Failure of ceramic THR with liner dislocation—a case report

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In September 1998, an all-alumina total hip replacement was performed in a 57-year-old woman using an ABS Cup System THR (Kyocera Ltd. Kyoto, Japan) (ABS HA Shell (CH 46)/ABS Liner (28-46)/Ball Head (28N: -4)/Perfix Stem #12-M) for left traumatic femoral head necrosis (Figure 1a). The liner had an alumina inlay packed with polyethylene.

In May 2002 discomfort appeared in the hip, with crepitation when walking. 3 weeks later, dislocation of the liner was confirmed on radiographs. The liner had rotated about 90° in the metal shell and the ball head had been displaced in superolateral direction (Figure 1b). At the revision operation, we observed pale gray color contamination in the synovia surrounding the neck and pseudocapsule. The inlay had been dislocated in the liner and the stem neck had been impinged against the rim of the inlay. The ball head was in contact with the metal shell in the superolateral area. We found no distraction of ceramic parts. The liner, metal shell and alumina ball were revised into a polyethylene liner, metal shell and metal ball (Figure 1c).

For the revised implant, we confirmed the lesion and degree of injury of the implants by the naked eye and light microscopy, and observed the wear pattern of the ball head and the inlay. We used scanning electron microscopy (SEM) to examine the microstructure of the bearing surface.

Based on macroscopic observation, about two-thirds of the circumference of the marginal part of the liner polyethylene had suffered a loss around the notch, to lock the liner between the shell. Metal contamination was observed on the rim of the alumina inlay, which had been dislocated in the liner (Figure 2).

The SEM findings in the normal load-bearing area suggested a very low wear rate, because the machine marks had just been smoothed out (grade II) (Shishido et al. 2002). On the other hand, in the rim of the bearing surface of the inlay and in the peripheral area of the ball head, the grain of the surface had been pulled out (grade V), so the wear was considered to be more severe (Figure 3).

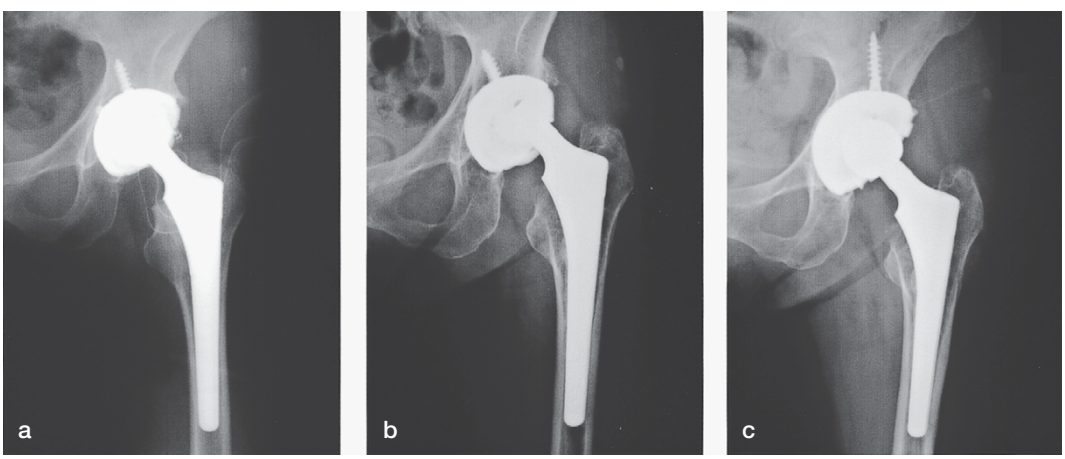

Figure 1. Radiographic findings.

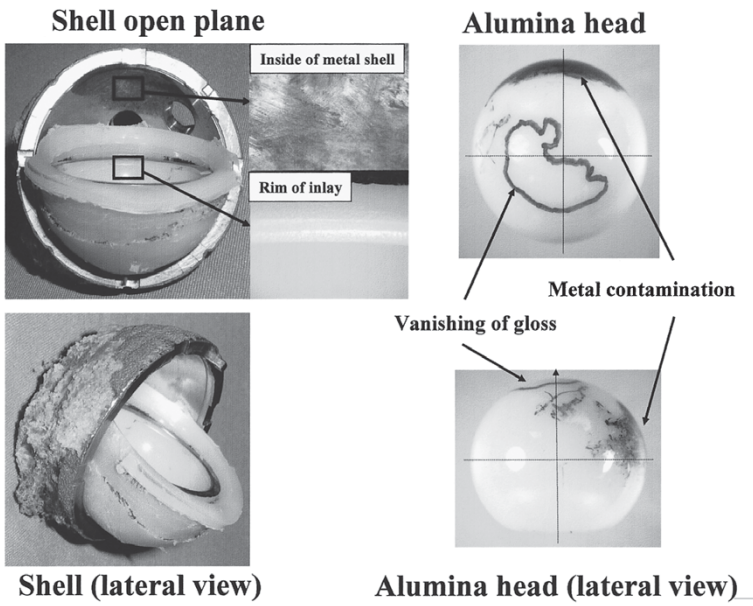

Figure 2. Condition of retrieval implants.

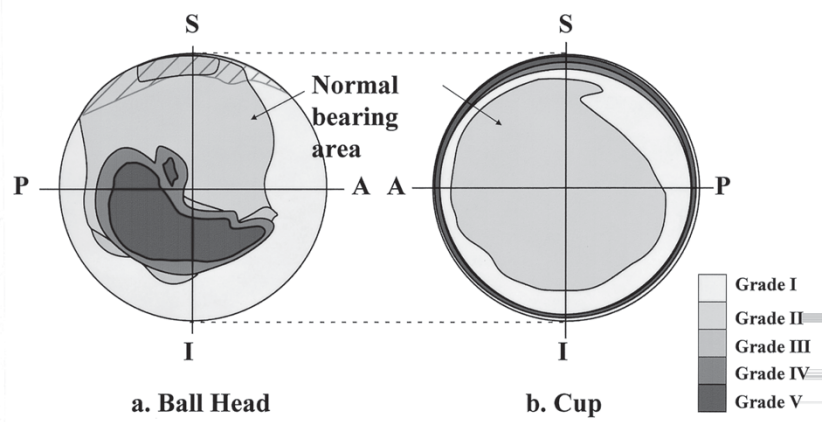

Figure 3. Wear map.

Discussion

All-alumina THR has a superior low wear rate and biocompatibility (Willman 2001), and it was expected to improve longevity. All-ceramic alumina implants were first used in 1970 by Boutin (1972). Sedel et al. (1990) have reported excellent clinical results, but high ware rates have been reported (Huo et al. 1996, Piconi et al. 1999).

In Japan, the all-alumina THR (ABS Cup System THR) was developed by Oonishi (1992) and since 1998, 5500 hips have been replaced by this system. Recently, problems of fracture and dislocation of the liner have been reported (Suzuki et al. 2003), and supply of the implants was stopped in 2001.

In our case, we assume that dislocation was caused first by an excessive rotational force acting on the rim of the inlay, and transmitted to the polyethylene liner, causing the liner-shell lock system to fail. The liner began rotating more in the shell, and gradually the marginal part was sharpened and at last dislocated out of the shell. The cup had a

metal shell (size 46 mm), and the liner consisted of a ceramic inlay covered with polyethylene with a thickness of only 2 mm; thus, creep deformity of the polyethylene was likely. Secondly, the system combining the shell and liner was probably not sufficient. In hard-on-hard THR, torque forces to the interface between the shell and liner can cause problems.

The wear was low in the normal weight-bearing area. According to SEM findings in this weight-bearing area, the surface finish marks from machining had just been smoothed out and no pulling out of grains was observed. The average grain size of the Kyocera alumina was 1.4 μm, surface roughness was below 0.02 μm and its sphericity was below 2 uRa (Oonishi 1992). Such data are far superior to the standard ISO 6474 (Piconi et al. 1999), and the quality of the Kyocera alumina was considered to be excellent. Previous simulator studies have confirmed the low wear rate of the bearing surface of Kyocera alumina (Oonishi et al.1996, Clarke 2003, Clarke et al. 2003).

Our case suggests that the alumina-on-alumina THR design should be tested carefully in a series of simulator experiments before clinical trials are begun.

No competing interests declared.

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