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Dual mobility: A choice for primary THA?

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ABSTRACT

Dual-mobility sockets were introduced in the United States in 2010. The smaller inside diameter head offered the potential advantage of lower wear and the larger outside diameter head offered the potential advantage of improved stability. Initially, indications were advocated for patients with increased instability risk. However, with larger diameter metal-on-metal articulations falling out of favor, the indications for dual-mobility components are expanding. The author has used this design in over 400 primary THAs with only one dislocation. One loose cup was revised. Dislocation of the smaller femoral head from the larger polyethylene head remains a theoretical risk with DM designs.

In the modern era, dislocation rates range from 0.2% to 7% after primary total hip arthroplasty (THA) [1]. In the United States, instability is the leading cause of revision THA in medicare patients [2]. Thus, minimizing the complications of impingement and dislocation are major goals for implant surgeons and implant designers. Biomechanically, larger diameter femoral heads are advantageous because of the increased range of motion to impingement and jump distance needed prior to hip dislocation [3]. These principles were demonstrated in our experience with large diameter metal-on-metal THA. Of 681 primary THAs followed for between 2 and 8 years, the rate if dislocation was only 0.15% (two hips) [4] (Table 1).

A dual-mobility (DM) socket, where there is an additional bearing with a mobile polyethylene component between the prosthetic head and the acetabular shell, was introduced in the United States in 2009. However, this design has been used in Europe for over 4 decades. Developed by Bousquet in 1974, the DM design has been shown to be a durable solution to hip instability after THA [5]. The smaller inside diameter head offers the potential advantage of lower wear and the larger outside diameter head offers the potential advantage of improved stability (Fig. 1A and B). Thus, it combines the longstanding Charnley principle of low wear rate with smaller heads combined with the larger outer diameter head to improve stability [6].

Although multiple designs are available in Europe, no less that four designs are now FDA approved in the United States. While the metallurgy, polyethylene manufacturing techniques differ, and sizing options differ, they all combine a 22 mm or 28 mm head inside a larger polyethylene head that articulates with a smooth polished shell. The Active Articulation (AA) (Zimmer-Biomet, Warsaw, IN) and the Anatomic Dual Mobility (ADM) (Stryker, Mahwah, NJ) use a non-modular, one-piece acetabular press-fit shell without the ability for supplemental screw fixation. The AA is a full hemisphere with rim fixation fins whereas the ADM offers rims cutouts for the psoas tendon. In addition, the AA may also be used with the G7 cup (Zimmer-Biomet, Warsaw, IN). Along with the press-fit Modular Dual Mobility (MDM) (Stryker, Mahwah, NJ), these latter two modular shells allow for screw fixation with the insertion of a modular CoCr alloy liner. Controversy exists, however, over the use of DM cups. Indications may include revisions for instability, all revision THAs, patients at higher risk of dislocation, THA after femoral neck fracture, patients with ligamentous or soft tissue laxity, an alternative to hip resurfacing and large diameter metal-on-metal THA, and even all primary THAs [6].

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Table 1 – Dual Mobility Cups in Primary THA

Study	THAs	Avg. Follow-Up (Years)	% Dislocation	% Survival
Aubriot et al. [8]	100	5	1	97
Farizon et al. [9]	135	10	0.7	96
Guyen et al. [10]	167	3.4	0	96
Bauchu et al. [11]	150	6.2	0	97
Philippot et al. [12]	384	17	0	97
Bouchet et al. [13]	105	4.3	0	100
Tarasevicius et al. [14]	42	1	0	100
Vielpeau et al. [15]	231	5.2	0	99
Boyer et al. [16]	240	22	0	83
Epinette et al. [5]	437	3	0	99
Vigdorchik et al. [17]	485	2-4	0	99

In theory, the DM construct appears advantageous with respect to stability. But the DM design has emerged favorably in the lab as well. Nevelos et al. compared a 48 mm DM cup to a 48 mm resurfacing, and a 36 mm and 28 mm fixed-bearing design. The DM articulation showed the greatest posterior dislocation distance throughout all combinations of pelvic tilt angles (5° standing and 26° sitting), cup anteversion (0°, 10°, and 20°), and cup inclination (30°, 45°, and 60°) [7]. A number of published reports have demonstrated relatively low dislocation rates after primary THA [5,8–17]. Boyer et al. [16] published one of the longest follow-up studies. No dislocations were noted in 240 primary THAs at an average follow-up of 22 years. Survivorship (revision of stem or cup) was 83%. Other authors have also reported a 0% dislocation rate with DM cups at an average follow-up between one and seventeen years [5,10–15,17]. Similarly, survivorship ranged between 96% [9,10] and 100% [13,14]. A recent meta-analysis of 1314 primary THAs from eight studies found only two dislocations (0.15%) [18]. The mean age of the 1292 patients was 65 years (range: 21–97 years) with a mean follow-up of 8 years (range: 1–20 years). The mean cup survivorship was 97.5% (range: 95.4–100%).

Enthusiasm over the DM concept may be tempered by a concern over polyethylene wear. Volumetric wear is proportional to the radius (head size) [19]. Head sizes with DM components my range from 38 mm to 60 mm. There are two interfaces of articulation with the polyethylene and bearings with two articulations raises the issue of increasing polyethylene wear. Even with advent of improved polyethylene (X3, Stryker and E-1, Zimmer-Biomet) the wear properties of DM designs remain of continued interest. However, laboratory investigations seem to place DM articulations in a favorable light with respect to wear. Loving et al. [20] compared volumetric polyethylene wear rates (X-3, Stryker) between 22.2/36/48 mm DM bearings, 28/42/54 mm DM bearings, and 28/54 mm fixed head bearings at 2.5 million cycles

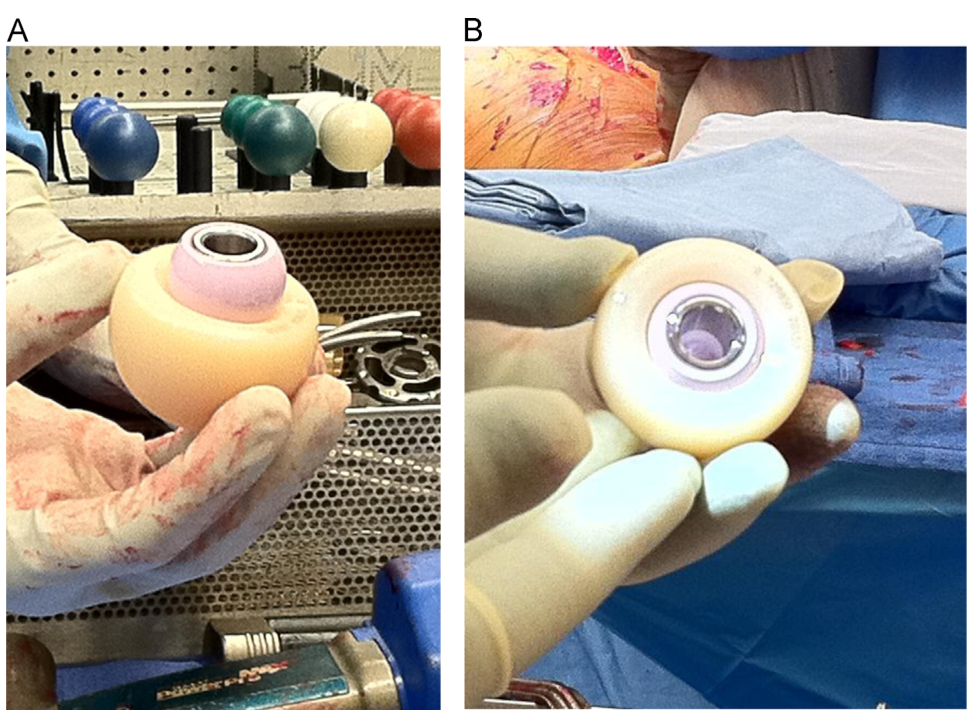

Figure 1 – Dual-mobility articulation demonstrating a mobile polyethylene component for articulation with the acetabular shell and a smaller 28 mm femoral head before (A) and after (B) placement within larger head.