Case Report

Metal Transfer on a Ceramic Head With a Single Rim Contact

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Abstract: A notable feature of retrieved ceramic-on-ceramic hips is metal transfer on the femoral head, which is an important alteration of the bearing surface. This report documents metal transfer streaks on a ceramic femoral head resulting from discrete subluxations, which occurred intraoperatively during reduction and stability testing. An important implication is that metal transfer can occur whenever a femoral head is reduced into the liner during surgery or from in vivo subluxation/dislocation. If a ceramic liner is recessed below a raised metal rim, care should be taken to prevent head-to-rim contact during intraoperative reductions and stability testing. If metal transfer occurs during final surgical reduction of the hip, its presence may remain undetected, and detrimental effects are present from the time of surgery. **Keywords:** metal transfer, ceramic hip, ceramic-on-ceramic, hip surgery, hip dislocation.

A notable feature of retrieved ceramic-on-ceramic (COC) hips is the presence of metal transfer on the femoral head. This phenomenon has been documented in previous studies of retrieved devices [1-3]. It has been hypothesized that metal transfer onto the ceramic head is associated with joint instability and subluxation/dislocation [1]. Other investigations of COC performance have associated the presence of metal debris to repeated impingement of the femoral neck on the acetabular component rim [2,4-6]. The presence of transferred metal on a ceramic head represents an important change in the articulating surface and is likely to have consequences in lubrication, friction, and wear. It has been hypothesized that the presence of metal transfer plays a role in COC squeaking [2,4,7]. Given the potential impact of metal transfer on the performance of COC-bearing couples, a full understanding of the factors surrounding its occurrence is warranted. This case report documents metal transfer streaks on a ceramic femoral head resulting from discrete subluxations onto the rim of the cup, which occurred intraoperatively during reduction and stability testing.

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Materials and Methods

Case Details

A 51-year-old woman underwent left primary hip arthroplasty for osteoarthritis using a COC-bearing couple, using a posterior approach with enhanced capsular repair. The femoral implant was an Accolade TMZF cementless femoral stem (Stryker, Mahwah, NJ), with a 32-mm minus 4 alumina ceramic head (Biolox Forte, Ceramtec, Plochingen, Germany). The acetabular shell was a cementless Trident PSL solid shell, with a 32-mm inner diameter alumina liner (Stryker). This particular ceramic bearing is manufactured with an elevated titanium-aluminum rim. This design feature aims to protect against femoral implant-to-neck impingement on the edge of the ceramic liner, reducing the potential for ceramic liner fracture. The metal-backed liner then engages in a trunnion-type locking mechanism within the acetabular shell.

After implantation of all components, a reduction of the hip was performed with a traction–external rotation maneuver. This was followed by stability testing through a full range of motion. In the position of maximum hip extension and external rotation, the hip was unstable anteriorly, dislocating the prosthetic head anteriorly out

of the liner. This event was noted by the surgeon as it occurred, and the prosthetic head was then reduced back into the socket with a traction and internal rotation maneuver. It was during this second reduction maneuver that a palpable grating was felt. The anterior dislocation maneuver was repeated one more time, and palpation of the femoral head after anterior dislocation revealed that it was sitting anterior to the acetabular cup, over the top of the anterior acetabular wall. The hip was again reduced, and again the same grating was felt.

At this point, the hip was dislocated posteriorly with a traction–internal rotation maneuver. The acetabular component was examined and found to be excessively anteverted. The acetabular liner was removed, and the cup was repositioned with reduced anteversion to address concerns about stability. The ceramic femoral head was exchanged for a 32-mm cobalt chrome head because of potential trunnion damage from impaction of the ceramic head. A polyethylene liner was implanted into the repositioned acetabular shell. Upon repeating range of motion testing, the previously noted anterior subluxation had now been corrected, and the hip was fully stable. The ceramic head and liner were examined, and upon inspection, the head showed streaks of metal transfer. There was no evidence of metal transfer into the alumina liner. The alumina ceramic femoral head that had been dislocated during reduction was handed off the surgical field and sent to the retrieval laboratory for evaluation.

Results

Description of Metal Transfer

The ceramic head shows 3 distinct lines of metal transfer (Fig. 1). All 3 lines lie along a direction approximately 25° to the right (eg, clockwise) of a line through the polar apex of the head and coincident with the axis of the trunnion. The metal transfer lines vary in width from a tapered point at the end near the equator of the head, growing to approximately 1.1-mm wide at the upper end (nearest the pole). Two of the lines are longer (29 and 34 mm, respectively), and the third is much shorter and situated such that it straddles the equator of the head. The longer 2 lines cross near the pole of the head. There is evidence of the head "dwelling" on the cup rim and shifting in a side-to-side motion, manifest as short smears of metal transfer that emanate out from the linear form of the main line of metal transfer (Fig. 1).

Within each of the streaks of metal transfer, there is a readily apparent directional texture of striations in the transferred metal, aligned mostly along the metal streak (Fig. 2).

Discussion

Evidence Indicates Metal Transfer During Reduction

The striated, continuous texture within the metal transfer streaks indicate that, in each instance, the transfer occurred during one excursion of the head across the metal shell rim. The shape of the metal streaks

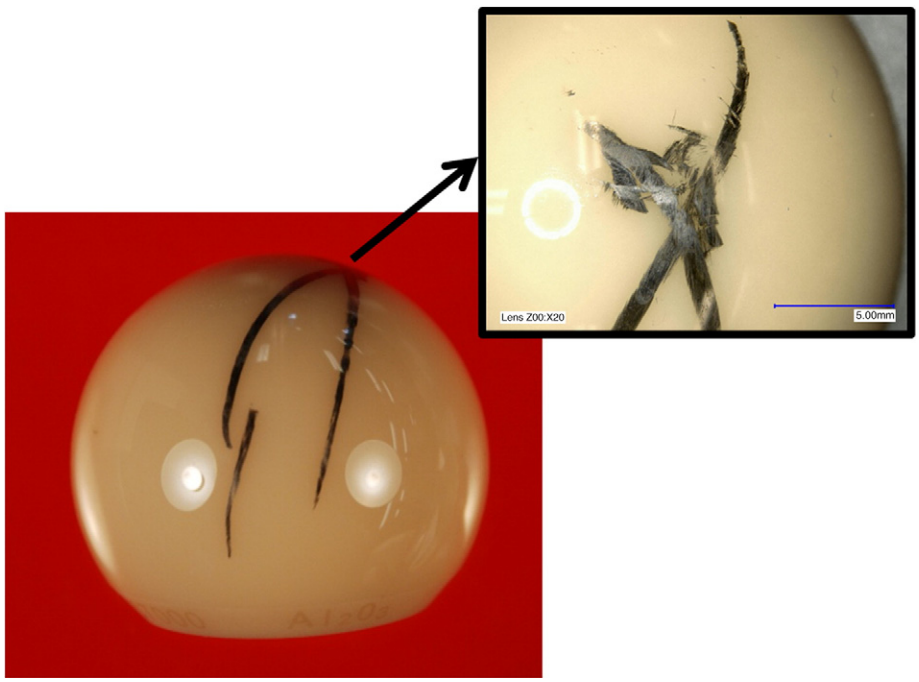

Fig. 1. Ceramic head at retrieval. Streaks of metal transfer are shown aligned approximately 25° to the right of the line through the trunnion axis. There is evidence of the head dwelling on the cup rim and shifting in a side-to-side motion, manifest as short smears of metal transfer that emanate out from the linear form of the main line of metal transfer (inset of pole region).