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Original article

Total hip arthroplasty using a cementless dual-mobility cup provides increased stability and favorable gait parameters at five years follow-up

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ABSTRACT

Background: Rates of dislocation following primary total hip arthroplasty (THA) vary from 0.5 to 10%. Dual-mobility cups in THA demonstrate increased stability. Clinical outcomes following THA with dual-mobility cups have been reported, but gait has not been assessed. Therefore we performed a retrospective case control study to answer: (1) is gait better in patients following THA with a dual-mobility cup than in frail, elderly patients of the same age? (2) Are clinical outcomes better in patients following THA with a dual-mobility cup than in frail, elderly patients? (3) What is the dislocation rate following THA with a dual-mobility cup?
Hypothesis: We hypothesized that patients who underwent THA with a dual-mobility cup have a better gait compared to frail, elderly patients of the same age.
Patients and methods: Twenty patients (22 hips), mean age 79.9 ± 7.7 (range, 62.3–88.3) years were assessed in this retrospective case-control series 5.6 ± 1.4 (range: 4.1–8.8) years following dual-mobility cup THA. A reference group consisted of 72 "frail elderly" patients in a rehabilitation hospital for health problems unrelated to the lower limb, with no lower limb surgery or neurological conditions. Temporal and spatial gait performance were measured with four miniature gyroscopes, mounted on each thigh and calf, while patients walked freely along a 30 m corridor. Harris Hip Score, WOMAC, radiological outcomes, and dislocation rate were determined.
Results: All gait parameters were better in the dual-mobility group compared to the frail elderly group. The dual-mobility group had a higher cadence (100.3 steps/minute versus 75.6 steps/minute), shorter (relative to gait cycle time) stance (61.6% versus 67.8%), shorter (relative to gait cycle time) double stance (23.3% versus 36.0%), longer stride (1.13 m versus 0.80 m), and faster walking speed (0.96 m/s versus 0.52 m/s). Range of motion of the shank, thigh and knee were better in the dual-mobility group. Harris Hip Score was 87.6 ± 13.9 (range 51–100) and WOMAC score was 11.3 ± 12.1 (range 0–34) in the THA group. We observed no dislocations.
Discussion: Gait patterns five years following THA with the dual-mobility cup were better or comparable to published study populations.
Level of evidence: III, retrospective case-control series.

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1. Introduction

A feared complication after total hip arthroplasty (THA), particularly in elderly patients, is instability and dislocation. Rates of dislocation vary from 0.5% [1] to 10% [2] following primary THA and up to 35% [3] following revision surgery. The dual-mobility cup reduces the risk of dislocation by using the large femoral head as the small joint to articulate against the "larger joint" acetabular shell. The large femoral head also provides enhanced mobility of the joint [4]. The dual-mobility system has been successful in preventing dislocation at long-term follow-up, with rates of dislocation ranging from 0% of 240 hips at 22-year follow-up [5] to 6.9% for 437 primary dual-mobility THA at 16.5 years [6]. A reported concern with the dual-mobility cup is the risk of intra-prosthetic dislocation, which occurs when the femoral head leaves the polyethylene insert after excessive wear of its retentive rim. Rates of intra-prosthetic dislocation range from 0% [5] to 5.3% [7]. Three causal mechanisms of intra-prosthetic dislocation include absence of arthrofibrosis and cup loosening, liner blockage due to extrinsic phenomena, and cup loosening [8].

Patient outcomes following THA with a dual-mobility cup are typically evaluated with the Harris Hip Score (HSS) [9–11], but this does not reflect the real walking performance of patients. Gait analysis using body fixed sensors, i.e., outside of the laboratory environment, has been used to objectively assess outcomes after THA [12–14]. However, gait analysis data following THA with a dual-mobility cup are lacking.

In this study, we hypothesized that patients who underwent THA with a dual-mobility cup have a better gait in comparison to frail, elderly patients. We asked the following:

- Is gait better in patients five years following THA with a dual-mobility cup than in frail, elderly patients of the same age?
- Are clinical outcomes better in patients five years following THA with a dual-mobility cup than in frail, elderly patients?
- What is the dislocation rate following THA with a dual-mobility cup?

2. Patients and methods

2.1. Patients

In this retrospective case-control series, 52 Gyros dual-mobility cups (DePuy J&J Corporation, Saint Priest, France) were implanted in 50 patients during primary THA or revision surgery prior to 2007 at a large urban hospital. A dual-mobility cup was chosen for older patients and those with poorer overall health. All patients with a dual-mobility cup implanted in our hospital during the study period were included. Fifteen patients had died or were cognitively impaired at the time of the study, five declined to participate, and nine could not be located, leaving 21 patients (23 hips). Thus, 22 hips (15 primary and 7 revisions) were reviewed in 20 patients at a mean follow-up of 5.6 ± 1.4 (range, 4.1–8.8) years. THA patients were compared to an age-matched reference group ("frail elderly population") of 72 patients in a rehabilitation hospital following treatment of health problems related to the upper limb (e.g., shoulder contusion, wrist fracture). They did not undergo lower limb treatment and had no cognitive or behavioral impairment. Gait analysis was performed in the reference group shortly before their discharge home, after a mean hospital stay of 3 weeks. Patients with THR and the reference group were similar in age and proportion of women (Table 1).

This study was approved by the Research Ethics Board of our institution (Protocol 265/10). All patients gave written consent.

Table 2
Gyros components used ($n = 22$).

Cup outer diameter (mm)	Femoral head (n)	
	22.2 mm	28 mm
46	3	0
48	0	2
50	0	3
52	0	4
54	0	1
56	0	2
58	0	6
60	0	1

2.2. Methods

The Gyros dual-mobility cup is made of a stainless steel cup with or without hydroxyapatite-coated legs. The outer diameter varies from 44 to 68 mm and two sizes of polyethylene liner were used (Table 2). A posterior surgical approach (Austin-Moore) was used, with patients in lateral decubitus position. For revision THA, the cup component was replaced in five patients due to instability, the polyethylene liner was replaced in one patient due to wear, and both components were replaced in one patient due to aseptic loosening of the stem.

2.3. Methods of assessment

At follow-up, an independent observer (AA) reviewed all patients clinically and performed the gait analysis. Lower limb rotation was measured using four miniature gyroscopes mounted on each thigh and calf and linked to a Physilog portable data logger (Gait Up, Lausanne, Switzerland) [15]. Temporal and spatial gait performance were recorded when patients walked freely at their usual pace along a 30 m corridor. Clinical evaluation included the

Table 1
Patient characteristics at time of gait analysis[a].

	Dual mobility cup THA ($n = 22$)	Frail elderly controls ($n = 72$)	P-value
Age, years	79.9 ± 7.7 (62.3–88.3)	82.0 ± 7.6 (63.0–98.0)	$P = 0.37$
Gender: female, n (%)	15 (68.2%)	48 (66.7%)	$P = 0.90$
ASA classification, n (%)		Not available	
1	3 (13.6%)		
2	16 (72.7%)		
3	3 (13.6%)		
Length of Follow-up after THA, years	5.6 ± 1.4 (4.1–8.8)	Not applicable	
Harris Hip Score	87.6 ± 13.9 (51–100)	Not available	
WOMAC Score	11.3 ± 12.1 (0–34)	Not available	

ASA: American Society of Anaesthesiologists.
[a] All values are shown as mean ± standard deviation (range), unless otherwise indicated.

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