Unique Failure Mechanism of a Femoral Component After Revision Total Hip Arthroplasty

J. Ryan Martin, MD; Robert T. Trousdale, MD

Abstract

As the prevalence of revision total hip arthroplasty increases, the mechanisms of failure of these revisions have become better delineated. Several studies have indicated infection, instability, and aseptic loosening to be the more common mechanisms of failure in revision surgery. However, with increasing numbers of revisions performed, unique mechanisms of failure are being seen, likely related to the implants that are used in the revision setting.

Revision implants offer certain advantages over primary implants with the use of modular components. The revision implants allow the surgeon to increase offset and leg length with modular femoral bodies and necks. However, these modular junctions represent additional areas for implant failure. These new methods of failure associated with modular implants are slowly presenting as the use of these implants continues to increase.

The authors recently encountered a mechanism of failure that, to their knowledge, has not been described in the literature. They report a 57-year-old man with dissociation of the proximal body from the diaphyseal component of a Wright Medical Link (Memphis, Tennessee) stem prosthesis. The patient presented with an audible click on physical examination, and radiographs confirmed dissociation of the proximal body. The intraoperative findings, treatment method, and proposed mechanisms for this type of failure are presented, as well as insight into potential ways to avoid this type of failure.
The prevalence of revision total hip arthroplasty (THA) is currently projected to increase 137% over the next 25 years. Revision surgery is typically more challenging than primary surgery. Potential reasons for failure include infection, instability, aseptic loosening, implant fracture, and periprosthetic fracture. In the setting of aseptic loosening, bone deficiency can make femoral fixation challenging. Modular components are commonly used in this setting because they allow differential diaphyseal and metaphyseal sizing. With the introduction of modular components, inherent concerns have been raised. Problems that have been reported regarding the femoral component include head-neck dissociation, corrosion at the male-female interface, and mechanical failures.

One type of modular stem frequently used worldwide is the Link stem prosthesis (Wright Medical Technology, Inc, Arlington, Tennessee). This prosthetic device consists of a diaphyseal component, a head-neck component, and a femoral head component. The diaphyseal component and head-neck component are locked together by an appropriately sized locking screw after seating the components properly, engaging the teeth of both components, and assessing proper version and offset (Figure 1). A polyethylene lock bolt is then inserted into the shaft of the screw to prevent screw loosening.

The authors report a unique mechanism of failure in a patient who underwent revision THA to the rotational femoral stem prosthesis. To the authors’ knowledge, disengagement of the proximal body has not been reported in the literature as a cause of failure after revision THA.

Case Report

A 57-year-old man underwent a left THA using a 2-incision approach approximately 2 years prior to presentation. One year after the primary surgery, the THA had to be revised secondary to aseptic loosening of the femoral component. The THA was converted to a Link stem. During the procedure, an operative fracture was noted distal to the stem. This fracture was bypassed by the stem. One year after primary surgery, revision to a Link stem was performed due to aseptic loosening of the femoral component. Radiographs revealed that the patient had sustained a Vancouver type B periprosthetic fracture.

Intraoperatively, the stem was found to be stable and well fixed. The patient underwent open reduction and internal fixation with a lateral plate. Seven months later, the lateral plate was removed secondary to pain. Several days after the plate removal, the patient noticed a clicking sound in his hip with rotation maneuvers.

On examination, he had essentially no discomfort with passive and active range of motion. While ranging his hip, a distinctly audible click was noted, especially with rotation motions of the hip. The patient was able to easily reproduce the clicking with similar movements. Radiographs revealed well-fixed femoral and acetabular components. On comparison with radiographs obtained after the last revision, it appeared that the screw that locks the diaphyseal component to the proximal body had backed out slightly. This manifested as an increase in space between the head of the screw at the implant body level (Figure 2).

The patient underwent a revision left THA. Intraoperatively, an examination was performed while the patient was under anesthesia. With rotational movements of the hip, the clicking was easily reproduced. On entering the deep compartment of the hip joint, black titanium debris was observed throughout the hip and was thoroughly debrided (Figure 3). It appeared that most of this debris was related to the dissociation of the proximal body at the teeth level.

After dislocating the hip, the authors were able to move the proximal body freely, reproducing the clicking noise. The screw appeared to have backed itself out several turns and was grossly loose. The proximal body was removed, and the teeth appeared intact and in relatively good condition. The proximal femur was reamed, and a 35-mm, 126° proximal body (the same size as the previous one) was placed. The highly cross-linked polyethylene liner was cracked at the locking mechanism from the 11- to 1-o’clock position secondary to impingement. After ensuring that the acetabular cup was secure, another 32° Longevity polyethylene liner (Zimmer, Warsaw, Indiana) was inserted. A 32-mm, 12/14 tapered-length, 55.5-mm femoral head was then inserted on the femoral body. The patient had good restoration of leg length, as well as good stability with range of motion. The wound was thoroughly irrigated and closed routinely.

Postoperative radiographs showed a well-seated implant with no evidence of proximal body disengagement. Postoperatively, he was able to reproduce the clicking noise. One year after re-revision, the patient stated that he was able to ambulate without pain. The clicking has ceased since the procedure.
Discussion

Modular stems are often beneficial for revision surgery because they allow the surgeon to customize the offset and version to optimize stability. The Link stem is a popular option for a revision femoral stem. Increased modularity has more potential sources for failure than its nonmodular counterpart. Problems that have been reported on the femoral component include head-neck dissociation, corrosion at the male-female interface, and mechanical failures. After completion of an extensive literature review of mechanisms of failure with this prosthetic device, the current authors believe they are the first to report disengagement of the proximal body as a failure mode.

Disengagement of the proximal body of the femoral component could be caused by several mechanisms. While seating the proximal body on the diaphyseal component, the teeth of both components must interdigitate as the screw that links these components is tightened. If the teeth are tightened on one another without interdigitating, the compression obtained with the screw may temporarily cause the implant to feel correctly fixed. With time, the micromotion at this interface could lead to decreased compression at the teeth interface, leading to increasing amounts of motion until gross mobility occurs. Another potential mechanism of failure would be that the screw underwent mechanical failure. The screw has a polyethylene lock bolt that is inserted into the shaft of the screw to prevent screw loosening. It is possible that the screw could disengage if this were inserted incorrectly. Finally, the teeth on the components could fail.

The current patient’s THA most likely failed because the teeth were not properly interdigitated at the time of insertion. At the time of component revision, the teeth appeared intact and the polyethylene lock bolt was still in place in the shaft of the screw.

The senior author (R.T.T.) has a systematic approach to locking the proximal body to the diaphyseal component. Prior to insertion of the screw into the proximal body-diaphyseal component, one should compress the proximal body with the correct version on the diaphyseal component while ensuring that the teeth interdigitate. While holding this compression, an assistant tightens the screw to compress the components in the correct alignment and ensure that the teeth interdigitate properly. It is important to ensure that the compression is held until the screw is appropriately tightened or the risk exists that the component could rotate and change version or the teeth may disengage.

References