Mobile Bearing Knees: Superior to Fixed Bearing?
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Depuy’s recent direct-to-consumer ad campaign has focused a great deal of attention on mobile bearing knees, with patients asking for the knee “that bends and moves.” For surgeons, the critical question is, “Are mobile-bearing knee systems a comparable, or superior, alternative to fixed bearing knee systems?” This paper will examine various issues surrounding mobile bearing knee technology as reported in peer-reviewed literature.

Is Mobile Bearing a New Technology?
Mobile-bearing knee replacements were designed in the late 1970s to minimize the wear and loosening seen in implants at the time. The New Jersey Low Contact Stress (LCS) Knee, designed by Beuchel and Pappas, has been available for sale in the U.S. for over twenty years, which has allowed for long-term clinical follow-up. After Johnson and Johnson acquired Depuy in 1998, the company was able to gain FDA approval to sell a mobile bearing version of the J&J PFC Sigma Knee in the U.S.

What are the purported benefits of Mobile Bearing Knees?
Mobile-bearing knee designers claim several benefits over fixed bearing knee replacement systems. These include 1) decreased polyethylene wear 2) the ability to self-align for better patellar tracking and 3) better flexion and kinematics. Each of these will be examined in detail.

Poly Wear
Two main issues arise concerning wear: the amount of particles generated and their size.

Some proponents suggest that highly conforming mobile-bearing knees would offer the solution of rotational forgiveness leading to less contact stress, which would result in less wear. Yet studies have shown that mobile-bearing knees wear more than fixed bearing. In a clinical review of 495 LCS mobile-bearing cases completed between 1985 and 1990, of the fifty-six knees (11%) that required revision surgery, forty-one had excessive wear on the tibial insert. A further comparison by the authors of fixed and mobile bearing knees requiring revision showed that the prevalence of osteolysis was higher in the mobile bearing group (47%) than the fixed bearing group (13%). Walker et al showed an increased wear generated on the lower bearing surface by rotate only and rotate/translate mobile bearing designs over fixed bearing designs. A retrieval of 47 LCS Rotating Platform knees showed backside abrasive wear of the polyethylene and scratching of the CoCr trays, due to third body wear.

Concerning particle size, a study comparing fixed versus mobile bearing found that, while mobile bearing knees generated fewer particles than a fixed bearing design, the particles produced were of the sub-micron size. Submicron particles have been found in the periprosthetic tissues of failed hips. A later study examined particle size and morphology of PE debris between mobile and fixed bearing knees and found mobile bearing knees produced smaller and more granular particulate debris. The authors concluded that due to the conforming articulation and undersurface wear, the LCS knee system might be more predisposed to osteolysis.

Self-Alignment
A major claimed benefit of mobile-bearing knees are that they can “self-align” to accommodate slight mismatches in alignment between the femoral and tibial components, therefore improving patello-femoral tracking and decreasing lateral releases and the prevalence of patellar tilt and subluxation. A randomized, prospective study between mobile bearing and fixed bearing total knees did not show a difference in lateral retinacular release rates between the two, and the mobile bearing knees did not decrease patellar subluxation or tilt. A subsequent study of 445 TKRs, with 312 fixed bearing and 112 mobile-bearing implanted, found a comparable
lateral release rate of 15% for the former and 11% for the latter. The authors concluded that the reported self-aligning ability of mobile-bearing knees may not reduce the need for lateral release in the cohort of patients in whom lateral tilt and subluxation of the patella persist even after other factors affecting patella tracking have been surgically addressed.

**Kinematics and Flexion**

Some have theorized that mobile-bearing knees would restore normal knee translation and rotation better than fixed-bearing TKA designs. In one study, robotic testing was performed on eleven knees in three phases: first, on the native knee, second, after TKA and implantation of a Zimmer TKR fixed bearing system, and third, after removal of the primary components and modification of the bony cuts for implantation of the Zimmer NexGen's mobile bearing design. In no area did either Zimmer post-TKA knee perform as well as the native knee. However, no statistically significant differences existed between the fixed-and mobile-bearing knees' kinematics. Both TKA designs only partially restored posterior femoral translation and internal tibial rotation at 120° flexion.

Most studies have shown parity in flexion between fixed and mobile bearing knees. Newer fixed bearing designs which allow for high flexion up to 155° feature a lowered posterior lip to reduce cortical impingement. The conforming posterior design of traditional mobile-bearing designs might reduce offset and potentially limit flexion.

**What are the survival rates?**

Designing surgeons Beuchel and Pappas have reported 98% survivorship of the LCS at twenty years. Non-designing surgeons' survivorship rates range from 88% at an average follow-up of 12 years, 93% at 8 years, and 100% at 11 years. The survivorship of the LCS system is comparable to those reported for various fixed bearing systems, including GENESIS Knee with 96% at ten years, AGC with 98.8% at 15 years, and the Total Condylar Knee with 95% at 15 years, 98% at 20 years, and 91% at 23 years in various studies.

Since it has only been available for implantation since 2000, the PFC Sigma RP does not yet have mid-term follow-up. It is not clear whether the PFC Sigma RP will have equivalent survivorship as the LCS, as it has both a different femoral component and tibial insert design and a different surgical technique/philosophy.

**What about complications?**

Instability is a possibility in mobile-bearing knees, which can lead to bearing breakage, subluxation, and dislocation. A study that examined a series of 25 unstable mobile-bearing knees found two patterns: 1) a flexion/extension mismatch with laxity on one side in flexion leading to “split-out” of the insert or “spin-out” of the tray or 2) less severe mismatches or joint line elevation leading to pain and effusions. Reported subluxation/dislocation has been as high as 9%. Use of mobile-bearing knees in severe varus deformities has been cautioned against as it is extremely difficult to balance the flexion space, increasing the risk of subluxation.

**Is it better for younger patients?**

Some literature has suggested that mobile-bearing knees might be more appropriate for younger, more active patients. The literature thus far contradicts that claim. One such study reviewing 117 patients under age 65 with the LCS knee at an average follow-up of 102 months concluded, “these (mobile bearing) results do not seem to exceed the results reported with the use of fixed-bearing design knee prostheses in younger patients.” A more recent study directly compared the results of the AMK fixed-bearing and LCS mobile bearing prostheses in the same young patients who had sequential, bilateral simultaneous TKR. At a minimum 10-year follow-up, the results were comparable for both systems.
References

1 Huang, C; Ma, HM; Lee, YM; Ho, FY. Long Term Results of Low Contact Stress Mobile Bearing Total Knee Replacements. Clin Orthop. 1(416): 265-270. Nove Mobile Bearing 2003

2 Huang, HC; Ma, HM; Liau, JJ; Ho, FY, and Cheng, CK. Osteolysis in Failed Total Knee Arthroplasty: A Comparison of Mobile-bearing and Fixed-bearing Knees. JBJS 84:2224-2229 (2002).


4 Atwood, SA; Currier, J; Collier, JP; Mayor, MOBILE-BEARING; Ostendorp, PT. Clinical Wear on the Backside of LCS Rotating Platform Knees. Paper presented at AAOS 2005 Annual Meeting, Washington D.C.


8 Goodmanson, P; Grandois, P; Suthers, K; Spitzer, AL. Mobile bearing total knee Arthroplasty does not reduce the need for lateral release. Poster Presentation at AAOS 2005 Annual Meeting, Washington D.C.

9 Most, E; Li G; Schule, S; Sultan, P; Park, SE; Zayontz, S; Rubash, HE. The Kinematics of Fixed-and Mobile-Bearing Total Knee Arthroplasty. Clin Orthop. 1(416): 197-207. Nove Mobile Bearing 2003

10 Ranawat, A; Rossi, R; Loreti, J; Rasquinha, V; Rodriguez, J; Ranawat, C. Comparison of the PFC Sigma Fixed Bearing and Rotating-Platform Total Knee Arthroplasty in the Same Patient. Journal Of Arthroplasty. Vol. 19, No. 1 2004.


12 Huang, C; Ma, HM; Lee, YM; Ho, FY. Long Term Results of Low Contact Stress Mobile Bearing Total Knee Replacements. Clin Orthop. 1(416): 265-270. Nov. 2003


20 Ridgeway, S; Moskal, JT. Early Instability with Mobile-Bearing Total Knee Arthroplasty. J Arthroplasty Vol 19 No. 6, 686-693. 2004


22 Bhav, S; Malhotra, R. Results of Rotating Platform, Low-Contact-Stress Knee Prosthesis. J Arthroplasty Vol. 18 No. 8 2003
