Introduction:

Total hip arthroplasty (THA) is one of the most clinically successful and cost-effective health care interventions. Numerous investigators have reported excellent clinical results in terms of improved function, reduced pain, and high rates of implant survivorship at up to 20-years follow-up. However, concerns about limitations in implant longevity related to the biological consequences of metal on polyethylene (M-PE) bearing surface wear have led to innovation in tribology and the introduction of new THA bearing couples over the past decade. In particular, second generation hard-on-hard bearings, including metal-metal (M-M) and ceramic-ceramic (C-C), have been introduced into the United States market based on laboratory studies showing lower wear rates when compared with metal-on-conventional polyethylene bearings. Despite the theoretical benefits of lower wear rates with both M-M and C-C bearings and improved stability with larger diameter M-M bearings, evidence that hard-on-hard bearings reduce complication and reoperation rates is currently lacking. Furthermore, the cost-effectiveness of hard-on-hard bearings, especially in the Medicare population where bearing surface wear is less of a concern, remains unproven. The purpose of this study was to compare the risk of complication and reoperation among Medicare patients with different THA bearings.

Methods:

The 2005-2007 100% Medicare inpatient claim files were used to perform a matched cohort analysis in 3 separate cohorts of THA patients (metal-polyethylene (M-PE), metal-metal (M-M), and ceramic-ceramic (C-C)). Patients in each THA cohort were matched by age, gender, and U.S. Census region to the comparison or “control” cohort, using a three to one matching ratio. An overall cohort of 36,423 THA patients with M-PE bearings were identified, along with 17,789 THA patients with M-M bearings, and 2,835 THA patients with C-C bearings, from which the matched cohorts were derived. Multivariate Cox proportional hazards models were constructed to compare complication and revision THA risk among cohorts, adjusting for medical comorbidities, race, socio-economic status, and hospital factors. The Medicare buy-in status was used as an identifier of patients whose Medicare premiums and deductibles were subsidized by the state (e.g., Medicaid), and was used as a proxy for the patient’s socio-economic status.

Primary THA patients were identified using ICD-9-CM procedure code 81.51 from the inpatient claims records and grouped into three bearing cohorts based on their corresponding ICD-9-CM optional code 81.51 from the inpatient claims records and grouped into three bearing cohorts based on their corresponding ICD-9-CM optional code 81.51. Using each patient’s unique de-identified beneficiary ID, the patients were tracked longitudinally with revision surgery or selected complications as end-points. The selected complications included deep venous thrombosis (DVT), dislocation, infection, and mechanical loosening.

Results:

The mean age of all THA recipients included in the study was 74.5 (SD = 6.4). Among younger Medicare patients (age 65-69), M-M bearings accounted for 35% of THA bearings and C-C bearings accounted for 8%. Among older Medicare patients (over age 80), 69% of patients had M-P bearings. Among female patients, 67% had M-P bearings, while 29% had M-M bearings, compared to male patients, among whom 60% had M-P and 35% had M-M bearings. The highest frequency of M-P bearing surface wear was in the Northeast (72%), and the highest frequency of M-M bearing usage was in the South (35%), while C-C bearing usage was fairly consistent across the four U.S. census regions (4-5%).

After controlling for patient and hospital factors, M-M bearings were associated with a significantly higher risk of peri-prosthetic joint infection (Hazard Ratio 3.03, Cl=1.02 - 9.09) when compared with C-C bearings. There were no other significant differences among cohorts in the adjusted risk of revision THA or any other complications, including DVT, dislocation, or mechanical loosening. When comparing the unadjusted complication rates using the Kaplan-Meier method, M-M bearings showed an apparent trend towards higher overall rates of deep venous thrombosis (DVT) and revision THA than C-C bearings. These apparent trends were not present after adjusting for other covariates in this matched cohort.

Discussion:

Total hip arthroplasty has become one of the most commonly performed operations in Medicare patients, with over 280,000 primary and revision THA procedures reported in 2007. Successful THA allows elderly patients who suffer from disabling hip disease to regain their function and maintain a more active, healthy lifestyle. However, increased utilization and rising costs have led to concerns regarding the appropriateness of using newer, more expensive implant technologies in Medicare patients. Hard-on-hard bearings have been shown to be associated with lower wear rates in the laboratory setting. However, wear-related failures, such as bearing surface wear, osteolysis, and mechanical loosening, may be less of a concern among Medicare patients who undergo primary THA, and therefore the higher cost associated with hard-on-hard bearings may not be justifiable in terms of improved patient outcomes and lower re-operation rates in Medicare patients.

In our study, we found that complication and re-operation rates were similar among Medicare patients during the first two years following primary THA, regardless of the type of bearing, with the exception of patients who had M-M bearings, who had a slightly higher risk of peri-prosthetic joint infection than patients who had C-C bearings. The reasons underlying the increased risk of infection for M-M bearings compared with C-C bearings, even after adjusting for medical co-morbidities and hospital factors, remain unclear. It is possible that some of these patients may have been misdiagnosed as having a peri-prosthetic joint infection in fact they had a different inflammatory reaction related to the metal-metal articulation. The findings in some patients with such reactions mimic peri-prosthetic joint infection, as reported previously by Mikhail, et al. Although the higher risk of infection in the M-M cohort compared with the C-C cohort was statistically significant (Hazard Ratio 3.03, Cl=1.02 - 9.09), the clinical significance of this difference is unclear, especially given the relatively low incidence of infection (0.59% vs. 0.32%, respectively).

The relatively high incidence of M-M bearings reported in the Medicare population is somewhat surprising, given that M-M bearings are thought to be primarily indicated for younger, more active patients who are at higher risk for bearing surface wear and osteolysis with M-P bearings. However, one theoretical advantage of M-M bearings in older patients is improved stability (e.g., lower risk of dislocation) due to the ability to use larger diameter femoral heads. Our data do not demonstrate an advantage of M-M bearings in terms of rates of dislocation when compared with either M-P or C-C bearings. This could be related to the increasing trend of using 32 and 36mm heads in M-P bearings, which may be sufficient to substantially reduce the risk for dislocation.

Our findings are limited by the use of an administrative database, where bearing surface type is an optional modifier code that can be reported in conjunction with the primary procedure code (primary or revision total hip arthroplasty), which introduces a potential source of bias into our study. Furthermore, we were only able to evaluate complications which are captured in administrative claims data, such as DVT, dislocation, infection, mechanical loosening, and revision surgery, rather than pain and patient reported functional outcomes. Finally, since the optional bearing surface modifier codes were only introduced in October, 2005, our study was limited to outcomes and complications that occurred within two years of the index procedure. Further study is necessary to evaluate differences in long-term clinical outcomes and revision rates as additional data becomes available.

In summary, we found that Medicare THA patients with hard-on-hard (M-M and C-C) bearings had a similar risk of complications and revision THA compared to patients who had M-P bearings during the first two years following primary THA. These findings provide a basis for additional analyses of the comparative effectiveness of THA bearing surfaces in the Medicare population.