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Original Article

Differences in subsidence rate between alternative designs of a commonly used uncemented femoral stem

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ABSTRACT

Introduction: Measurement of early subsidence of uncemented femoral stems can be used to evaluate the likelihood of long term stem component loosening and therefore clinical failure.

Our aim was to evaluate the factors associated with subsidence in collared and uncollared versions of the Corail femoral stem.

Methods: 121 hips in 113 consecutive patients were studied, operated on by two surgeons in our hospital differing in their choice of Corail stem. This gave two groups of patients with 66 hips having collared stems and 55 hips having uncollared. We recorded patients' age, sex, ASA grade and BMI. Radiographs post-operatively at day 1, 6 weeks and 1 year were evaluated measuring subsidence, angulation, signs of stability and fixation, and canal fill ratio at the metaphysis and diaphysisafter correcting for magnification errors by calibration using femoral head size.

Results: Clinically significant subsidence (>3 mm) occurred in 7.6% of collared and 10.9% of uncollared stems, all within 6–8 weeks, but did not reach statistical significance ($p = 0.345$). Revision for symptomatic loosening was required in 1 patient in each group (1.5% collared versus 1.8% uncollared).

Discussion: Early subsidence of Corail femoral stem should alert surgeons to closer patient follow-up as the rate of early revision is 18% in stems with >3 mm of subsidence. However, the presence of a collar does not seem to be protective.

1. Introduction

The data from National Joint Registry (NJR) of England and Wales shows that the Corail is the most common uncemented femoral stem used in primary total hip arthroplasty, with a recorded increase in its usage from 15% in 2003 to just under 50% in 2011.[1] Corail femoral stems are manufactured in two designs; the collared and the collarless. Each design is available in two further subsets. The collared stems are available as standard and lateralised neck segment stems. The collarless stems are available as standard and high offset neck segment stems.[2,3] The Corail implant is made of forged titanium alloy (TiAl6V4). The proximal part of the stem is trapezoid in cross section, which flares in the sagittal and coronal plane to resist axial and torsional stresses providing initial stability in metaphyseal area. The distal part of the stem is quadrangular in cross section, which provides rotational stability in the absence of cortical contact. The whole stem is coated with 150 mm thick layer of hydroxyapatite (HA), which not only helps to prevent the release of metal ions, but also helps to provide maximum osteointegration at the bone–implant interface and prevents the interposition of the fibrous membrane around the distal portion of the stem.[2]

The differences in the short- and long-term durability of the two available designs of Corail stems are controversial. One potential limitation of any uncemented femoral stem is the risk of early subsidence or migration leading to loosening and implant failure.[4–7] Berend reported that the early subsidence of femoral stem was associated with higher revision rate.[4] However, Krismer et al. reported an increased incidence of early subsidence but better subsequent stability and good long-term results.[8] However, there is still a lack of sufficient evidence outlining the factors responsible for early subsidence in uncemented Corail femoral stems.[8–10] Our study aimed at another attempt to identify the factors responsible for early subsidence of the Corail femoral stems and to assess if the differences in the stem designs were responsible for this subsidence.

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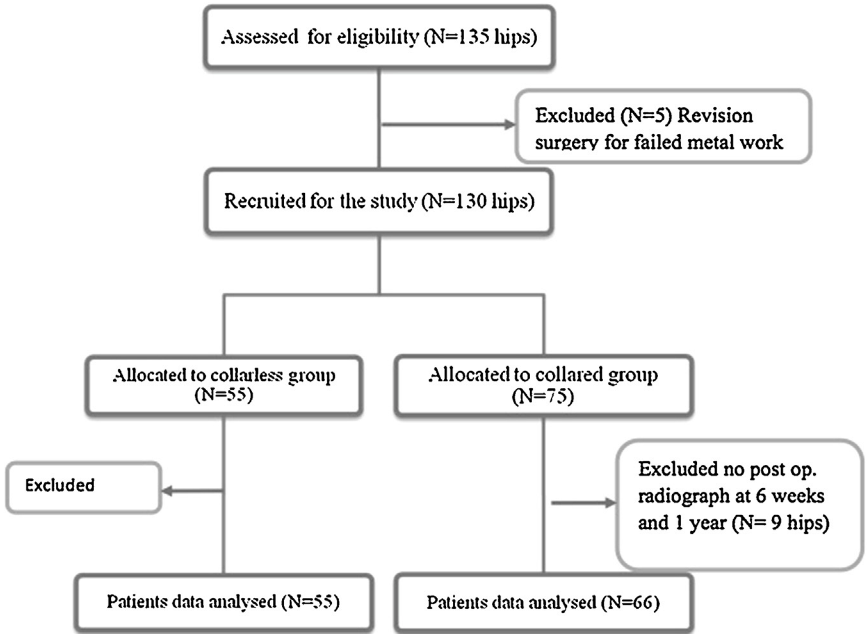

Fig. 1. Flow diagram of recruitment of patients.

2. Patients and methods

Between August 2007 and February 2010, 135 uncemented total hip replacements were performed using the Corail femoral stems and Pinnacle acetabular component (Corail; DePuy Orthopaedics Inc., Warsaw, IN) in 126 patients by two surgeons (IC and APW) in a district general hospital in the UK. One of these surgeons (IC) used the collarless stems, while the other surgeon (APW) used the collared stems for all his patients. We reviewed the outcome of these patients retrospectively. All consecutive primary total hip replacements performed for osteoarthritis, rheumatoid arthritis, avascular necrosis and dysplastic hips using the above implants were included. As a routine, plain radiographs were obtained at first postoperative day, as well as at 6–8 weeks and 1 year follow up. All primary hip replacements performed for fractured neck of femurs and all revision hip replacements were excluded from the study. Patients who lost to follow up were also excluded. The study was approved by the Biomedical Research Ethics Sub-Committee (BREC), University of Warwick, as a service evaluation for subsidence rate for alternative designs of the Corail femoral stems.

Fourteen hip replacements (13 patients) were further excluded from the study. Five of these were excluded because they had conversion of failed internal fixation for previous hip fractures to total hip replacements, and nine were excluded due to incomplete radiographic follow up at 6–8 weeks or 1 year stages. The remaining 121 hip replacements (113 patients) were considered valid for the study. Fifty-five hip replacements (51 patients) were allocated to the collarless group, and 66 hip replacements (62 patients) were allocated to the collared group. There was no loss to follow up in these patients (Fig. 1).

Radiographic assessment was done on anteroposterior (AP) radiographs obtained at the afore-mentioned follow up intervals and included the degree of subsidence or early migration, angulation, signs of loosening and associated implant complications. Subsidence of the femoral stems was measured comparing the radiographs at the first day after surgery with the radiographs taken at the mean of 1 year using the following technique (Fig. 2):

1. The magnification error (ME) for both the films was minimised. It was measured by a straight line drawn from the centre of the head to the margin of the head, and then dividing the measured value with the actual size of the head used (28 or 36 mm).
2. The distance from the centre of the head to the tip of the stem or the most prominent point of the lesser trochanter (LT), and then divided it by the magnification error.
3. The distance from the tip of greater trochanter (GT) to the shoulder of the stem and then divided it by the magnification error.
4. Calcar height (CH), which is the distance from the most prominent aspect of the medial part of the femoral neck to the tip of the lesser trochanter, divided by the magnification error.
5. Valgus or varus angulation of the stem.
6. The canal-fill ratio at the distal (diaphyseal) and the middle (metaphyseal) third of the stem, measured only on the radiographs at the first day postoperatively.

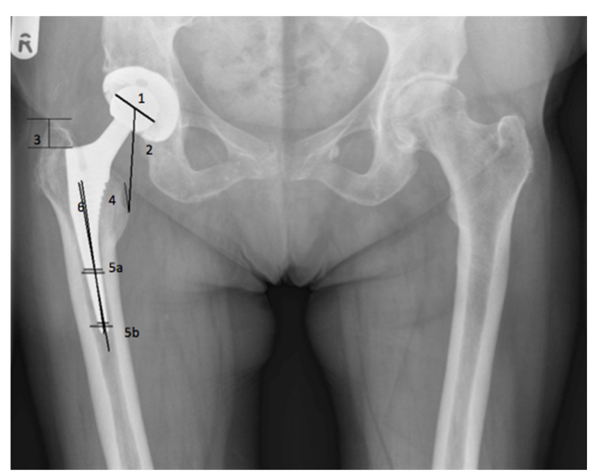

Fig. 2. Subsidence measurement. (1) Centre of head for magnification error (ME), (2) centre of head to tip of lesser trochanter (LT), (3) tip of greater trochanter to shoulder of stem (GT), (4) calcar height (CH), (5) canal fill ratio, (5a) middle 1/3, (5b) lower 1/3, (6) varus or valgus angulation.