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Are Modern Dual Mobility Cups a Valuable Option in Reducing Instability After Primary Hip Arthroplasty, Even in Younger Patients?

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ABSTRACT

Hip instability after total hip replacement has been shown to be a critical cause of failure. The use of dual mobility has been classically restricted to patients "at risk", over 70 years of age. The question rises up about extended indications of so-called "modern" second generation dual mobility cups. This prospective multicenter study reports on first results at 2–5 years of the HA anatomical ADM cup upon two comparative groups of patients under 70 years (112 hips) vs. over 70 years of age (325 hips). No dislocation, migration, tilting, wear, or intra-prosthetic dislocation was recorded within each of the two cohorts. Survivorship for cup failures at this 4-year period was ideal at 100% in the younger patients, and 99.7% in the older group of patients.

Hip instability and recurrent dislocations after total hip replacement have been shown to be a critical cause of failure, according to several authors and registries. Bozic et al. stated that the most common causes of revision were instability/dislocation (22.5%), far ahead of mechanical loosening (19.7%), and infection (14.8%) in a US study of the Medicare population [1]. The Australian Registry 2011 [2] reports dislocations as the second leading cause of revision with one fourth of failures. The 2009 Swedish report states that 20.5% of revisions are for dislocations in primary total hip replacement within the 3 first years post index surgery [3]. The NJR 2012 report [4] showed that dislocations and subluxations are recorded as again the second cause of failures.

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 replacement. This configuration consists of a large, fixed, acetabular component and a bipolar femoral component and provides a stable, well-fixed implant platform against bone and 2 articular interfaces, a large polyethylene surface directly facing a highly polished metal implant, and a standard-sized femoral head captured within polyethylene. According to numerous reports [5–11] the dual-mobility cup appears 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 [8,12], or insufficient means of fixation [8–10]. More recently, the long-term outcomes for second generation dual-mobility cup have been more promising [5], mostly addressing new polyethylene manufacturing techniques with second generation of cross-linked polyethylenes, anatomical designs preventing from ilio-psoas tendon impingement, and improvements in metal cup fixation [13,14].

So far, and upon recommendations provided by the French Health Authorities, indications for dual mobility cups have been classically restricted to patients with relatively short lifespan, or "at risk", i.e. in case of revision surgeries and primaries in the elderly over 70 years of age, or in case of muscular or neurological deficiencies. As a matter of fact, both wear and potential instability can be considered for all patients as two major issues in hip replacement and would be addressed as a whole with this modern generation of dual mobility cups matched with new crossed-linked polyethylene mobile inserts. Hence a potential extended use of dual mobility systems in primaries and younger patients, with no longer any restriction, would be seen as a significant step forward. This point only addresses an anticipated theoretical benefit, and has not been formally proven in the Literature. Hence the aim of this prospective multicenter continuous study consisted in assessment of first results at 2–5 years upon an extended use of a modern anatomical HA-coated dual mobility cup in primary

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hip replacement, with particular focus in younger patients. This would serve as a basis for our study hypothesis upon which prevention of hip instability could be securely obtained for all patients without any restriction regarding age or anatomical conditions by using this new generation of dual mobility acetabular components, upon appropriate selection of patients.

Material and Methods

The Restoration ADM Acetabular System

The Restoration ADM acetabular system (Stryker Orthopaedics, Mahwah, NJ, USA) is a two-piece component design that is assembled intra-operatively (Fig. 1). The ADM shell consist of a HA- fully coated pressfit metal acetabular cup articulating with a non-constrained Duration (Stryker Orthopaedics, Mahwah, NJ, USA) stabilized annealed mobile PE liner, in which a constrained standard CrCo 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. Fixation to bone is ensured by a HA vacuum plasma-spray technology coating upon a pure titanium macrostructured CP Titanium Arc deposition (Secur-Fit, Stryker Orthopaedics, Mahwah, NJ, USA).

The choice for the 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 (no limitation due to age, aetiology, or specific shape of the pelvis was recorded). With regard to bearing surface choice, in young patients Alumina was the main choice, and CoCr heads were used only when the head offset was not available in Alumina (−4 mm). Conversely in older patients, CoCr heads were selected in 55% of cases in relation with a lower price for this component, without any specific selection of patients, and depending on the personal choice of each surgeon.

Clinical Series

This study reports on five French Institutions, which have implanted the same HA-coated ADM cup, at 2- to 5-year follow-up, as a prospective multicenter consecutive study grouping the outcome of 437 primary hips in 417 patients. In all cases the patient's consent to be enrolled in the study was obtained. All enrolled hips were primary surgeries operated on between January 2007 and October 2010 upon two 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 such a choice of implant, we have defined two groups under versus over this threshold. Hence a first group collected data of patients under 70 years (younger patient group or YPG = 112 hips in 106 patients, average age at 61.3 y; 42–69) and was systematically compared to the "Regular Dual Mobility Group" (regular patient group or RPG = 325 hips in 311 patients, average age at 78.6 y; 70–95), grouping patients over or equal to 70 years. In 99% of cases in the two groups the approach was posterior-lateral. The mean flexion was significantly greater ($P < .001$ at t test) in the younger group (average 116 degrees, 90–140, SD 11.89) versus older patients (average 108 degrees, 60–130, SD 13.98). Moreover, the series was consecutive without inclusion or exclusion due to any specific identified high risk factors for dislocation in any of the two groups. Demographic data from each group are listed in Table 1.

Fig. 1. The ADM acetabular HA coated anatomical dual mobility cup: Note the anatomic shape of the shell, preventing for any potential conflict with ilio psoas tendon.

Bearing surfaces were CoCr/Polyethylene (PE) and alumina/PE respectively in 21.7% and 78.3% in the YPG versus 54.9% and 45.1% in the RPG. In all cases the mobile insert was a stabilized annealed cross-linked UHMPE (Duration™, Stryker Orthopaedics, Mahwah, NJ, USA). All femoral components were HA-coated except for 1.8% and 17.3% of stems in the YPG and RPD, respectively which were cemented. No post-operative restrictions were placed on patients, and patients were allowed to recover full weight bearing and regular motion immediately after surgery.

According to the archiving status at the time of the review (Table 1), of the 437 available hips in the two groups, 107 hips (95.5%) from the YPG group and 301 hips (92.7%) remained in situ and functioning well. No patient was lost to follow-up within the first group while 3 hips belonging to 3 patients (0.92%) of the RPG group were lost to follow-up despite all efforts to reach them. Twenty hips belonged to dead patients due to non-related causes. An isolated stem retrieval had been recorded in 5 hips (3 for accidental fracture and 2 for ALVAL adverse reactions). Only one cup failure was recorded within the RPG cohort, due to an inappropriate selection of patient.

Methods

The clinical course of each patient was evaluated preoperatively, early postoperatively (five to ten weeks), at six months, one year, and yearly thereafter. At the various post-implantation follow-up periods,

Table 1
Demographics According to Group Distribution.

Demographics		YPG	RPG
N Hips		112	325
N Patients		106	311
Gender N Pat (%)	Males	54 (48,6)	100 (30,9)
	Females	58 (51,4)	225 (69,1)
Mean Age (y)		61,3	78,6
		(42–69)	(70–95)
Aetiology	OA	91 (81.2)	263 (80,9)
N Hips (%)	Necrosis	11 (9,8)	15 (4,6)
	Rheumatoid	0	3 (0.9)
	Post Tr arthritis	6 (5.4)	12 (3.7)
	Revision/Bipolar	0	3 (0.9)
	CDH	1 (0.9)	0
	Acute fracture	1 (0.9)	19 (5.9)
	Other	2 (1.8)	10 (3.1)
Approach	N Posterior	111 (99.1)	324 (99.7)
N Hips (%)	N Anterior	1 (0.9)	1 (0.3)
Bone quality	A: Dense	34 (30.4)	34 (10.5)
N Hips(%)	B: Regular	77 (68.8)	246 (75.7)
	C: Poor	1 (0.9)	45 (13.8)
Type of stem	HA-coated	110 (98.2)	269 (82.8)
N Hips (%)	Cemented	2 (1.8)	56 (17.3)
Bearing Surfaces	CoCr	24 (21.7)	178 (54.9)
N Hips(%)	Alumina	88 (78.3)	147 (45.1)
Archiving Status	On File	107 (95.5)	301 (92.7)
N Hips (%)	Lost to Fup	0	3 (0.9)
	Dead	3 (2.7)	17 (5.2)
	Stem retrieval	1 (0.9)	2 (0.6)
	Cup failure	0	1 (0.3)
	Stem failure	1 (0.9)	1 (0.3)