Numerous studies have shown highly cross-linked polyethylene (XLPE) to be an extremely low wear bearing surface for total hip arthroplasty (THA) at intermediate term follow-up.[1-3] Wear rates and the incidence of osteolysis for CoCr femoral heads on XLPE liners appears to be considerably less than what is observed for conventional polyethylene (PE). This has been demonstrated even in younger, more active patients.[4,5]

Nevertheless, polyethylene wear and associated osteolysis are still a concern, since the indications for THA have been expanded to include younger and more active patients. Both wear simulator and clinical data suggest that ceramic femoral heads can reduce bearing surface wear of conventional PE.[6,7] There is, however, extremely limited evidence supporting any advantage of ceramic femoral heads over CoCr femoral heads with regards to bearing surface wear of XLPE. This is perhaps due to the relative difficulty in measuring the low wear rates of XLPE bearings in general, regardless of material composition of the femoral head. Although ceramic femoral heads are more scratch resistant and less susceptible to third body wear, their current clinical use to reduce wear of XLPE bearings is, in reality, based on the unproven assumption that use of ceramic femoral heads will have a similar effect on wear reduction as is seen with ceramic on conventional PE bearing couples. Nevertheless, the use of ceramic femoral heads has become common in younger, more active patients. Historically, concerns about ceramic femoral head fracture have limited their use in THA. Newer, more fracture resistant ceramic materials, however, seem to have an extremely low incidence of fracture in comparison to earlier ceramic materials.

Recently, corrosion at the head neck junction of modular THA (trunnionosis), has been determined to be the possible source of metal debris and metal ions associated with adverse local tissue reactions (ALTR or ARMD) in THA, including ALVAL and pseudotumors.[8-10] There is general agreement that trunnionosis results from mechanically assisted crevice corrosion (fretting) of the modular junctions common to nearly all contemporary THA designs. Several design, material and patient factors have been implicated as contributors to this problem including larger diameter femoral heads (>36 mm), reduced femoral neck and taper geometry, flexural rigidity of the taper, and patient body weight and activity level. Data from our multicenter implant retrieval program has shown that corrosion at the head-neck junction of contemporary modular THAs may be reduced with use of ceramic femoral heads.[11] Using a matched cohort study design of 50 THAs with ceramic femoral heads with 50 THAs with CoCr heads which were matched for implantation time, offset, stem design, and flexural rigidity, corrosion was reduced in THAs with ceramic femoral heads. The use of ceramic femoral heads also eliminates the potential for release of cobalt and chromium ions from the taper junctions of titanium alloy stems. In younger patients, the long term effects of cobalt ions released from corrosion at the modular neck junction are still unknown.
While there appears to be some advantages to the use of ceramic femoral heads in THA, increased cost and the risks of femoral head fracture are still concerns. Alumina matrix composite ceramic femoral heads (AMC- Biolox Delta) currently in use, appear to have an extremely low risk of fracture that has been estimated to be 0.03-0.05%. Phase transformation and sensitivity to manufacturing technique, seen with earlier zirconia ceramic femoral heads, have not been seen with ceramic femoral heads currently in use.

Although the surgeon’s selection of a ceramic femoral head in combination with a XLPE acetabular liner is likely based on the desire to minimize PE wear, the impact of femoral head composition on taper neck corrosion and ALTR is perhaps more of a concern in 2015. Until the problem of taper neck corrosion is more thoroughly understood and effectively addressed by implant manufacturers, the use of ceramic femoral heads in THA should be considered in the younger or more active patient. The increased cost of ceramic femoral heads creates a dilemma in defining who is “young” enough and “active” enough to be considered an appropriate candidate for a ceramic femoral head in our current environment of bundled care payments, value based purchasing and concern about providing cost-effective health care to our patients.

References: