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Original article

Is there any range-of-motion advantage to using bearings larger than 36 mm in primary hip arthroplasty: A case-control study comparing 36-mm and large-diameter heads

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ABSTRACT

Background: Large-diameter (>36 mm) total hip arthroplasty (THA) has developed rapidly since the advent of ceramic-on-ceramic (CoC) bearings and highly cross-linked polyethylene. Theoretically, the increase in diameter reduces the risk of instability, although the advantage of calibers beyond 36 mm has not been demonstrated in terms of range-of-motion recovery. We conducted a comparative study with a single prosthesis model to determine whether increasing the caliber beyond 36 mm provides: (1) better recovery of range-of-motion, (2) a higher functional score, and (3) reduction of the dislocation rate.
Hypothesis: Increasing the range-of-motion by increasing the caliber beyond 36 mm provides better range-of-motion.
Material and methods: We analyzed two consecutive, single-operator cementless THA series performed via the mini posterior approach, which differed only in the bearing system (51 metal-on-metal [MoM] with a mean caliber of 45 mm ± 3.3 [range, 40–54] and 61 CoC with a 36-mm caliber). Both series were comparable preoperatively in terms of age, diagnosis, functional scores, preoperative range-of-motion, body mass index, UCLA activity level, and Charnley score. We compared the joint range of movement at follow-up and the gains in range of movement, onset of dislocation, and functional scores (Oxford, Postel-Merle d'Aubigné [PMA]).
Results: The mean overall joint range-of-motion was 254° ± 39° (range, 150–310°) for an 81° ± 44° (range, −50 to 180°) gain in the MoM group and 256° ± 23° (range, 200–280°) for an 84° ± 40° (range, 0–160°) gain in the CoC group (NS). The MoM group presented the following results: Oxford = 13.71 ± 3.66 (range, 12–33) for a gain of 24.82 points ± 7.9 (range, −1 to 40), PMA = 17.75 ± 1.06 (range, 11–18) for a gain of 7.78 points ± 4.01 (range, 2–15). The CoC group had: Oxford = 14.98 ± 4.42 (range, 12–36) for a gain of 24.75 points ± 6.55 (range, 12–40), PMA 17.66 ± 0.7 (range, 14–18) for a gain of 8 points ± 3.77 (range, 1–15). None of the gains and scores at follow-up differed significantly between the two groups. No episode of dislocation was identified.
Discussion: The current trend of increasing femoral head diameters beyond 36 mm to improve the gains in joint range-of-motion and function is not warranted. The potential side effects of increasing the caliber call for even greater caution in the use of large-diameter heads because our hypothesis has not been confirmed.
Level of evidence: Case-control study, level III.

1. Introduction

The complications related to the use of polyethylene in primary hip arthroplasty (THA) (wear, osteolysis, loosening) have motivated an upsurge in the use of hard-on-hard implants: ceramic-on-ceramic (CoC) and metal-on-metal (MoM) [1]. The latter have made it possible to use large-diameter heads with the advantage

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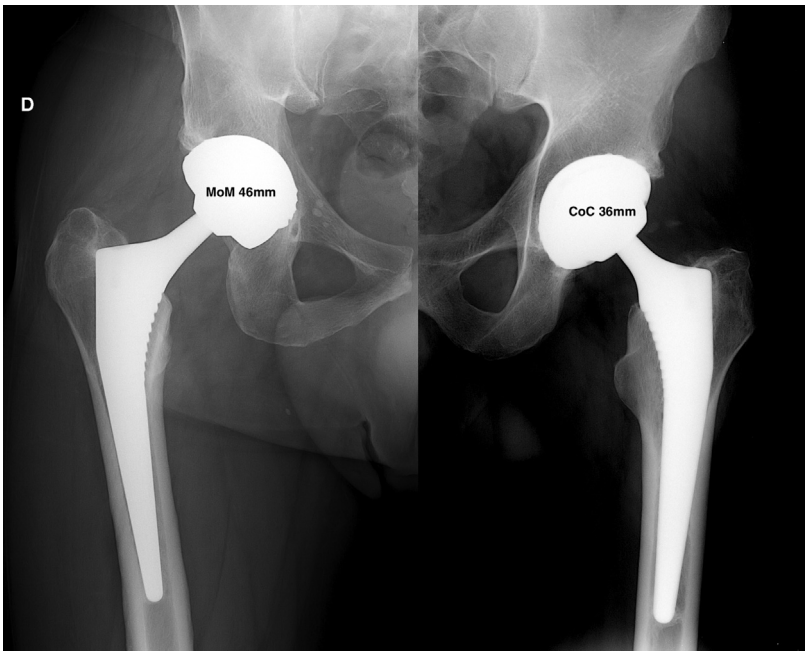

Fig. 1. Images from two patients: right hip, Meije stem associated with Dynamom™ cup (metal-on-metal, bearing diameter 46 mm, right) and left, Meije stem associated with Dynacup™ cup (ceramic-on-ceramic bearing, 36 mm diameter).

of optimizing the femoral head–neck ratio, delaying prosthetic impingement [2]. This theoretically allows one to improve the joint range-of-motion and minimize dislocation risk [3–6].

For MoM-bearing THAs, the increase in head diameter has led to corrosion problems at the Morse taper junctions, resulting in it being abandoned for calibers greater than 32 mm [7]. These problems also affect the polyethylene–metal bearing with a caliber greater than 40 mm [8], but this has also been demonstrated recently for smaller diameters [9]. The CoC bearing also allows use of larger calibers (> 36 mm) even if they are a source of a high rate of abnormal noise and groin pain [10–12].

The value of large-calibers (> 36 mm) in primary arthroplasty can be questioned because, although their contribution in terms of stability has been demonstrated in vivo, their influence on functional recovery and joint range-of-motion is not known. Theoretically and based on experimental arguments, it seems that impingement between the edge of the cup and the neck of the stem disappears nearly completely with 36-mm diameters and larger [4]. However, these observations made in vitro have not been clinically validated. The published studies did not compare a single prosthesis model [6,13–15] or compared calibers ranging from 28 mm to 36 mm [4,11,16,17], but none specifically examined recovery of range-of-motion with calibers greater than 36 mm.

We therefore conducted a comparative study with a single prosthesis model that differed only in the bearing system: the 36-mm CoC versus the large-head MoM (whose caliber was close to the caliber of the native femoral head) with the objective of examining whether use of calibers greater than 36 mm provided:

- better recovery of range-of-motion;
- a higher functional score;
- reduction of the dislocation rate.

We hypothesized that increasing the range-of-motion sector by increasing the femoral head caliber beyond 36 mm provided better range-of-motion.

2. Material and methods

2.1. Patients

We analyzed two consecutive series of primary THAs performed between September 2008 and December 2011. All primary THA patients were included (106 patients, 117 THAs) performed by a single experienced operator using a hard-on-hard bearing system because of the patient's age (< 70 years) and/or a sufficient activity level (UCLA ≥ 2 [18]) and patients for whom resurfacing was not possible (because of dysplasia, bone cysts on the femoral head larger than 1 cm, or osteonecrosis of the femoral head) (186 resurfacing procedures were performed by this operator during the same period). Five patients (five hips) were excluded because they had received implants with a 32-mm femoral head because of the small size of the cup, leaving 112 arthroplasties in 101 patients with a caliber 36 mm or larger, comprising the study population. In this overall group of patients, the first 48 (51 hips) received a MoM-bearing system with a large-diameter femoral head between 38 mm and 56 mm (anatomic diameters [14]) with a theoretical range-of-motion between 154° and 169° (Fig. 1). Beginning in 2010, after the large-caliber MoM was abandoned [7] (Fig. 1), the following 53 patients (61 hips) received a Delta CoC bearing system with a 36-mm femoral head (theoretical range-of-motion, 146°). The patients from both series of implants (MoM and CoC bearing systems) had comparable etiologies and demographic data, notably concerning the preoperative functional scores and preoperative range-of-motion (Tables 1–3).

2.2. Surgical methods

The implants included a cementless femoral and acetabular fixation (Meije Duo, Tornier, St Ismier France) and were identical in both series; only the bearing system varied (Dynamom™ for the MoM, anatomic caliber in forged chrome-cobalt and Dynacup™ in 36-mm Delta ceramic for the CoC Tornier, St Ismier, France). The mini posterior approach was used for all interventions with