Editorial "Mid-term results of the BIOLOX delta ceramic-on-ceramic total hip arthroplasty"

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Comment on: Lee YK, Ha YC, Yoo JI, *et al.* Mid-term results of the BIOLOX delta ceramic-on-ceramic total hip arthroplasty. Bone Joint J 2017;99-B:741-8.

Received: 16 August 2017; Accepted: 09 November 2017; Published: 22 November 2017.

doi: 10.21037/aoj.2017.11.01

View this article at: http://dx.doi.org/10.21037/aoj.2017.11.01

Historically, ceramic-on-ceramic (COC) articulations in total hip arthroplasty (THA) have been shown to have the lowest rate of wear and osteolysis (1). However, the use of COC bearings has been lessened by their risk of fracture, squeaking and revision surgery (2-4). As a result, in 2003, Ceramtec (Plochingen, Germany), the largest manufacturer of ceramic bearings in the world, introduced their 4th generation of ceramic components—Biolox Delta. This 4th generation ceramic is a zirconia toughened alumina ceramic designed to decrease the risk of fracture by incorporating yttria-stabilized tetragonal zirconia particles that prevent the initiation and propagation of cracks and strontium oxide that dissipate energy by deflecting cracks, and thereby increasing the strength and toughness. Lee *et al.* reported their mean 66.5 months follow-up of 286 hips prospectively followed after a THA with a 4th generation COC bearing (5). Specifically, they determined the rate of ceramic fracture, post-operative noise, mid-term results and survivorship in this cohort.

This study confirmed that the fracture rate is low with 4th generation COC bearings. Lee *et al.* reported no fractures of a ceramic head, but there was one case of an atraumatic fracture of the ceramic liner (0.3%) 10 months post-operatively. The authors acknowledged that the liner was incompletely seated on the postoperative radiograph. Failure to seat the liner can be dependent on the surgical technique. Lee *et al.* indicated that the acetabular components were "press-fitted", but do not comment on the degree of press-fit. Press-fit acetabular components are susceptible to rim deformation and if the press-fit is very tight, it can deform the acetabular component significantly so that it is difficult to properly seat the very stiff ceramic liner (6). This can result in malpositioning of the liner and subsequent fracture. In a study with a longer follow-up of 6 years, Aoude *et al.* found no cases of ceramic fracture or chipping, and no revision surgery necessary for a complication related to the Biolox Delta COC bearing (7).

Since fracture has become an uncommon complication with 4th generation ceramic bearings, individual surgeon experiences do not provide a sufficient cohort of patients to truly understand the incidence of this complication. For this, large joint registries provide a better insight into the risk. Using data from the National Joint Registry (NJR) for England, Wales, Northern Ireland and the Isle of Man, Howard *et al.* indicated that incidence of fracture of a Biolox Delta head and liner was 0.009% (7/79,442) and 0.126% (101/80,170), respectively (8). Overall, they found that there is good evidence that the latest generation of ceramic has greatly reduced the odds of head fracture but not of liner fracture.

Although the etiology of squeaking in COC bearings is not well understood, it has been associated with poor lubrication, implant design, third body wear and implant positioning resulting in edge loading. The study by Lee *et al.* specifically addressed at the incidence and activity associated with noise generated by the COC bearing (5). Overall, 11.9% of the patients reported post-operative noise in their hip. Although there was no significant difference in the abduction of the acetabular components, hips with noise had a significantly greater anteversion of the cup than those hips that had no noise. This illustrates the sensitivity of COC bearings to implant orientation and the risk of neck-rim impingment. The 11.9% incidence is much higher than the incidence of squeaking of 4.2% reported by Owen *et al.*

in their meta-analysis of 43 studies including 16,828 COC THAs (3).

Lee *et al.* reported that no hips had detectable wear, focal osteolysis or signs of loosening. All of the acetabular components and femoral stems were reported as having radiological evidence of bone ingrowth at final follow-up. However, radiolucent lines were noted around the Corail stem in Gruen zones 1 and 7 in 2.8% of the cases, which has been associated with femoral loosening with this particular stem—this is illustrated in figure 3 of the article, where the implant appears to have subsided between the 1- and 6-year radiographs. Unlike the Lee study with a small cohort of patients, other larger series from national databases have questioned the longevity of COC hips compared to metal-on-polyethylene (MOP) THAs. COC bearings have previously been shown in the Australian Registry to have higher revision rates due to dislocation when compared with MOP THAs (9). As well, Jameson *et al.* reported that in 35,386 THAs in the NJR with the same stem and cup, the overall 5-year revision was significantly higher in patients with COC bearings [COC, hazard ratio (HR)=1.55, P=0.003] compared to MOP bearing (4). Until longer-term data is available, the increased mid-term rate of revision with COC THAs and the decreased concerns about wear and osteolysis with cross-linked polyethylene, suggests that it might be prudent to target the use of COC bearings in younger patients.

The study by Lee *et al.*, as well as the other studies specifically looking at the early and mid-term results of the 4th generation COC bearings, reassure the orthopaedic community that it is a reliable and safe bearing in patients undergoing THA. However, they also highlight the sensitivity of this bearing to implant positioning and surgical technique to avoid postoperative fracture and noise. Longer-term studies from the Registries remain crucial in determining the best patients for this technology and the ultimate risk of fracture.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned and reviewed by the Executive Editor-in-Chief, Dongquan Shi, MD, PhD (Department of Sports Medicine and Adult Reconstruction, Drum Tower Hospital, Medical School, Nanjing University, Nanjing, China).

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/aoj.2017.11.01). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Kang BJ, Ha YC, Ham DW, et al. Third-generation alumina-on-alumina total hip arthroplasty: 14 to 16-year follow-up study. J Arthroplasty 2015;30:411-5.
2. Stanat SJ, Capozzi JD. Squeaking in third- and fourth-generation ceramic-on-ceramic total hip arthroplasty: meta-analysis and systematic review. J Arthroplasty 2012;27:445-53.
3. Owen DH, Russell NC, Smith PN, et al. An estimation of the incidence of squeaking and revision surgery for squeaking in ceramic-on-ceramic total hip replacement: a meta-analysis and report from the Australian Orthopaedic Association National Joint Registry. Bone Joint J 2014;96-B:181-7.
4. Jameson SS, Baker PN, Mason J, et al. Independent predictors of failure up to 7.5 years after 35 386 single-brand cementless total hip replacements: a retrospective cohort study using National Joint Registry data. Bone Joint J 2013;95-B:747-57.
5. Lee YK, Ha YC, Yoo JI, et al. Mid-term results of the BIOLOX delta ceramic-on-ceramic total hip arthroplasty. Bone Joint J 2017;99-B:741-8.
6. Small SR, Meding JB, Oja JW, et al. Shell design and reaming technique affect deformation in mobile-bearing total hip arthroplasty acetabular components. Proc Inst Mech Eng H 2017;231:691-8.
7. Aoude AA, Antoniou J, Epure LM, et al. Midterm Outcomes of the Recently FDA Approved Ceramic on

Ceramic Bearing in Total Hip Arthroplasty Patients Under 65 Years of Age. J Arthroplasty 2015;30:1388-92.
8. Howard DP, Wall PDH, Fernandez MA, et al. Ceramic-on-ceramic bearing fractures in total hip arthroplasty: an analysis of data from the National Joint Registry. Bone Joint J 2017;99-B:1012-9.
9. Sexton SA, Walter WL, Jackson MP, et al. Ceramic-on-ceramic bearing surface and risk of revision due to dislocation after primary total hip replacement. J Bone Joint Surg Br 2009;91:1448-53.

doi: 10.21037/aoj.2017.11.01
Cite this article as: Tanzer M, Tanzer D. Editorial "Mid-term results of the BIOLOX delta ceramic-on-ceramic total hip arthroplasty". Ann Joint 2017;2:72.

