Femoral revision with a primary cementless stem

O. Gastaud *, P.M. Cambas, J. Tabutin
Centre hospitalier de Cannes, 15, avenue des Broussailles, CS 5008, 06414 Cannes cedex, France

Abstract

Introduction: The use of a primary cementless component is a tempting option for revision total hip arthroplasty (reTHA), however, the results of this type of revision have not been clearly determined. The goal of this retrospective study was to determine: if revision with a primary anatomical cementless femoral stem gives adequate bone fixation; the rate of secondary subsidence or recurrent loosening; the survival rate with this device.

Hypothesis: Revision with a primary anatomical cementless femoral stem results in a low rate of subsidence and recurrent loosening.

Materials and methods: This retrospective series of 43 reTHA performed between 1994 and 2012 included 43 patients, mean age 66 years old (37–90) with a minimum follow-up of 24 months. There were grade 1 (n = 24) or 2A (n = 19) bone defects according to the Paprosky classification. The causes of revision were aseptic loosening in 27, septic loosening in 6, malposition of the implant in 7 and periprosthetic fractures in 3. Clinical (Postel Merle d’Aubigné [PMA] and Harris scores), and radiological (subsidence) assessment was performed, as well as survival analysis (with a 95% confidence interval).

Results: All components were changed through posterolateral approach without femorotomy. In four cases de-escalation (use of a primary component for secondary revision of a prior revision component) was performed. There were no perioperative fractures or perforations. After a mean 47 months (24–134), the mean PMA score increased from 10 (5–15) to 16 (11–18), and the Harris score from 58 (20–80) to 85 (66–96). Radiological assessment did not show any extensive radiolucencies or secondary subsidence. Only 3 components were placed in a varus position, with no clinical consequences. One patient had subsequent revision for recurrent dislocations. Estimated survival at 80 months by Kaplan-Meier analysis was 85% (CI 95%; 64–100%).

Discussion: There are very few studies in the literature (7 series) on this topic, which shows the reluctance of surgeons to use this technique. Placement of a primary femoral stem requires good metaphyseal bone quality for primary stability. Thus, the indication is limited to Paprosky 1 and 2A stages. Revision surgery must be performed by endofemoral approach requiring good preoperative planning, as well as knowledge of the explanted component and a revision component must be available, if necessary, in the operating room.

Level of evidence: Retrospective study, level 4.

1. Introduction

In France revision THA represents an estimated 12% of all hip arthroplasties [1,2]. These figures will probably rise because of the increase in the number of primary THA and in patients’ life expectancy. Revision THA with a primary femoral stem is not new. When Austin-Moore prostheses were used on femoral neck fractures, fixation did not occur in a certain number of implants and revision THA was required, using in most cases a primary cemented stem [3]. Longer revision stems were then developed, with very different characteristics and that compensated for metaphyseal bone defects [4–6]. In most cases this resulted in treatment escalation, which was sometimes not useful, limiting the options in later revisions.

The choice of a femoral component for reTHA should be made based on precise radiographic criteria: depending on the stage of loosening (bone quality) [7,8] especially of the calcar, the rest of the metaphysis and the presence or not of a fracture. Thus, if bone quality is good and there is no fracture to compromise fixation of a standard implant, a primary femoral stem can be considered even when replacing a revision stem [1,4,6,9]. In this way treatment...
escalation is prevented, which would limit future component options if additional revisions are necessary. Moreover, the choice of a primary design is more satisfactory because of the press-fit, resulting in stabilization at the metaphysis and a relatively short surface contact in the diaphyseal zone (3 to 5 cm), which is easier to obtain than with a long stem (even if it is curved) [10]. However, the outcome of this type of revision has not been clearly determined, thus we performed a retrospective study to define:

- if femoral revision with a primary anatomical cementless stem would provide adequate bone fixation;
- the rate of secondary subsidence or recurrent loosening;
- implant survival.

Our hypothesis was that femoral revision with a primary anatomical cementless stem would result in a low rate of subsidence and recurrent loosening.

2. Materials and methods

2.1. Patients

Between 1984 and 2012, we used a primary stem in 117 cases of femoral component revision (23% of 508 revisions). Until 1994, the standard implant was a cemented GBI™ stem (Tornier, Montbonnot, France), afterwards the cementless Linéa™ stem (Tornier, Montbonnot, France) was used. This is an anatomical stem for primary arthroplasty, proximally hydroxyapatite-coated on sandblasted titanium, with a global anteverision of 13°. This device has a CCD angle of 125° or 135°, a 12/14 morse taper and a homothetic increase in neck length. Fixation is trochanteric or subtrochanteric. There is a simple modular neck, with a 28 mm diameter cobalt-chrome alloy head. This single center, single surgeon cohort study performed between October 1994 and December 2012 included all patients who underwent revision of the femoral component with a standard Linéa™ stem (for primary THA). Femoral bone defects were all SOFCOT stage I or II [7], or Paprosky 1 or 2A [8] which was the main criterion for revision with a primary femoral component. We analyzed the causes of revision, the implant that was changed and the number of previous revisions.

2.2. Surgical technique

Technically, after removing the existing implant and, if necessary, the cement whose removal should be complete, the canulated revision rasps were gently hammered down along an intramedullary stem guide to prevent any perforation. A trial revision component, which was 5 to 7 cm longer than the standard one, checked the correct position. If the metaphyseal stability/bone quality was found to be good, a standard trial rasp was then used (following the pathway that had been prepared), to confirm firm implant fixation. Thus, although bone quality was estimated during surgical planning, the final decision to use a standard primary device was made during surgery.

2.3. Methods of assessment

Mean follow-up was 47 months (24–174). There were no lost to follow-up in the cohort. Four patients died a certain time after surgery (more than 24 months) but there was no relationship with reTHA. Patients systematically underwent a follow-up consultation at 1, 3 and 6 months, then at one year and every two years thereafter, including a clinical evaluation with the Postel Merle D’Aubigné (PMA) [11] and Harris [12] scores and a radiological assessment including an AP view of the pelvis and Lequesne’s false profile view of the hip to identify progressive radiolucencies or stem migration. The Engh grading scale was calculated for each patient to evaluate component fixation at the final follow-up [13].

2.4. Statistical methods

Statistical analysis used means, standard deviations and ranges. The Student t-test was used to compare values before surgery and at the final follow-up. Significant P value was set at 5%. Survival for all causes of stem revision was estimated by a Kaplan–Meier curve with a confidence interval (CI) of 95%.

3. Results

This study included 43 components in 43 patients (15 men and 28 women), 20 right hips and 23 left. Mean age was 66 years (37–90). This represented 15% of the 286 femoral revisions performed during this period. There were 17 cases (40%) of SOFCOT stage 1 aseptic loosening (or Paprosky 1), and 10 cases (23%) of SOFCOT stage II (or Paprosky 2A) [7,8]. There was component malposition in 6 patients (14%) with recurrent dislocation, septic loosening in 6 (14%), and metaphyseal periprosthetic fractures in 3 (7%) (SOFCOT B2) [14]. One patient presented with head-cup disassociation of a hemiarthroplasty with femoral component malposition (Fig. 1).

The femoral component that was changed was a standard stem in 34 cases (79%), a revision stem in 4 cases (10%), a hemiarthroplasty stem in 4 cases (10%), and an Austin–Moore prosthesis in one case. This was the first revision in 30 cases (70%), a second revision in 10 cases (23%), and a 3rd revision in three cases. The explanted component was cemented in 19 cases (44%) and cementless in 24 cases.

There were no perioperative perforations or fractures. One patient treated for septic loosening by single stage surgery presented with recurrent postoperative dislocation and underwent revision surgery with a dual–mobility cup at another center at 70 months postop. This was the only patient who was reoperated in this series. None of the patients who underwent one-stage surgery for septic loosening presented with recurrent infection after a mean follow-up of 54 months (27–83).

Twenty-three patients underwent bipolar revision (53%) (with 2 dual-mobility cups) while 20 (46%) underwent unipolar revision (changing only the stem in 10 cases, with the liner in 10 cases). Revision was performed by a single surgeon through a postero-external approach. No femorotomy, trochanterotomy or femoral windows were performed in this series. A 28 mm metal-on-polyethylene bearing couple was used in all cases.

The mean PMA score increased from 10 (5–15) to 16 (11–18) points, or an improvement of 6 points (P<0.001) (Fig. 2) and the mean Harris score at the final follow-up was 85 (66–96), for an improvement of 27 points (P<0.001). Thigh pain was reported in 7 patients, which had resolved at 6 months.

The radiographic assessment showed that all femoral components were integrated, with no secondary subsidence, loosening of the stem or progressive radiolucencies. In 34 cases (79%), a radiolucent line was seen around the stem in Gruen zones 3, 4 and 5 [15], corresponding to the area with no bioactive coating. The bone was in contact with the implant in zones 1, 2, 6 and 7. The final mean Engh grade w[13] as 12.4 (2–26). This was considered to be good (0–5) in 3 cases and excellent (>5) in the 40 other cases (93%).

Three stems were in a varus position, with no clinical consequences (no thigh pain) and a PMA score of 17,17 and 16. There were no complications in the 4 revisions of revised stems with standard stems (all were unipolar revisions). At the final follow-up (24, 32, 90 and 135 months) the mean PMA score in these four patients had
Fig. 1. Preoperative (A) and final follow-up (B) (85 months) X-rays, of revision for intra-prosthetic dislocation of a hemiarthroplasty.

Fig. 2. Comparative diagram of preoperative Postel Merle d’Aubigné (PMA) scores [11] at follow-up for each patient.

improved by 4 points (from a mean preoperative score of 11.2 to 15.2 at the final follow-up) (Fig. 3).

Ten patients presented with residual limb length discrepancies (23%) of no more than 1 cm, including one with 1 cm lengthening. One patient presented with a single episode of dislocation one month after surgery, which was treated conservatively by closed reduction. At the final follow-up the PMA was 12, which was an improvement of six points, with persistent shortening of 1 cm.

Fig. 3. (A) Preoperative X-ray of aseptic loosening on a revision femoral component. (B) X-ray at 32 months follow-up after revision with a primary stem.
Another patient, who was clinically obese (BMI = 38) and with psychiatric disorders and whose first revision was indicated due to septic loosening, presented with eight episodes of dislocation despite a dual-moitylity system. This was the only patient who underwent further surgery with a bipolar revision in another center, the stem was found to be stable during revision. Estimated survival at 80 months (all causes of revision combined) by the Kaplan-Meier method was 85% (CI 95%: 64–100%) (Fig. 4).

4. Discussion

The hypothesis of this study was confirmed: it is possible to obtain adequate fixation using a primary anatomical cementless femoral stem in rETHA. Criteria for this indication are both preoperative (SOFCOT I or II, Paprosky I or 2A), and perioperative (endofemoral approach, stability of the trial implant). Under these conditions we obtained a stable, durable implant fixation in all cases. The clinical results were good (PMA = 16), and stem fixation was good (no secondary subsidence, no extensive radiolucencies).

Our study has certain limitations. It is a retrospective study with a mean follow-up of 47 months, however, the results are comparable to those in the literature on femoral revision with primary stems [17–20]. A review with an additional five years of follow-up is needed to confirm these encouraging results on the good long-term survival of the femoral component. Nevertheless, this type of component remains well fixed once osseointegration has occurred. We did not consider associating a graft since the device should be stable with sufficient filling. The number of cases in this series was small (43 cases) showing that the indications are limited by the bone quality. Because of the retrospective design of the study, it was impossible to determine how many revision stems were used instead of primary stems during surgery. However, this is a single-surgeon, homogeneous study using a single technique and component with no lost to follow-up patients.

Our review of the literature shows that most femoral components are revised with cementless revision stems, which may be covered with hydroxyapatite, with or without locking screw fixation [4–6,21]. The advantage of this type of component is immediate diaphyseal fixation which favors osseointegration. It is also logical to bridge bone defects by extending distal fixation by at least two femoral diameters [20]. Unlike the series by Mencière et al. [22], and like Miletic et al. [17], our series shows that therapeutic de-escalation is sometimes possible with a cementless system. The literature of femoral revisions using primary stems is limited (Table 1). Results with cementless stems seem to be slightly better, although the published articles have evaluated both standard and revision stems [6,25] or standard cemented and cementless stems [17]. Moreover, many different devices are used including relatively long stems (6 inches, or more than 15 cm) [19]. Only 3 studies report the use of partial hydroxyapatite coating, for a total of 131 implants with 6 perioperative fractures, 1 case without immediate postoperative bone fixation and 2 cases of secondary postoperative loosening (1 septic and 1 aseptic) [16,23,24].

Most perioperative complications involved perioperative fractures or perforations [16,18,19,23,24], which can be avoided by using a component whose metaphyseal shape is the same for both revision and standard versions. This makes it possible to correctly center the final device using the descent of the revision rasp along an intramedullary guide: asymptomatic postoperative varus only occurred in 3 patients. A perioperative fracture or perforation would have been a contraindication to the use of the primary design. Postoperatively, the different rates of complications in the published series (mainly secondary subsidence) are probably due to differences in bone defects, which we voluntarily limited (selection criteria) [26]. Severe bone defects require long revision stems.

<table>
<thead>
<tr>
<th>Study</th>
<th>Implant and type of surface treatment</th>
<th>N patients</th>
<th>Bone defect</th>
<th>Complications</th>
<th>Follow-up (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelly et al. [16]</td>
<td>Securfit plus™ (Stryker) Parital HA coating</td>
<td>33</td>
<td>AAOS type I, II or III</td>
<td>3 perioperative fractures 1 dislocation</td>
<td>5</td>
</tr>
<tr>
<td>Thorey et al. [23]</td>
<td>Bicontact (B-Braun) Partial HA coating</td>
<td>79</td>
<td>Paprosky I, II</td>
<td>2 perioperative fractures</td>
<td>7</td>
</tr>
<tr>
<td>Tauber et Kidron [18]</td>
<td>CLS Spotorno (Zimmer) Complete HA coating</td>
<td>24</td>
<td></td>
<td>2 perforations 1 dislocation</td>
<td>4.5</td>
</tr>
<tr>
<td>Miletic et al. [17]</td>
<td>De-escalation++ Zweymuller (10) full porous without HA coating (Zimmer) + cemented stems (5) (Stryker)</td>
<td>15</td>
<td>SOFCOT I et II</td>
<td>0 fracture</td>
<td>4.5</td>
</tr>
<tr>
<td>Khanuja et al. [24]</td>
<td>Accolade TMZF (Stryker) Partial HA coating</td>
<td>19</td>
<td>Paprosky I, II</td>
<td>1 perioperative fractures 1 aseptic revision</td>
<td>5</td>
</tr>
<tr>
<td>Tetreault et al. [19]</td>
<td>Versys (Zimmer) Echelon (Smith &amp; Nephew)</td>
<td>144</td>
<td>Paprosky I, II, IIIA</td>
<td>6 aseptic revisions 3 postoperative fractures 8 dislocation</td>
<td>4</td>
</tr>
<tr>
<td>Our series</td>
<td>Partial HA coating</td>
<td>43</td>
<td>SOFCOT I and II</td>
<td>1 recurrent dislocation: change 1 isolated dislocation</td>
<td>4</td>
</tr>
</tbody>
</table>
and are associated with a higher rate of complications because of the initial bone loss [21]. As a precautionary measure, a revision component should be available in the operating room. Indeed, bone defects are sometimes underestimated on preoperative X-rays, and in this case the choice of implant must be changed during surgery.

Our results on the causes of revision are similar to those in the literature [2,5,27]. Although they are different from those in the SOFCOT 2012 symposium on causes of revision THA in France, our study only includes revision with primary stems, excluding diaphyseal periprosthetic fractures or revisions without changing the femoral component [28].

5. Conclusion

This series confirms that with careful preoperative templating it is possible to use a primary anatomical cementless stem rather than a revision stem in at least 15% of femoral revisions. This requires thorough knowledge of the device to plan implantation and to prevent problems with fit. The stem should be removed by endofemoral approach to preserve the femoral sheath and to ensure primary stability. This method should be limited to loosening with moderate bone defects (SOFCOT stages I and II or Paprosky I and 2A, good metaphyseal bone quality), and exclude diaphyseal periprosthetic fractures (SOFCOT B or C). The final choice of implant is made during surgery.

Disclosure of interest

J.T. is an occasional consultant for Tornier, he did not received any payment for this study. O.G. and P.M.C. declares that he has no competing interest.

References