Dual Poly Liner Mobility Optimizes Wear and Stability in THA: Opposes

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Abstract

Total hip arthroplasty (THA) is an effective intervention for the treatment of arthrosis with excellent survivorship. Nonetheless, dislocation and osteolysis remain significant complications. A dual-mobility acetabular component has been advocated to improve stability and wear. Stability is imparted by increasing the effective femoral head size, which allows a larger range of motion (ROM) before neck–socket impingement occurs. Increasing ROM, however, introduces an additional problem of bony impingement of the trochanter against the pelvis. Consequently, there is little improvement in ROM for heads >36 to 40 mm. A 0.4% incidence of instability at the larger articulation has been reported in primary THA using the dual-mobility liner, which is equivalent to reports for conventional THA. The dual-mobility liner has introduced the unique complication of intraprosthetic dislocation, where the femoral head dissociates at the smaller articulation as a result of polyethylene wear. An incidence of intraprosthetic dislocation of 3.6% has been reported, which far exceeds dislocation of conventional arthroplasty. The dual-mobility liner is a monoblock acetabular component without the capacity for augmented bony fixation. Inability to achieve primary stability has been reported as high as 18% and therefore its usefulness in revision THA is questionable. Proponents of the dual-mobility liner cite improved wear characteristics over conventional THA; however, few studies support this proposition. Retrieval studies have reported that the dual-mobility liner does not avoid wear or osteolysis. Theoretically, it is inconceivable that wear would be diminished with an additional articulation with a huge surface area, where the differential hardness has been reversed to a soft-on-hard bearing.

Figure 1: Dual-mobility concept: 2 articulations sharing the same motion center. Figure 2: Fixed porous-coated monoblock cup articulates with a large polyethylene ball into which a small metal head inserts.
Total hip arthroplasty (THA) is an effective intervention for the treatment of arthrosis with excellent survivorship. Nonetheless, instability and osteolysis remain challenging problems for both primary and revision THA. A dual-mobility acetabular component was advocated by Bousquet and Grammont in 1972 to address prosthetic instability. The indication for its implantation has been reserved for patients at risk of dislocation with low activity levels. Several concerns remain, however, about its use in clinical practice, such as long-term durability, the additional bearing surface and its inherent wear problems, intraprosthetic dislocation, lack of modularity, and therefore limited role in revision THA.

**CONCEPT**

Dislocation in primary THA has been widely reported with an incidence of 2% to 3%. Surgery for instability accounts for 14.4% of all revisions in the Australian Orthopaedic Association Joint Registry. Instability is multifactorial and includes: (1) surgical factors such as orientation of the components, soft tissue tension, and surgical approach; (2) patient factors such as age, sex, connective tissue and neurological disorders; and (3) implant factors such as component geometry and, more specifically, head diameter and head–neck ratio.

Increasing femoral head diameter has distinct advantages in preventing dislocation. The increased head–neck ratio increases the primary arc of motion prior to component-to-component impingement. Additionally, larger heads require a greater jump distance (vertical excursion) to dislocate. Femoral head size has historically been limited by the material properties of conventional polyethylene and concerns regarding linear wear, with a minimum thickness of 8 mm advocated. Numerous surgical interventions with mixed clinical results have been reported to prevent dislocation, such as modular components, elevated and reoriented acetabular liners, alternative bearing surfaces, and constrained acetabular components.

The dual-mobility liner was developed to improve stability by increasing the effective head size and the head–neck ratio of the construct. The dual-mobility liner is essentially a tripolar cup: a fixed porous-coated monoblock cup articulates with a large polyethylene ball, into which a bipolar 22- or 28-mm head is inserted (Figures 1, 2).

**STABILITY**

An increase in the head–neck ratio allows a larger range of motion (ROM) before neck–socket impingement occurs. Increasing ROM, however, introduces an additional problem of bony impingement of the trochanter against the pelvis. Consequently, there is little improvement in ROM for heads >36 or 40 mm.

The dual-mobility liner moves primarily at the smaller articulation (80%); when the smaller femoral head impinges, the large femoral head rotates. The dual-mobility liner has been suggested to tolerate imperfect component alignment before instability occurs. Surgical excellence should be maintained at all times with respect to component alignment, despite the latitude afforded the dual-mobility liner.

A 0.4% incidence of instability at the larger articulation has been reported in primary THA using the dual-mobility liner. These figures should be tempered due to the limited indication for which they were implanted: patients older than 70 years with low activity profiles. Similar dislocation rates have been reported for conventional THA for all indications.

The advent of dual-mobility technology has introduced the unique complication of intraprosthetic dislocation. Wear at the liner–head interface decreases the retaining power of the polyethylene liner and results in dissociation at the smaller articulation. Philippot et al reported an incidence of 3.6% (14 of 384) of intraprosthetic dislocation, which is greater than the dislocation of conventional primary THA. The cumulative risk of dislocation at both articulations must be considered when assessing this prosthesis for its effectiveness in achieving greater stability than conventional THA.

The dual-mobility liner in the revision setting, for the specific indication of recurrent instability, has dislocation rates as low as 3.7% at 2 years. The instability risk for revision THA is an accepted complica-
tion, and achieving stable fixation of the construct should be the primary treatment goal. Farizon et al\textsuperscript{12} reported an inability to achieve a press fit sufficient for primary stability in 18\% of his revisions. The dual-mobility liner is a monoblock component without the capacity for peripheral or polar screw augmentation, and its usefulness in revision THA is limited.

\textbf{WEAR}

Proponents of the dual-mobility liner cite improved wear characteristics over conventional THA, as the majority of the motion occurs at the smaller articulation. This concept follows Charnley’s\textsuperscript{13} low-friction THA principle. Few studies of the in vivo wear properties of the dual-mobility liner support this proposition.\textsuperscript{14,15} Retrieval studies have reported that the dual-mobility liner does not avoid wear, osteolysis, or aseptic loosening.\textsuperscript{14} The unique complication of intraprosthesis dislocation has been attributed to wear at the liner–head interface.\textsuperscript{4} It is inconceivable that polyethylene wear would be diminished as a result of an additional articulation with a huge surface area. Volumetric and linear wear has been well documented to be minimized with a 28-mm head, increasing with increasing head sizes.\textsuperscript{16} The addition of a second articulating surface in mobile-bearing total knee arthroplasty potentiates osteolysis by generation of more third-body and volumetric wear with smaller, more granular, and biologically active particles.\textsuperscript{17} Furthermore, THA requires a differential hardness bearing with a hard femoral head articulating against a softer liner surface. When the differential hardness has been reversed, increased wear has been documented.\textsuperscript{18} The dual-mobility liner, therefore, by design is inherently associated with increased wear properties.

\textbf{CONCLUSION}

The dual-mobility liner was developed to address instability and wear in THA. The dual-mobility liner has been reserved for a narrow indication of high risk of instability in low-activity patients. The lack of modularity and augmented fixation precludes its use in revision THA because of the risk of not achieving primary stability of the component. The femoral/acetabular dislocation incidence is equivalent to conventional THA; however, intraprosthesis dislocation is a significant complication unique to the dual-mobility liner. The cumulative risk of dislocation at both articulations renders the dual-mobility liner inferior to conventional THA. Furthermore, both theoretically and practically, the wear properties of the dual-mobility liner cannot be less than conventional THA.

\textbf{REFERENCES}