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Mid-Term Outcomes and Complications with Cementless Distal Locking Hip Revision Stem with Hydroxyapatite Coating for Proximal Bone Defects and Fractures

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ABSTRACT

We revised the first 100 revision total hip arthroplasties using a cementless distal locking revision stem conducted in our referral centre. Average follow-up was 9.2 years (range: 5.5–12 years). Harris Hip Score improved from 42.5 to 81.6, and none had thigh pain at last follow-up. No significant stress shielding, osteolysis, or radiologic loosening was found. All patients showed radiological evidence of secondary implant osseointegration. Overall survival was 97% with three patients being revised: two stem ruptures and one subsidence. We could trace these complications to technical errors. These findings suggest that a diaphyseal fixation of the revision stem with distal locking can provide the needed primary axial and rotational stability of the prosthesis. This would allow further bony ingrowth, enhanced by the hydroxyapatite coating.

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Osteolysis around the primary femoral implant in total hip arthroplasties may result in cavitary lesions, cortical fracture, and distortions of the normal femoral anatomy, as well as segmental defects of the proximal femur. These subject the surgeon conducting revision surgery to the added challenge of tackling a previously operated proximal femur, with resultant bone defect and mechanical incompetency. The primary challenge resides in determining the best method for securing the revised femoral implant and providing immediate stability for load bearing and motion. In addition to providing secure fixation, the construct must be reproducible and durable, and must facilitate host bone regeneration and ingrowth in the deficient proximal part.

Some series report unpredictable results with cemented revisions of femoral components, and intermediate term results are still discouraging [1–3]. These have led surgeons to shy away from cemented revisions and to explore other options, not without some setbacks [4–13].

The cementless distal locking hip revision stem with hydroxyapatite coating offers a relatively fresh and attractive alternative, with promising results and a much less demanding technique than that required for standard press-fit stems [14]. Its distal locking screws provide primary diaphyseal stabilisation, with further secondary metaphyseal fixation through osseous ingrowth into the proximal hydroxyapatite-coated portion of the prosthesis [14–20].

The aim of this study was to conduct a comprehensive retrospective analysis of the first 100 cases treated with this type of implant in our referral centre. We report and analyse overall survival, reasons for failure, and mid-term clinical and radiological outcomes in these patients. We specifically study bone ingrowth, stress shielding and incidence of thigh pain. We also report and investigate complications we encountered.

Patients and Methods

The interlocking hip revision stem (IRH) (I.CERAM Implants Orthopédiques, Limoges, France) as a total hip revision stem was first introduced in our hospital in November 1998. Between November 1998 and November 2008, our hospital conducted 976 hip revisions.

All the authors have participated in this paper. We confirm that it has not been sent to any other journal.

Institutional Review Board (IRB) approval was not required because patients were treated according to local standards of care; no clinical interventions were made based on the data collected

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2015.01.026.

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Out of these, 118 were IRH stems (12%) and were implanted in 112 patients. We retrospectively reviewed the first 100 IRH stems implanted in 94 patients. Patient characteristics were recorded, as well as the indication for the first joint arthroplasty and the need for subsequent surgeries. Preoperative radiographs were available for analysis prior to the index surgery. Femoral bone deficiency was classified according to the American Academy of Orthopedic Surgeons classification. Periprosthetic femoral fractures were classified according to the Vancouver classification.

We did not use the IRH when septic loosening was suspected. In patients with no major proximal femoral defect (Paprosky Type 1 and 2), and whenever possible, we used the more conventional long cemented or proximally porous revision stems. The IRH stem was used during the reported period preferentially in either aseptic hip prosthesis revision surgery or periprosthetic hip fracture, when faced with deficient proximal bone stock (Paprosky Type 3 and 4) (Fig. 1). Other modalities used in these patients were the Wagner conical stems.

The IRH stem is composed of titanium alloy, coated with alumina and hydroxyapatite using the plasma spray technique. It is cylindrical in shape and has longitudinal grooves that increase in depth from proximal to distal. It behaves similarly to a conical or tapered device in spite of its cylindrical geometry. The cylindrical shape affords greater surface area for bony contact, when compared to a tapered design. Neck angulation is fixed at 135°. The concept behind the implant's design is that the primary stability provided by the interlock is sufficient to allow bony ingrowth, which is then enhanced by the hydroxyapatite coating. This type of interlock also offers the added advantage of allowing for adjustment of stem depth and rotation, in accordance with the degree of intraoperative hip joint stability encountered, before locking the hip with the distal screw(s). Thus the surgeon enjoys the benefits of a degree of "modularity," without the need for modular components or their associated complications. The device's proximal locking screw and dorsal fin can be used to seal the osteotomy and to properly anchor the abductor (gluteal) muscles and adjust their tension. The stem is available in different lengths: 210, 240, 270 or 310 mm. Diameter options range from 14 to 22 mm in 2-mm increments. The compatible femoral head diameters are 28 and 32 mm. Locking screws are 5 mm or 7 mm in diameter, and are partially threaded laterally.

Surgical Technique

The postero-lateral hip approach was used, with an extended trochanteric osteotomy of 12 cm or longer in all cases, except in the patient with a pathological fracture. Following the removal of the prosthesis, cement and fibrous membranes, the bone defect was evaluated; it was usually found to be more extensive than what had been estimated radiologically. The femoral canal was reamed between 1 and 2 mm wider than the stem which had been selected for use. Different from other types of cementless stems, the IRH is not a press-fit stem. Primary stability is insured by distal locking and not by tight canal filling. This actually offers the surgeon some advantages. Over-reaming allows us to adjust both the depth and the rotation of the final implant prior to distal locking. Also, over-reaming reduces the risk of anterior cortex perforation inherent to long and straight femoral stems, such as the IRH. After reaming, medullar cavity diameter and length were checked with a special trial device. The final stem was selected based on the canal filling and distal resistance after impacting the trial version. The stem was then introduced and joint stability assessed, adjusting stem length and rotation as needed. The stem was fixed with one or two interlocking screws, depending upon its length. We advocate the use of the smallest possible length to insure a distal anchoring, further reducing the risk of anterior cortex perforation. In our series, the most commonly used stem was the 240 mm stem (72 stems) and the least used was the 310 mm stem (2 stems). Finally, the osteotomy was sealed using the proximal locking screw and/or cerclage wires through the stem's dorsal fin (Fig. 2). Lyophilised bone allograft was used when deemed necessary to fill osteotomy gaps. Postoperative bed rest averaged 3–4 days. The mean hospital stay was 10 days. Partial weight bearing was encouraged with crutches during the first 6 weeks. At 3 months full weight bearing was reached with or without a crutch, depending upon the patient's tolerance.

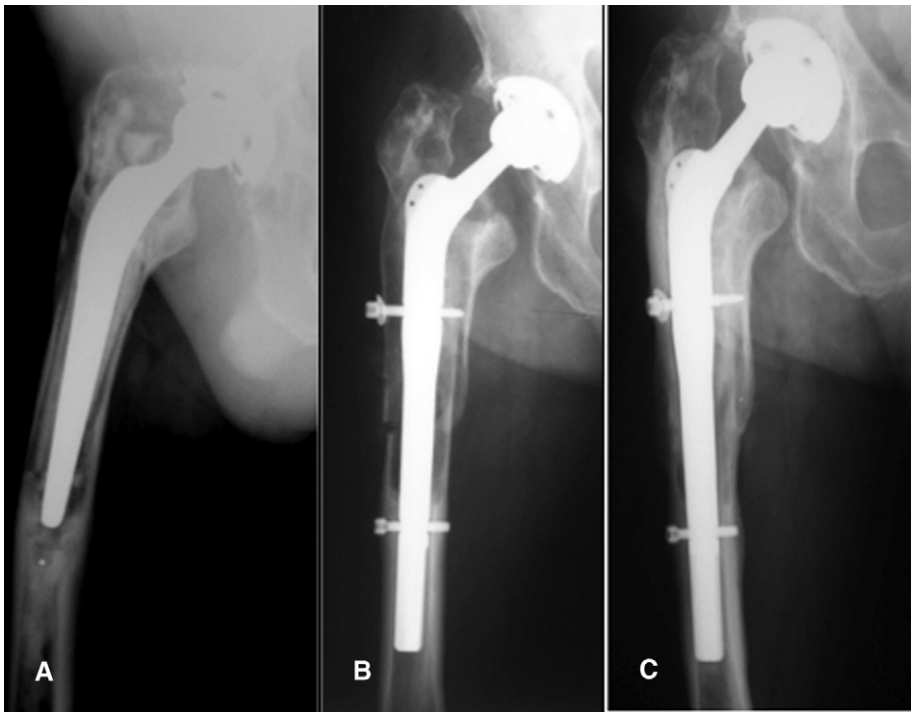

Fig. 1. (A) Preoperative X-ray of a 72 year old female with aseptic loosening of a hybrid total hip arthroplasty conducted 9 years prior to presentation. (B) 6 weeks postoperative x-rays of the index revision using the described technique. The transfemoral osteotomy line is still visible. (C) At the 9-year follow-up, the osteotomy has healed, and no stress shielding can be observed. Also note the proximal femoral bone stock regeneration.

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