



Long Tapered Hydroxyapatite-Coated Stems in Revision Total Hip Arthroplasty

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Introduction

Component stability is critical in the reconstruction of the failed total hip arthroplasty (THA). Femoral component options used during revision THA include diaphyseal engaging long fully porous-coated stems and modular tapered stems designed for distal fixation.¹ While these femoral components have been shown to be reliable at achieving stable fixation in the setting of revision THA, one disadvantage of these distally fixed rigid implants is proximal stress shielding and the potential for femoral bone loss.²

In Europe, long tapered revision femoral components coated with hydroxyapatite (HA) have been shown to provide stable fixation and ingrowth in cases with adequate proximal femoral bone stock and favorable canal geometry.³⁻⁶ Osteoconductive properties of the HA coating may fill microdefects and provide additional bony contact to augment bone restoration.⁷ In the United States, however, the experience with these implants has been limited. Therefore, the purpose of this study is to: 1) evaluate the clinical outcome of THA revisions using long tapered HA-coated femoral components; 2) evaluate radiographs for evidence of bone ingrowth, loosening, or stress shielding, and 3) to report complications associated with the use of these implants.

Methods

Fifty-five patients underwent revision THA using the Kar (Depuy, Warsaw, IN) long tapered HA-coated femoral revision stem. Preoperatively femoral bone loss was classified using the Paprosky classification.⁷ Postoperatively patients were followed at two weeks, three months, one year, two years and five years. The Harris Hip Score (HHS) was used to assess clinical outcomes.⁸ Serial radiographs were reviewed for evidence of loosening, osteointegration, stress shielding, or femoral bone loss.

Results

Twenty-three men and eighteen women were available for follow up with average age of 62 years (range 28-92). Patients were followed

for average of 59 months (range 26-117). One patient died and 13 were lost to follow up. Reasons for revision were aseptic loosening in 31, infection in 10. Preoperative femoral Paprosky classifications were as follows: 24 type I, 14 type II, and 3 type IIIA. There were no type IIIB or IV femurs.

The average HHS at final follow up was 71 (range 22-100). Three patients required subsequent revision: one for infection, one for aseptic loosening at 15 months, and one due to symptomatic limb length discrepancy. There were no cases of instability or fracture.

Radiographically, 40 stems were well fixed; one stem had subsided compared to postoperative images and was subsequently revised. No hips showed evidence of proximal femoral resorption or stress shielding. Evidence of osteointegration (spot welding) was present in all femurs postoperatively.

Discussion

Long, tapered, HA-coated revision femoral components have been shown to provide stable fixation and ingrowth in cases where there is good proximal femoral bone stock and favorable canal geometry.⁹⁻¹³ The KarTM stem, in addition to being fully HA-coated, possesses distal slots which improve stem elasticity as well as a trapezoidal design with vertical and horizontal grooves to increase metaphyseal and proximal diaphyseal fit and improve rotational stability.^{14,15} However, the experience with these implants has been limited in the United States.

We report on a series of 55 patients undergoing revision THA using a long tapered HA-coated prosthesis. At a mean 59 months of follow up, 41 patients were available for analysis with a femoral component survivorship of 93 percent. Radiographic analysis revealed osteointegration in all but one case with no evidence of loosening. One patient underwent revision for aseptic loosening of the femoral component. Preoperatively, the femoral bone loss was classified type IIIA according to the Paprosky classification system. These results are comparable to other series of proximally HA-coated cylindrical components. Gosens and van Langelaan reported on a series of 48 revision

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THA procedures using a Mallory-Head proximally HA coated femoral component.¹⁶ All femoral defects were Paprosky class I and II and at a mean of 6.1 year follow up, there were no aseptic failures of the femoral component. Furthermore, Trikha *et al* reported on a series of 107 patients revised with a JRI Furlong hydroxyapatite-ceramic femoral component.¹⁷ At an average follow up of 8 years, there were no femoral component failures, radiolucent lines, or evidence of failure of osteointegration. Consequently, a long tapered fully HA-coated femoral component can achieve reliable fixation in patients with Paprosky I and II femoral defects.

Most cases of femoral bone loss in this series were Paprosky types I and II. The only femoral component failure in this series was a case in which the patient had Paprosky type IIIA femoral bone loss. The patient had subsidence and loosening of the femoral component and underwent revision to a fully porous coated femoral component. Femoral components with conical distal tapers have been shown to be able to achieve stability in cases of significant bone loss.¹⁸ Wedge-shaped tapered stem designs rely on interference fit against the medial and lateral cortices proximally that provides initial rotational stability that facilitates osteointegration. However, when the bone loss is substantial and involves a large portion of the metaphysis and extends to the isthmus, it can compromise the prosthesis ability to achieve initial axial and rotational stability that is crucial for eventual bone ingrowth. As a result, we have limited the use of these stems to cases with only mild proximal femoral bone loss.

We acknowledge several limitations of this study. First, this is a retrospective study and therefore limited by recall bias. Secondly, because there was no control group of patients treated with traditional revision femoral components, no direct comparison between the femoral components can be performed. Finally, this is a relatively short-term follow up of a group of patients treated with this type of prosthesis. Longer follow up will be necessary to evaluate the true effects of this particular stem design and geometry on the bone quality and quantity of the proximal femur.

In conclusion, a wedge shaped long tapered HA-coated prosthesis can provide reliable fixation and osteointegration in patients with Paprosky I and II defects of the proximal femur. The advantages of these stems include preservation of the distal diaphyseal bone, reduction of stress shielding of the

proximal femur, and no end of stem thigh pain. In patients with adequate bone stock and favorable canal geometry, these stems can be considered viable reconstructive options.

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