	28 (9)	0.53		
6 months	41 (9)	35 (8)	0.16	0.58	0.003[d]
1 year	46 (5)	36 (7)	0.01[d]	0.25	0.001[d]
Frontal plane (Abduction/adduction)					
Presurgery	9.6 (2.6)	6.9 (1.7)	0.02[d]		
6 months	9.6 (1)	10.8 (3.7)	0.32	0.007[d]	0.01[d]
1 year	10.6 (2.6)	12.6 (4.1)	0.26	0.02[d]	0.01[d]
Transverse (internal/external rotation)					
Presurgery	10.7 (4.3)	9.14 (4.5)	0.45		
6 months	15 (6.5)	9.07 (3.4)	0.03[d]	0.04[d]	0.05[d]
1 year	14 (6.5)	9.09 (2.5)	0.04[d]	0.04[d]	0.09

DAA, Direct anterior approach; PA, Posterolateral approach.
[a] Independent t-test between groups.
[b] Repeated measures ANOVA (group by time; preoperative to 6 months; preoperative to 1 year).
[c] Repeated measures ANOVA (time; preoperative to 6 months; preoperative to 1 year).
[d] Significant value.