Case Report

Fracture of Femoral Component in a Resurfacing Total Knee Arthroplasty

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Abstract: We present a case of an unusual complication after a resurfacing total knee arthroplasty. Fracture of the uncemented porous-coated femoral component occurred 4 years after its implantation. The mechanical axis was restored and collateral ligament balance was achieved at the primary procedure. At revision, the femoral component was found fractured at the junction of the trochlea with the medial condyle, anteriorly to the medial peg. A thin layer of fibrous tissue was interposed between bone and metal under the fracture area. Metallurgical analysis of the fractured component revealed fatigue failure but no structural defect. Lack of bony support and excessive cyclic loading led to fracture of the implant. Key words: fracture, femoral component, total knee arthroplasty.

Fracture of a metal component in total knee arthroplasty is an unusual complication, partly due to use of wrought or forged alloys and partly due to advances in the design. Occasional fractures of the tibial metal component in resurfacing designs have been reported [1-7].

Femoral component breakage after unicompart-mental knee arthroplasty has also been reported and attributed to poor surgical technique and heavy activity of the patients [8-11].

Fracture of the femoral component in resurfacing total knee arthroplasty is a rare complication [6,12-14]. All cases but one [14] refer to the same type and size of implant, the Ortholoc II, small size (Dow Corning Wright, Arlington, Tenn). All fractures occurred at the same area, the junction between the posterior flange and the beveled surface. Reasons were the inadequate thickness of the metal substrate and further weakening by the double porous layer coating process [6,13]. The design of the specific implant had been revised before the development of the clinical problems [6].

To our knowledge, no other similar complication has been reported since.

We present a case of a fracture of a medium-size uncemented GENESIS femoral component (Smith and Nephew Richards Inc) in a resurfacing total knee arthroplasty.

Case Description

A 72-year-old female patient, weighing 68 kg, underwent a total knee arthroplasty for osteoarthritis of her right knee. A medium-size prosthesis (GENESIS, Smith and Nephew Richards Inc) was inserted. The femoral component of cobalt-chromium alloy had a porous coating layer, but the monobloc tibial tray was fixed with cement. Equal tension of
the collateral ligaments and normal mechanical axis were achieved at surgery.

The patient made a satisfactory recovery. She had no pain and was able to walk up to 1 mile without using any type of support. At 3 years postoperatively, she developed gradually increasing pain and walking difficulty. Clinical examination revealed a slight varus deformity with weight bearing. There was medial laxity and flexion from $0^\circ$ to $100^\circ$ with some crepitation. Radiographs showed narrowing of the medial joint space indicating wear of the polyethylene insert. There were porous beads scattered but no signs of gross implant loosening or osteolysis (Fig. 1A-B). At revision surgery, the femoral component was found broken just anterior to medial peg, at the junction between the trochlear flange and the medial condyle area (Fig. 2A-B).

The polyethylene insert showed degradation changes under the fractured implant. The remaining femoral component and the tibial tray were both stable. After removal of the components, a thin

**Fig. 1.** A. Anteroposterior radiograph showing scattered beads and narrowing of the medial space. B. Lateral radiograph of the prosthesis, without signs of broken implant.

**Fig. 2.** A. The broken implant as seen during the operation. B. The broken implant on the table.

**Fig. 3.** A. Electron microscopy picture showing the fatigue ridges at the intercondylar aspect fracture surface. B. Fatigue striations at the medial aspect of the fracture surface.
layer of fibrous tissue under the fracture area was observed. There were no signs of focal osteolysis.

Bone ingrowth was seen on the porous surface of the femoral component, except that of the fractured area. A Gigli saw was used for implant removal. The prosthesis was revised to another cemented PS implant. The retrieved component was sent for metallurgical examination. The retrieved material was studied by scanning electron microscopy. There was a characteristic outer pattern of an inclined front with dense ridges (although faded out). Presence of fatigue ridges and striations starting from the inner surface of the component indicates fatigue failure (Fig. 3A-B). No signs indicative of metallurgical fault were found at the broken surfaces, so structural defect of the femoral component was excluded.

Discussion

Improvement of metal alloys has significantly reduced the incidence of components fracture, but this complication has not been totally eliminated. In total knee arthroplasty, the tibial component is more susceptible to fracture owing to structural characteristics and pattern of stresses applied to it [7,12].

The porous coating of the prostheses reduces the strength of the substrate, partly due to surface notching by the porous layer and partly due to application process, which involves excessive heating. With a double porous layer, further reduction of the substrate’s strength is expected [15].

All cases reported so far [6,12,13] are referred to the same prostheses (Ortholoc II), with double porous coating layer and small implant sizes. All fractures happened at the same area, at the junction between the beveled surface and the posterior flange, where the metal thickness was only 3 mm.

In our case, the fracture area is located slightly anteriorly to the medial peg, at the junction between the trochlear flange and the medial condyle. The angled areas at the junction of the beveled surfaces are difficult to obtain full and stable contact, and therefore, bone ingrowth is hampered. Huang et al [14] reported a case with fracture of the LCS femoral component in the patellar groove area because of underlying extensive osteolysis, leaving the metal unsupported and exposed to high stresses. In our case, no bone lysis was seen at revision and the scattered beads presumably have been released from the broken area of the component. The polyethylene wear matched the flexion path of the fractured metal edges, witnessing no significant previous wear.

To our knowledge, there have been no previous reports of GENESIS femoral component fracture. The GENESIS femoral component is a porous-coated cobalt-chromium implant. Our case was not a small-size component, but failed because of high stresses due to absence of bone ingrowth at that area. The correct axis alignment indicated that there were no excessive stresses on the medial compartment. The varus deviation seen on the radiograph was due to polyethylene excavation by the metal’s broken edges.

The area between the beveled surfaces seems to present unfavorable circumstances for bone ingrowth. Cement fixation secures more uniform stress distribution, making component fracture less likely. We attribute the component failure to the lack of bony support between the beveled surfaces. Mechanical stresses create an unfavorable environment for bone ingrowth and the surgeon should pay special attention to achieve good metal-to-bone contact during surgery.

References


