ORIGINAL ARTICLE

Postural Balance During Quiet Standing in Patients With Total Hip Arthroplasty With Large Diameter Femoral Head and Surface Replacement Arthroplasty

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ABSTRACT. Nantel J, Termoz N, Ganapathi M, Vendittoli P-A, Lavigne M, Prince F. Postural balance during quiet standing in patients with total hip arthroplasty with large diameter femoral head and surface replacement arthroplasty. Arch Phys Med Rehabil 2009;90:1607-12.

Objective: To compare postural balance between patients who have had either a large diameter head total hip arthroplasty or surface replacement arthroplasty.

Design: Observational study.

Setting: Outpatient biomechanical laboratory.

Participants: Two groups of 14 patients with surface replacement or large diameter head total hip arthroplasties recruited from a larger randomized study and 14 control subjects.

Interventions: Not applicable.

Main Outcome Measures: Postural balance during quiet standing in dual and one-leg stance (operated leg), hip abductor muscle strength, clinical outcomes, and radiographic analyses were compared between groups.

Results: Compared to the control group, patients in both groups showed smaller center of pressure displacement amplitude in the medial-lateral direction in dual stance. Patients with large diameter head total hip arthroplasty showed lower hip abductor muscle strength compared to control subjects. There was statistical difference between the 2 patient groups in biomechanical reconstruction of the hip. Despite these differences, there was no significant difference in the ability to complete the one-leg stance task between the 3 groups.

Conclusions: The muscular strength in the operated limb could be mainly responsible for the lower center of pressure displacement amplitude compared to control subjects. However, the ability to complete the one-leg stance demonstrates that patients do not fear to load the hip prosthesis when needed. The large diameter femoral head may be a major mechanical factor contributing to these results.

Key Words: Arthroplasty; Biomechanics; Hip; Posture; Rehabilitation.

TOTAL HIP ARTHROPLASTY is a common and successful procedure that relieves pain and improves hip function, with an overall high patient satisfaction.[1,2] Functional and clinical outcomes are recognized to be quite positive, with reported gains in hip isometric strength,[3,4] restoration of gait velocity,[5,6] and improved quality of life in the early period of postsurgical recovery.[2]

Despite these positive outcomes, residual functional disabilities persist after conventional THA using smaller diameter heads (22 to 32mm head) and affect major daily living activities such as postural balance. Previous studies have reported deficits in postural control 6 to 12 months after surgery.[7–9] More specifically, previous studies reported a lower endurance on the operated limb compared to the contralateral limb during one-leg standing[9] as well as a restricted amplitude in the trunk movement during quiet standing.[7] A more commonly reported deficit is a general weakness in abductor muscles after THA.[5,10] This point has important functional implications in postural control because the hip abductor muscles are strongly implicated in the medial-lateral control of balance.[11]

A recent study highlighted difficulties in patients after conventional THA to maintain one-leg stance posture and a tendency to avoid loading the prosthetic hip during the dual stance task.[12] However, these results suggested that although muscle strength is an important factor to fully regain normal postural balance, other factors, such as the characteristics of the prosthetic, could also be important. More specifically, the hypothesis was that a more anatomical bearing surface versus the smaller femoral heads used in THA (22 to 32mm) might greatly affect postural balance. Large diameter head components can be used in 2 types of prostheses: the THA with large diameter femoral heads, and the SRA of the hip. Both prostheses have specific characteristics that might also affect postural regulation processes. Among them, the presence or not of a metallic stem in the medullar canal could be an important factor.

SRA has been recognized to better restore normal hip anatomy.[13,14] It has been proposed that the preservation of the

List of Abbreviations

COM	center of mass
COP	center of pressure
RMS	root-mean-square
SRA	surface hip arthroplasty
THA	total hip arthroplasty

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Table 1: Characteristics of the 3 Groups

Subjects	Control	LDH-THA	SRA
Age (y)	44.5±8.7	50.8±5.8	45.0±8.0
Sex (M/F)	8/6	11/3	9/5
Mass (kg)	75.2±13.4	80.7±14.4	81.4±17.4
Height (m)	1.71±0.07	1.70±0.06	1.69±0.08
BMI (kg/m^2)	25.7±3.3	27.9±4.0	28.4±4.3

NOTE. Values are mean ± SD or as otherwise noted.
Abbreviations: BMI, body mass index; F, female; LDH, large femoral head diameter; M, male.

femoral head and neck in the SRA allows a more physiologic load transmission to the proximal femur as well as a better proprioception.[14-16] Large diameter femoral head in SRA and large diameter head THA improve joint stability in both patients with recurrent dislocations and those undergoing revisions.[17-19] However, until now, to our knowledge, no study has investigated the functional differences between large diameter head THA and SRA during a quiet standing task. This comparison is important to understand the relative importance of large diameter head and other prosthetic characteristics, such as preservation of the native femoral neck. Therefore, the aim of this study was to compare postural stability in patients after they underwent hip arthroplasty with either large diameter head THA or SRA.

METHODS

Study Group

Forty-two subjects divided in 3 groups (14 controls, 14 large diameter head THA, and 14 SRA) participated in the study. Patients were selected on the basis of unilateral hip disease classified by consensus of the 3 surgeons (P.A.V., M.L., and A.G.R.). Exclusion criteria for all subjects included the presence of any condition that may have affected balance (contralateral hip arthroplasty or osteoarthritis, knee osteoarthritis, knee arthroplasty, neurologic or musculoskeletal impairments, and reported falls for the past 6mo). After surgery, all patients underwent a 12-week rehabilitation program including isometric and stretching exercises that targeted the knee and hip flexor-extensor muscle groups as well as the hip adductor-abductor muscles and internal-external rotator muscles. They were evaluated at a short-term follow-up (range, 5–7mo). The healthy control subjects were age-matched volunteers recruited from the community through our institutions. The descriptive characteristics of the groups are presented in table 1. All participants provided their written consent, and the project was approved by our institutional review boards.

Three experienced surgeons performed the surgeries. In all cases, they used a posterior surgical approach. In the SRA group, the hybrid Durom hip-resurfacing system[a] was implanted (fig 1). In the large diameter head THA group, a CLS Spotorno titanium uncemented femoral stem[a] was used with a large diameter modular metal head (Metasul) and a Durom acetabular component[a] (fig 2). Figure 3 shows a radiograph of the pelvis of a patient (not included in the study) with both types of prostheses. During each procedure, the surgeons tried to reproduce the patient's hip anatomy by using preoperative templating with the opposite side as a reference and by using bony landmarks. Surgical techniques for all the procedures as well as the radiographic analyses have been described previously.[13,20,21]

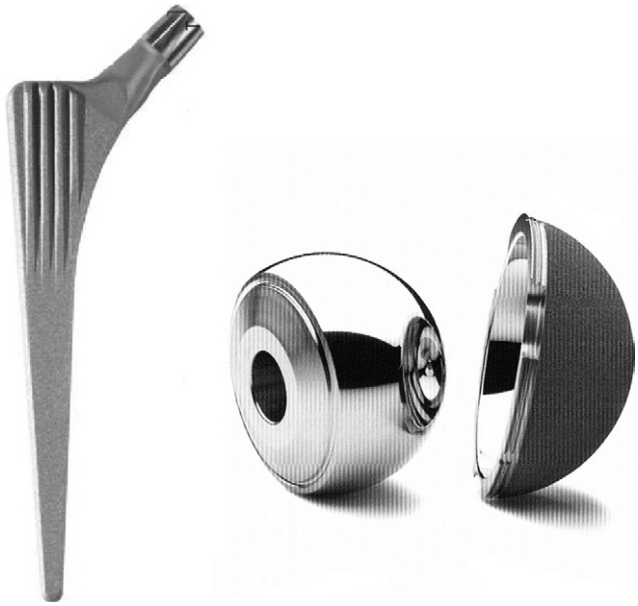

Fig 2. The CLS femoral stem, the Metasul large diameter head, and the Durom acetabular component.[a]

Fig 1. The hybrid Durom hip surface replacement arthroplasty system with chrome-cobalt femoral head and acetabular cup.[a]

Fig 3. Radiograph example of the pelvis of a subject (not included in the study) with a large diameter head THA on the right hip and an SRA on the left hip.