The Journal of Arthroplasty 30 (2015) 241–248

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Clinical Outcomes, Survivorship and Adverse Events With Mobile-Bearings Versus Fixed-Bearings in Hip Arthroplasty—A Prospective Comparative Cohort Study of 143 ADM Versus 130 Trident Cups at 2 to 6-Year Follow-Up

Jean-Alain Epinette, M.D.

Orthopaedic Research and Imaging Centre in Arthroplasty, Clinique Médico-Chirurgicale, Bruay-Labuissière, France

ARTICLE INFO

Article history:
Received 3 March 2014
Accepted 22 September 2014

Keywords:
hip arthroplasty
instability
mobile bearings
MHB
fixed bearings
FHB

ABSTRACT

The principle of dual mobility cups, often called "tripolar", has been developed to overcome the problem of instability following primary hip arthroplasty. We prospectively compared two cohorts which differed only by the type of bearings, i.e." mobile bearing hip" (MBH) in a 143-study cohort of ADM cups versus "fixed bearing hip" (FBH) of 130 Trident PSL cups, at a follow-up at 2–6 years. The survival rates at 4.13-years, with instability as endpoint was significantly ($P = 0.0176$) in favor of mobile bearings at 100% with no dislocation reported, versus 94.8% with fixed bearings. These mobile bearings, matching both "modern" dual mobility cups and annealed highly crossed polyethylene, would appear to offer at longer follow-up a valuable solution to clinical outcomes in acetabular arthroplasty.

Major concerns have arisen about instability following primary hip arthroplasty as a major cause of failure in all published reports from several authors and registries [1–4]. The principle of a dual mobility cup, often called "tripolar", was developed in 1974 by Bousquet to overcome the problem of instability after total hip arthroplasty [5,6]. This Mobile Bearing Hip (MBH) configuration consists of a large, fixed, acetabular component and a bipolar femoral component and provides a stable, well-fixed implant platform against bone and two articular interfaces, a large polyethylene surface directly facing a highly polished metal implant, and a standard-sized femoral head captured within polyethylene (Fig. 1). These dual-mobility cups aim to offer a safe, effective and durable solution to hip instability. However, significant complications have been highlighted after the use of first generation cups, which were mainly due to premature wear of the polyethylene, leading to early intraprosthetic dislocations [7–9], or insufficient means of fixation [7,10]. So far, and upon recommendations provided by the French Health Authorities, indications for dual mobility cups have thus been classically restricted to patients with relatively short lifespan, or “at risk”, i.e. in cases of revision surgeries and primaries in the elderly over 70 years of age, or in cases of muscular or neurological deficiencies.

In a recently published paper [11], we have presented successful mid-term outcomes for a second generation dual-mobility cup which has demonstrated promising results, with respect to new polyethylene manufacturing techniques as a second generation of annealed cross-linked polyethylenes, anatomical designs preventing from ilio-psoas tendon impingement, and improvements in metal cup fixation [12,13]. These results were in accordance with several reports from the Literature [14,15], and would support the evidence upon which, based upon extensive laboratory and clinical support, so-called "modern" dual-mobility cup coupled with new highly crossed polyethylene could be seen as a valuable option to deal at the same time with both wear and instability [16]. In such a way, even when no specific risk factors for dislocation can be identified, all patients, including younger and active ones, wish for the elimination of potential hip dislocation as an unbearable "sword of Damocles", while aiming to return earlier to full functional activities and thus could potentially take benefit of this new generation of Mobile Bearing Hip.

Hence the present study, at 2 to 6 years of follow-up, intended to analyze the potential benefits afforded by this "mobile bearing" option by minimizing the potential risk of instability after hip arthroplasty while demonstrating valuable clinical results and low rate of adverse side effects, through a systematic comparison with a homogeneous cohort of "fixed bearings" as a prospective comparative cohort study. Within the frame of the benefit/risk ratio of the MBH option, some complications with previous dual mobility designs have been reported as intra-prosthetic dislocation of the implant. Also, the dual mobility hip has a freely moving insert that can achieve continued movement after femoral neck/acetabular insert impingement [6,7]. In addition, the second articulation introduces an additional area that may be

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2014.09.022.

Reprint requests: Jean-Alain Epinette, M.D., Orthopaedic Research and Imaging Centre in Arthroplasty, Clinique Médico-Chirurgicale, 62700 Bruay-Labuissière, France.

http://dx.doi.org/10.1016/j.arth.2014.09.022
0883-5403/

Fig. 1. The ADM Mobile Bearing System.

Fig. 2. The Trident PSL Fixed Bearing System.

susceptible to abrasion. These various behaviors can cause accelerated wear of the polyethylene component [17], and thus specific attention has been paid for evaluation of wear results within the MBH cohort. A second complication has been reported with dual mobility cups, as ilio-psoas conflicts causing groin pain; this has been addressed as a part of clinical results.

Our aim was to demonstrate that these Mobile Bearing Hips (MBH) could perform significantly better than the Fixed Bearings (FBH) control cohort, in terms of instability, clinical outcome and potential adverse events. The investigations of this cohort study have addressed the cumulative survival rates with revision for instability as the main dependent variable, and clinical results and occurrence of adverse events as secondary variables.

Material and Methods

Implants

The acetabular component used in the mobile bearing hip study group (MBH) was, in all cases, the *Restoration ADM acetabular system* (Stryker Orthopaedics, Mahwah, NJ, USA), which consists of a two-piece component design that is assembled intra-operatively (Fig. 1). The ADM shell was an HA-fully coated pressfit acetabular cup articulating with a non-constrained Duration (Stryker Orthopaedics, Mahwah, NJ, USA) stabilized annealed mobile polyethylene (PE) liner, in which a constrained standard Cobalt Chrome (CoCr) or Ceramic head articulates. ADM's anatomic design also addresses potential psoas conflict with left and right anatomical cup shapes incorporating a 3.5 mm deep anterior notch to prevent any conflict between the acetabular shell rim and the iliopsoas tendon [12,13]. The acetabular shell used in the fixed bearings study group (FBH) was the *Trident PSL cup* (Stryker Orthopaedics, Mahwah, NJ, USA), which consists of a hemispherical HA-fully coated pressfit titanium acetabular shell coupled with a fixed PE insert thanks to a secure locking mechanism (Fig. 2). The polyethylene insert was, in all Trident cups, made of the highly cross-linked polyethylene (HXLPE) Crossfire (Stryker Orthopaedics, Mahwah, NJ, USA). Fixation to bone is ensured in these two models by an HA vacuum plasma-spray technology coating upon a pure titanium macrostructured CP Titanium Arc deposition (Secur-fit, Stryker Orthopaedics, Mahwah, NJ, USA), with the optional addition in the Trident cup of using up to 3 screws. The choice for the uncemented HA-coated pressfit cup implantation was dictated solely by the quality of the host bone, allowing for a sound primary mechanical fixation at the time of the index surgery.

In all cases within the two groups the stem was the HA proximally-coated ABG II monoblock (Stryker Orthopaedics, Mahwah, NJ, USA), coupled with a 28 mm head. With regard to bearing surface choice, Alumina was the main choice, and CoCr heads were used only when the head offset was not available in Alumina (−4 mm).

Clinical Series

We performed baseline surveys as a prospective collection of data through our Global Joint computerized database with two concurrent cohorts of patients, having received either mobile (MBH) or fixed (FBH) bearings acetabular implants. In all cases the patient's informed consent to be enrolled in the study was obtained, and the surveys were conducted according to the rules of the local ethic committee. All enrolled hips were primary surgeries operated on between February 2007 and December 2011 for both cohorts of patients according to their age at index surgery. Since the "official" and currently used limit was 70 years of age to consider patients as eligible for dual mobility cups, the use of ADM cups was mainly proposed for older patients or patients at supposed risk for dislocation, while the PSL cup was implanted as a regular procedure.

We thus have defined two homogeneous cohorts of hips belonging to the MBH cohort in 143 ADM cases (136 patients) versus 130 PSL cases (125 patients) within the FBH. In all cases the stem was the same, and the acetabular shell was an HA-coated press-fit cup, coupled with a 28 mm head. Demographic details about gender, BMI, etiology, sizes of implants (stem, cup and neck offset), as well as preoperative pain, function and total HHS scores were systematically compared by statistical methods in order to address potential sources of bias. With the exception of age at surgery (Average at 70.63 in MBH vs. 65.50 years in FBH; $P = 0.003$) there were no significant differences at $P > 0.05$ (Table 1). Hence potential confounding variables, i.e. demographic details as well as preoperative clinical scores, demonstrated no significant bias between cases and controls. In such a way, our two cohorts, i.e. the ADM cases group versus the PSL control group, could be considered as homogeneous, and allowed for consistent comparison. On the other hand, no bias was anticipated with regards to surgical procedures: all patients were operated on as primary arthroplasty by a single surgeon (JAE) using the same approach (posterior lateral in all cases), the same preparation of acetabular and femoral implantations (line to line preparation). With regards to capsular management, a capsular repair by purse-string suture was systematically performed in all fixed bearings cups, while the capsule was simply replaced at posterior aspect of the pelvitrochanteric muscles in mobile bearings cups. Specific attention has been paid at the time of implant insertion with regards to cup anteversion, especially in all cases of MBH patients, to leave a consistent uncovered wall of bone and soft tissue at anterior aspect of the pelvic cavity, to prevent from any potential ilio-psoas conflict with the metallic implant. Such principles have been easier to follow with the used ADM cup which features an anatomical design of the rim, with a "valley" at the anterior–inferior part of the rim leaving space for the tendon location [13,14]. All patients took benefit of strictly the same postoperative and rehabilitation protocol (immediate full weight bearing). The type of bearing did not interfere in the surgical