Coupling Failure Between Stem and Femoral Component in a Constrained Revision Total Knee Arthroplasty

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ABSTRACT
Knee revision using constrained implants is associated with greater stresses on the implant and interface surfaces. The present report describes a case of failure of the screw coupling between the stem and the femoral component. The cause of the failure is surmised with outline of the treatment in this case with extensive femoral bone loss. Revision implant stability was augmented with the use of a cemented femoral stem, screw fixation and the metaphyseal sleeve of an S-ROM modular hip system (DePuy international Ltd).

Key words: Constraint. Revision knee arthroplasty. Coupling failure. Stemmed femoral prosthesis.

INTRODUCTION
Use of constrained knee prosthesis is reserved for complex primary or revision knee replacements with bone or soft tissue deficiency. However, increase in constraint also increases the forces transmitted to the implant and fixation interface.¹ The stem extension is important in transmitting the bending and torsional stresses generated by the constrained articulation away from the joint surface to the stronger diaphyseal bone.² Modular implant designs are available which allow the surgeons to achieve intra-operative customization providing improved fixation and optimum kinematics.³⁴ The system that the authors use is the press fit condylar (PFC), Sigma, total condylar III (TC3) (Johnson & Johnson; DePuy international Ltd.) which utilizes a locking screw mechanism to connect femoral component to the stem.

Here, we report a rare complication that is a failure of the coupling mechanism between the stem and the femoral component in a revision total knee arthroplasty.

CASE REPORT
A 67 years old man underwent right total knee replacement in 1999 for severe end stage arthritis. He had a history of previous patellectomy with severe valgus deformity. A constrained knee replacement with a high tibial post was used. The tibia was stemmed and the femoral component was cemented without a stem extension. The patient did well for three and a half years, until in 2003, he started complaining of knee pain mainly around the femoral component. His blood tests did not show any sign of infection. X-rays showed loosening of the femoral component (Figure 1). The femoral component was revised and a TC3 (J&J) stemmed femoral implant was used with a new constrained polyethylene liner. The patient’s knee pain improved post revision and at 6 weeks he had a range of motion between 0 – 100 degrees.

Three years later in 2006, he presented again with an acute onset of painful right knee and marked decrease in range of motion of 10 – 40 degrees. An X-ray revealed a broken screw in the knee joint and failure of the coupling between the femoral component and the stem. The screw in the joint was blocking knee movement (Figure 2).

The patient underwent a second revision to a constrained press fit Condylar TC3 implant. Only the femoral component was revised. After removal of the implant there was a significant medullary and medial femoral condyle bone loss. To address this bony deficiency, and potentially weak coupling, the stemmed femoral component was reinforced at the stem component junction using cement and the metaphyseal sleeve from the S-ROM hip system (DePuy International Ltd.). Two standard 6.5 mm cancellous screws were also incorporated into the construct to support proper positioning and alignment of the femoral component in the presence of bone deficiency (Figure 3).

Following this surgery, the patient made an uneventful recovery and is now 4 years post revision. He is satisfied with his knee with a knee society score (KSS) of 81,⁵ only has occasional knee pain and has a range of motion of 0 – 100 degrees. There are no radiographic signs of loosening.

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DISCUSSION

To our knowledge, fracture of a PFC Sigma TC3 stemmed femur in revision total knee replacement has not been reported. In this case, the screw that locks the stem to femoral component failed.

Constrained knee designs have a high tibial post-providing varus-valgus and antero-posterior stability in knees with marked ligamentous laxity. This lead to increased stress at the implant and fixation interface. The use of a cementless stem transmits the load away from the fixation interfaces at the joint line to stronger diaphyseal bone or in the case of cemented stems the force is transmitted along a broader surface area of implant-cement-bone contact. The tolerance of such modular components is variable, and is at risk for premature failure. Poor quality bone in distal femur means that more stress is taken by the femoral stem which leads to fatigue failure of the weakest link in the construct, which in this case was the locking screw. Another possible reason is that during impaction of the femoral component the vibration may have loosened the screw, predisposing it to fatigue failure. Finally, metallic wear, corrosion and fretting between the body of the prosthesis and various modular components may be both theoretical and real problems. The joint fluid can move into the stem and screw interface leading to corrosion of the metal causing weakness and ultimately failure.

Whatever may be the cause of this screw failure it is a rare complication of an uncemented femoral stem and if it does happen the stem needs to be revised. Replacing the screw alone may not be enough to prevent further failure. To reinforce the construct we used cement and metaphyseal sleeve of the S-ROM hip system (DePuy international Ltd.) at the stem component junction, multiple screws to support the component at joint surface and cementing the stem in the femur using finger packing technique.

REFERENCES


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Figure 1: AP and lateral. Loosening of the femoral component of a TKR. Original surgery was for severe valgus deformity with previous patellectomy. A standard femoral component, stemmed tibial component and high tibial post was used.

Figure 2: AP and lateral. Broken screw from the coupling between the stem and the femoral component is seen within the knee joint.

Figure 3: AP and Lateral. The femoral components were revised. The severe bone loss required the used of a cemented stemmed femoral component, multiple screws and the metaphyseal sleeve of an S-ROM modular hip prosthesis to augment the cement.