

Fracture of an Acetabular Component Inserted without Cement

A CASE REPORT*

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The use of acetabular components without cement for total hip arthroplasty has increased dramatically in the last decade, for several reasons. With increased follow-up, fixation of sockets with cement has proved to

cent of the ninety-eight hips in the patients who were alive at a minimum of twenty years had a loose or revised acetabular component. Kavanagh et al.¹⁰ reviewed the results of the first 333 Charnley total hip replace-

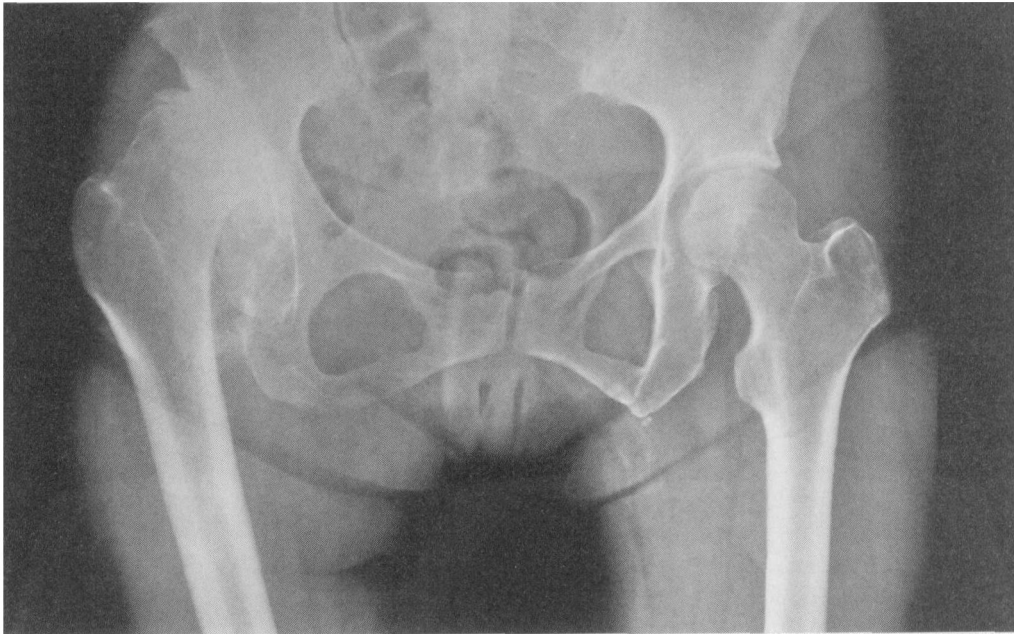


FIG. 1

Radiograph of the pelvis, showing a dysplastic hip with end-stage osteoarthritis.

be problematic, with as many as 48 per cent of such sockets reported to be radiographically loose at twenty years^{1,9,10,15,19,20}. In a study of 330 total hip replacements performed with cement, Schulte et al. noted that 23 per

ments performed with cement at the Mayo Clinic and found possible loosening of thirty-three (48 per cent) of sixty-nine cups in patients who were followed for twenty years.

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Sockets designed to be inserted without cement are so-called user-friendly. They are technically easy to insert, and the position of the cup can be readily changed intraoperatively. Growth of bone into the sockets is reliable, as has been shown in many studies of retrieved specimens^{5,6,8,12,17}. Elevated modular polyethylene liners may improve positioning of the socket (by modifying the angle of abduction or anteversion) and can accommodate multiple sizes of the femoral head, which is useful in revision operations.

Clinical and radiographic results of total hip arthro-

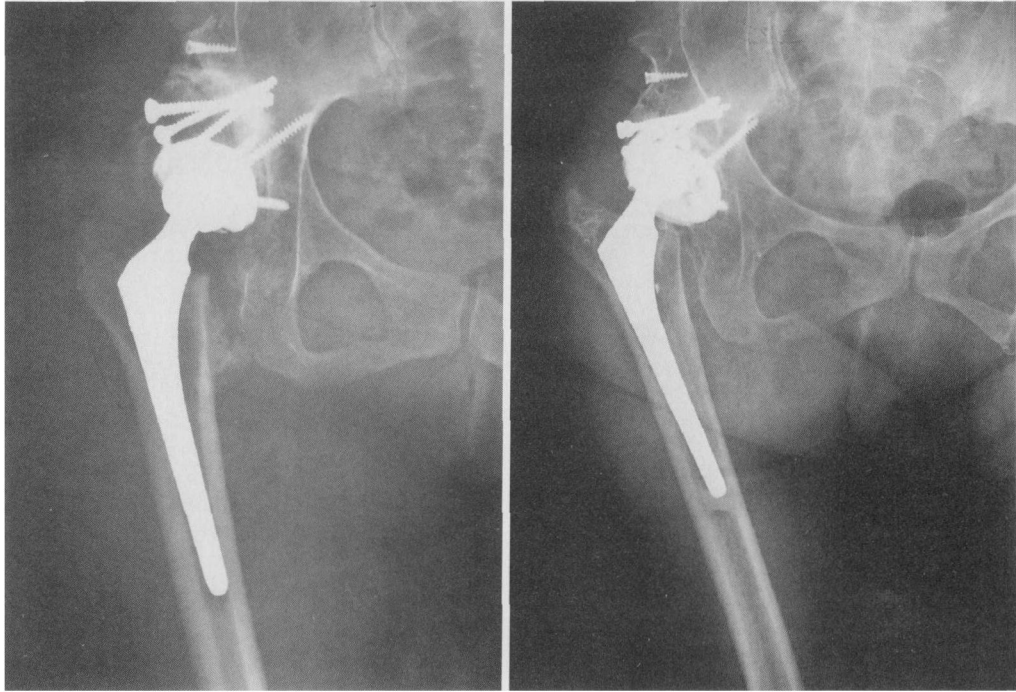


FIG. 2

FIG. 3

Fig. 2: Immediate postoperative radiograph showing the acetabular component, which was placed superior and lateral to the normal hip center without cement. A large portion of the socket is covered by autogenous graft from the femoral head.

Fig. 3: Radiograph showing the fractured acetabular shell. The femoral component has subsided and is radiographically loose.

plasty without cementing of the acetabular component have been quite satisfactory^{11,13,14}. However, when the results of such arthroplasties are evaluated, it should be kept in mind that loosening of cemented sockets historically has not been a major problem until at least five to ten years after the operation¹⁶. Although the fixation of

acetabular components inserted without cement often is stable at the time of intermediate follow-up, problems not seen with cemented implants have been reported less than ten years after insertion of sockets without cement. These problems have included dissociation of the liner from the shell, catastrophic failure of the poly-

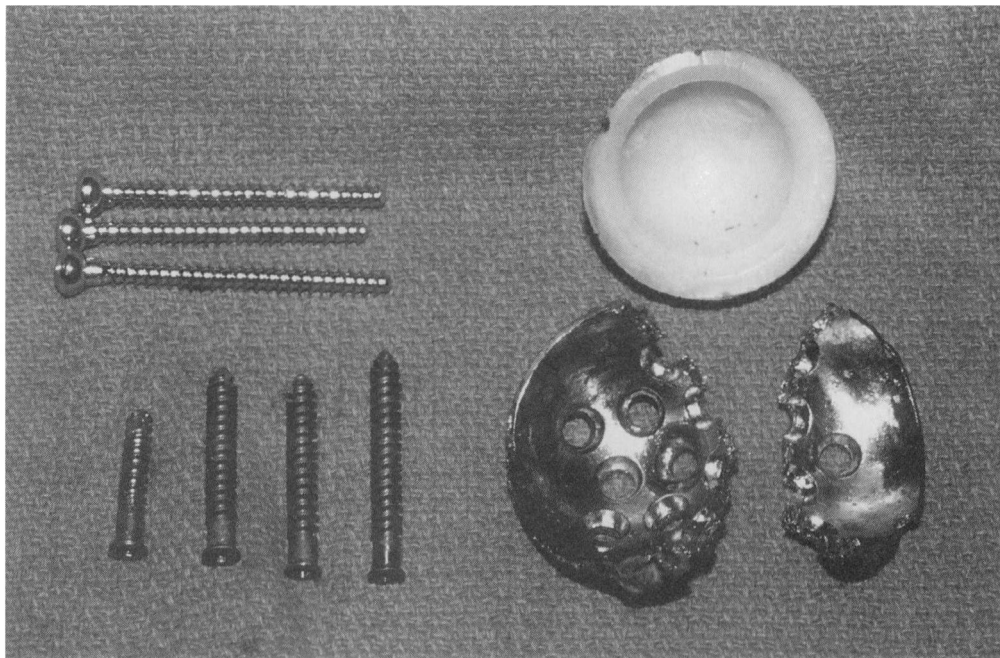


FIG. 4

Photograph showing the retrieved components. The acetabular component is fractured along its multiple screw-holes.

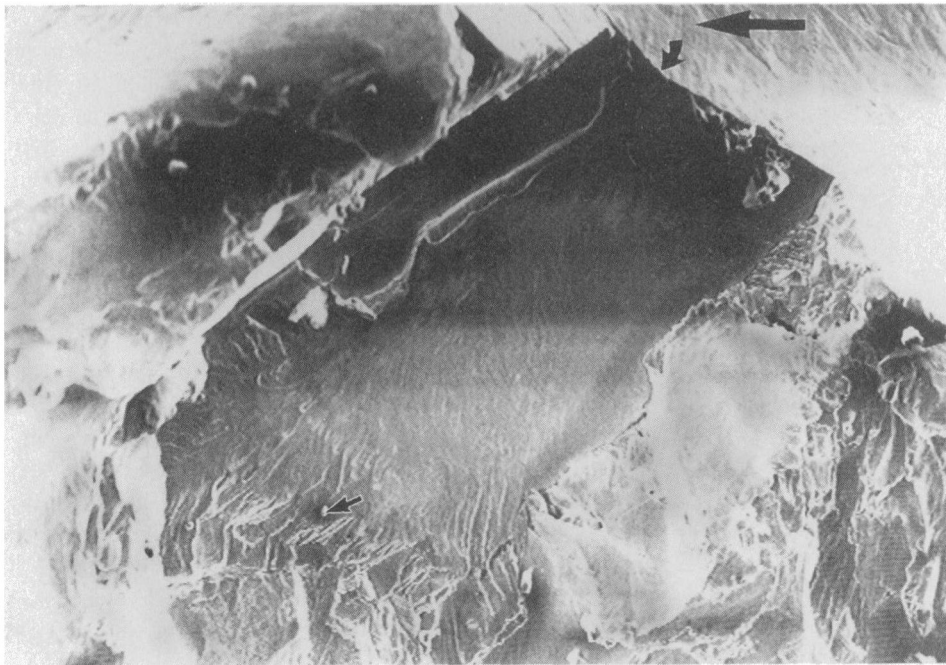


FIG. 5

Scanning electron micrograph of the site of the initiation of the fatigue crack. The large arrow indicates the free surface of the countersink of the screw-hole, and the curved arrow shows the intersection of the countersink with the fracture surface. On the fracture surface, there is an approximately 500-micrometer flat, fracture facet with the so-called river pattern (small arrow). These features are characteristic of a fatigue failure (magnification, $\times 90$).

ethylene liner, impingement on the iliopsoas, possibly accelerated rates of wear of the polyethylene, and acetabular osteolysis^{2,4,7,18}.

We report a case in which the metal shell of an acetabular component that had been fixed to a large segment of autogenous graft without cement fractured after less than ten years.

Case Report

A fifty-three-year-old woman who had a history of congenital dysplasia of the left hip was first seen in our clinic in 1987. The dysplasia had been diagnosed when the patient was a child, and an open reduction had been performed at the age of four years. One year later, she had a second open reduction. She did relatively well until 1987, when she had increasing pain in the hip that limited her daily activities (Fig. 1). She was able to walk no more than one block, and she needed a cane. In 1987, a total arthroplasty of the left hip was performed with insertion of a Harris-Galante-I porous-coated acetabular component (Zimmer, Warsaw, Indiana) and a proximally porous-coated femoral stem (Osteonics, Allendale, New Jersey) without cement (Fig. 2). A forty-eight-millimeter acetabular shell was placed superiorly, and autogenous graft from the femoral head was secured to the ilium to improve superolateral coverage. The graft was secured with four screws, and the acetabular component was secured with three screws. The patient initially did well, with a substantial decrease in pain and increase in the level of activity.

Seven years after the operation, mild so-called start-up pain (pain that occurs with the initiation of walking) developed in the thigh. At that time, it was noticed that the femoral component was loose. The acetabular component appeared to be intact. The pain in the thigh was not severe enough to warrant operative intervention. Over the next ten months, the pain in the thigh increased and discomfort developed in the groin and buttock. There was crepitation with motion of the hip, and the patient required crutches to walk. Approximately eight years after the primary total hip replacement, radiographs revealed that, although there was no history of trauma, the acetabular component had fractured (Fig. 3).



FIG. 6

Radiograph made after the revision, which included use of a reinforcement ring. The center of the hip has been restored to a more anatomical location.

At revision, the polyethylene was noted to be intact but dissociated from the fractured shell. There was extensive abrasion, delamination, and pitting on the non-articulating surface of the liner as well as eccentric wear and foreign-body debris on the bearing surface with cracking on the superior rim. The acetabular shell was fractured along its outer third between the multiple screw-holes (Fig. 4). The fractured component was analyzed visually, and specimens were examined with a scanning electron microscope (model S120; Cambridge Instruments, Deerfield, Illinois). The morphological appearance of the fracture surface was consistent with a fatigue failure emanating from the countersink of a screw-hole. This was evident on visual examination in that an area adjacent to a posterosuperior screw-hole had a glossy, faceted appearance. The fracture surface exhibited characteristic patterns of fatigue on examination with the scanning electron microscope. The site of the initiation of the fatigue crack (Fig. 5) consisted of a 500-micrometer flat, fracture facet with the so-called river pattern emanating from the surface of the countersink. The countersink adjacent to the site of the initiation of the crack had persistent slip bands and a secondary fatigue crack indicating extensive fatigue damage in the vicinity of the fracture. The inferior portion of the acetabular component was well fixed but easily removed. The femoral component was grossly loose. Because of the large amount of graft used in the primary total hip replacement, reconstruction was performed with use of a fifty-six-millimeter acetabular reinforcement ring and a femoral head allograft to fill multiple cavitory defects. Approximately 70 per cent of the autogenous graft that had been placed during the primary total hip replacement had been incorporated. A standard femoral stem fixed with antibiotic-impregnated cement was used in the revision (Fig. 6).

At the time of the most recent follow-up examination, the recovery had been uneventful and the patient was pain-free and able to walk without aids.

Discussion

The long-term survival of acetabular sockets inserted without cement is unknown. It is hoped that the rate of radiographic loosening will be lower than the high rates seen with cemented sockets with increased follow-up. The intermediate clinical and radiographic results of most sockets designed to be inserted with-

out cement have been excellent, but there have been problems, even after periods of implantation of less than a decade. These complications include dissociation of the liner from the shell, catastrophic failure of the polyethylene liner, impingement on the iliopsoas, and possibly increased rates of polyethylene wear^{2,4,7,19}. A fractured acetabular shell appears to be extremely rare.

The cause of the fracture in our patient may have been multifactorial. The thickness of the substrate of the Harris-Galante-I porous-coated cup was 2.3 millimeters with an additional 1.4 millimeters of titanium mesh. One of the changes in the design of the second generation of this component was an increase in the thickness of the shell by 1.5 millimeters. This patient also had dysplasia of the hip, and the initial acetabular shell was placed on a large segment of autogenous graft. The acetabular component became fixed by inferior ingrowth of bone. Subsequently, the graft appears to have been reabsorbed superiorly and laterally. As the shell was continually loaded during the eight years of use, the unsupported superolateral portion of the socket eventually failed through the screw-holes. The initial acetabular component was placed superiorly and laterally to the normal center of rotation of the hip. This position of the socket leads to a short limb with a marked increase in the joint-reaction contact forces. The valgus position of the femoral stem also decreases the offset of the femoral head and increases the abductor forces on the hip.

This case report demonstrates that an acetabular component inserted without cement can fracture when support by intact host bone is diminished. Maximizing contact between the cup and the host bone may decrease the risk of fracture of the component.

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