RESEARCH ARTICLE

Total Hip Replacement Revision in a Single Brand Small Cementless Stem – Our Experience after the Findings of the National Joint Registry

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Abstract

Background: Cementless total hip replacement is the common THR performed in England, Wales, Northern Ireland and the Isle of Man. The Corail stem is the most popular cementless implant and has a ODEP 10A rating. Review of its performance in the registry identified an increase rate of revision amongst the smaller stem sizes. However, clarity was not provided on the explanation for this finding. We reviewed our own experience of smaller stems with a view to understanding the reasons for revision.

Methods: We reviewed a single centre, single surgeon experience of the smaller Corail stem sizes for a ten-year period from 2003 to 2013. All data was collected from a prospectively maintained database. Details of clinical and radiological follow up were collected for all patients who had Corail stem size 8 and 9 implanted. Revision for any cause was taken as our endpoint.

Results: 542 patients underwent total hip arthroplasty using the Corail stem during the study period. 53 small size Corail stems were implanted. The average age was 59 (range 17-88 years) and the average follow up was 41.4 months (range 1-118 months). 6 patients underwent revision during the study period, but only 4 stems required revision. The reasons for revision were aseptic loosening, fracture and metal-on metal complications. Only two stems required revision for stem related factors (3.8%).

Conclusion: There was no evidence of an increased rate of revision in the small Corail stems in our cohort.

Keywords: Cementless total hip replacement, Corail stem, Revision total hip replacement

Introduction

Cementless Total Hip Replacement (THR) emerged in the 1970s and press-fit biological fixation of THR is accepted as an alternative to traditional cemented designs (1). The volume of cementless THR surpassed cemented THR in the National Joint Registry (NJR) of England, Wales, Northern Ireland and the Isle of Man in 2009 (2). The Corail femoral stem (DePuy Ltd, Ringsakiddy, Cork, Ireland) remains the most commonly used cementless femoral stem in the NJR (2). It is also the most common cementless prosthesis in both the Norwegian and Australian joint registry (3, 4). In 2015, Corail was awarded a 10A rating from the Orthopaedic Data Evaluation Panel (5). The stem is a fully hydroxyapatite (HA) coated non-porous forged titanium alloy stem, which has gradual change in cross section for a trapezoid shape proximally to a quadrangular shape distally. The neck of the stem is a polished, low profile neck with a 12/14 taper ("Articul/eze", DePuy). The stem is available with or without a collar, and available in a range of sizes (6-20), with options for coxa vara, high offset and short neck morphology. The 'philosophy' for this prosthesis is based on compaction broaching of the proximal femur to achieve maximal porous bony ingrowth at the metaphyseal and diaphyseal stem.

Jameson et al. reviewed the performance of the Corail stem and Pinnacle cup in 35,386 cases over a 7 and half-

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year period using the NJR data (6). They investigated for predictors of failure and found the risk of revision was greater in smaller femoral stem (sizes 8 to 10) when compared to the mid-range sizes. They concluded that this may be secondary to "inadequate press-fit or poor bone quality" but could not be explain their findings fully without access to patients medical and radiological records. The Irish National Orthopaedic Registry is in its infancy and thus no national data from the republic of Ireland is readily accessible. For this reason, we are limited by our local experience in respect to smaller Corail stem. Using revision of either femoral or acetabular component as an end point, our aim was to investigate the rate of revision and reasons for revision in our cohort of small Corail stems.

Materials and Methods

We interrogated our local prospectively maintained database of a single surgeon's experience with the Corail stem over a ten-year period. The first Corail stem was implanted in this hospital in 2003, and in total 542 had been implanted for primary THR up until the end of 2013. The mean stem size for this prosthesis in the Irish population is size 11 (7). Corail DDH (size 6) and Corail short neck stems were also excluded, as they were not available for implantation at our institution during the study period. We included all size 8 and 9 Corail stems that were used in primary total hip replacement in a ten-year period, but unlike Jameson et al, we excluded size 10 stems as they were within one size of the mean in the Irish population. Data available included femoral and acetabular components details, bearing surfaces and length of follow up. Radiology follow up was conducted for all patients to identify any radiological problems. A full chart review was also conducted to identify patient symptoms and any patient who were awaiting revision or who had declined it. Patients who underwent hip hemiarthroplasty using the Corail stem were excluded from the review.

Results

Fifty-three total hip replacements were identified in 50 patients over the 10-year period that fulfilled the criteria. The average age at surgery was 59 years of age (range 17-88 years). The ratio of female patients to male was 2.8:1. In our cohort there were 14 size 8 stems and 39 size 9 stems inserted. 10 femoral stems were collared and all of these were size 9. All Corail stems were combined with appropriate DePuy matched acetabular components. In the case of 6 hips, the Corail stem was coupled with the Articular Surface Replacement (ASR) (DePuy Ltd, Ringsakiddy, Cork, Ireland). The bearing surface breakdown is given in Table 1. The average length of follow up was 41.4 months post-total hip replacement (range 1-118 months)

Six patients underwent revision total hip replacement during the study period. The revision THR cases are summarised in Table 2. Of these 6, two patients

Table 1. Bearing Surfaces of small Corail stems (N=53)

Bearing Surface	Number
Metal-on-polyethylene	36
Ceramic-on-ceramic	10
Metal-on-metal	6
Ceramic-on-polyethylene	1

Table 2. Revision THR Details

Revision Case	1	2	3	4	5	6
Patient age	55	66	17	32	74	71
Patient sex	Female	Male	Male	Male	Male	Female
Initial indication for THR	Symptomatic end stage OA	Symptomatic end stage OA	Osteonecrosis post SUFE fixation	Avascular necrosis of femoral head	Symptomatic end stage OA	Symptomatic end stage OA
Initial components						
Stem	Corail 9	Corail 9	Corail 9	Corail 9	Corail 9	Corail 9
Cup	Duraloc 56mm	ASR 52mm	ASR 58mm	Duraloc 56 mm	Duraloc 64mm	Duraloc 62mm
Bearings	Metal-on-polyethylene	Metal-on-metal	Metal-on-metal	Metal-on-polyethylene	Metal-on-polyethylene	Metal-on-polyethylene
Time to revision	39 months	52 months	84 months	118 months	1 month	85 months
Indication for revision	Recurrent dislocations	Symptomatic pain with soft tissue reaction on MRI and raised metal ion levels	Symptomatic pain, loose stem and raised metal ion levels	Symptomatic loose stem	Early postoperative periprosthetic fracture	Symptomatic loose stem
Revised to						
Stem	Not changed	Not changed	Corail 15	Corail Revision 13	Solution Stem 13.5mm x 8 in	Cemented Corail 10
Cup	Pinnacle 58mm	Pinnacle 58	Pinnacle 66mm	Not changed	Not changed	Not changed
Bearings	Ceramic-on-ceramic	Metal-on-polyethylene	Ceramic-on-ceramic	Ceramic-on-polyethylene	Metal-on-polyethylene	Metal-on-polyethylene

Figure 1. Patient 1 pre and post revision surgery x-rays.

Figure 2. Patient 2 pre and post revision surgery x-rays.

underwent revision of their acetabular components only. Of the 4 stems revised, one was for metal-on-metal (MOM) related aseptic, lymphocyte-dominated vasculitis-associated lesion (ALVAL), one for periprosthetic fracture, and two for aseptic loosening.

Mean time to revision was 63 months (range 1-118 months) for the six patients who underwent revision. However two of these patients did not have their femoral component revised. This leaves a total of 4 stems from 53 revised during the course of the study, with a mean time to follow up for these 4 stems of 72 months (range 1-118 months).

Patient 1: 55-year-old female revised for recurrent left hip dislocation 3 years post left total hip arthroplasty due to inadequate acetabular inclination. Intraoperative assessment of the Corail stem showed it to be osteointergrated without complication. The Acetabular component was revised and patient suffered no postoperative complications [Figure 1].

Patient 2: 66-year-old female underwent revision of acetabular components of left stemmed ASR 6 years post primary procedure, due to pain, raised ion levels (Co 264 nmol/L Cr 180 nmol/L) and MRI evidence of ALVAL lesion adjacent to the left hip. During revision surgery, the acetabular component and bearing surfaces were exchanged and ALVAL lesion excised. The Corail stem was well osteointergrated and was left in situ. Interval follow up continues, and no sequelae noted [Figure 2].

Patient 3: 17-year-old boy underwent right total hip replacement following osteonecrosis of his right femoral head following percutaneous in situ fixation of a slipped capital femoral epiphysis. He underwent Total hip replacement with ASR bearing surface. Four years following primary surgery, patient complained of significant right hip pain. Metal ion levels were raised, with Cobalt measuring 651 nmol/L and Chromium

Figure 3. Patient 3 Pre-op, pre-revision and post-op revision x-rays.

Figure 4. Patient 4 initial follow up x-ray and pre-op revision x-ray.

measuring 451 nmol/L. X-ray demonstrated a loose femoral stem and MRI showed evidence of a significant ALVAL lesion. Patient underwent revision of right total hip replacement to a ceramic-on-polyethylene bearing and stem size changed from Size 9 to 15 and had an uneventful course since revision surgery [Figure 3].

Patient 4: 42-year-old male 10 years post THR (for severe coxarthrosis) underwent revision left total hip replacement for aseptic loosening. Patient complained of left hip pain and x-rays demonstrated eccentric polyethylene wear and extensive lysis around the stem. Preoperative work up demonstrated no evidence of infections and patient underwent single stage revision of all components. The stem was changed from Size 9 to Size 13 Corail Revision stem [Figure 4].

Patient 5: 74-year-old man underwent right total hip replacement for osteoarthritis. Patient returned four weeks post primary procedure after a mechanical fall complaining of severe pain and decreased mobility. X-rays confirmed early postoperative periprosthetic fracture. He underwent revision right femoral component with a diaphyseal bearing fully HA coated distally loaded stem [Figure 5].

Patient 6: 77-year-old female underwent revision of left total hip replacement for left hip pain associated with aseptic loosening 6 years after index surgery. The acetabular component was left in situ but the liner was changed, and the femoral component was revised. In this case the stem was revised to a cemented Corail stem [Figure 6].

Figure 5. Patient 5 initial post op x-ray, post fall x-ray and post revision x-ray.

Figure 6. Patient 6 initial follow op, pre-op and post-op revision x-rays.

Discussion

Small Corail stems were found by Jameson et al to be an independent predictor of failure with interrogation of the NJR (6). They hypothesised that this may be of a result of inadequate press-fit of the initial prosthesis or indeed from poor bone quality. However, data is lacking to make meaningful conclusions from the registry data. Qualitative data from our smaller cohort shows a standard range of reasons regarding indications for revision. Our indications included aseptic loosening, periprosthetic fracture, dislocation and metal-on-metal bearing related issues. Periprosthetic infection remains a devastating complication of total hip arthroplasty, but was not identified in this patient cohort and would not be related to the size of the femoral stem and thus was not considered further.

Small uncemented stems may fail due to undersizing in the proximal femur. This may be related to difficult anatomy associated with younger patients with thicker cortices, e.g. in patients with Dorr type A femurs, or coxa vara deformities, or due to younger, smaller females, often with DDH. The relative increase in size of the smaller Corail stems between sizes 8, 9 and 10 is larger than for the rest of the range. Fear of intraoperative fracture may cause surgeon to err towards undersizing, which results in inadequate cancellous impaction, and insufficient bony ingrowth between the HA coating and bone. Undersizing of the Corail stem has been shown to be associated with aseptic loosening by Magill et al, and they highlight the trend away from the smaller sizes in their series which they attribute to preoperative templating and a learning curve (8). Both of our stems which were revised for aseptic loosening were revised to larger Corail stems and post-operative x-rays demonstrate that they were undersized at the time of the original surgery which indicates that the cause of revision was surgeon related and not prosthesis related. With experience and digital pre-operative templating undersizing may be avoided.

The is a wide variation in types of femurs, but in particular computed tomography studies have shown women and small femurs tend to be narrower in cross section (9). These narrower femurs tend to have a higher fracture rate, and the Corail stem size was statistically smaller in those with fracture than without (9). Only one of the 4 stems revised in our cohort was in a female. However, surgeons using this particular stem should be familiar with these potential problems and have strategies to combat them. Due to the unavailability of the dysplasia stem during our period of review, the senior author utilised alternative stems with increased modular options for potentially problematic narrow femurs in our unit.

It is interesting in our cohort that all revisions were associated with collarless stems. Since 2011 the senior author has evolved his practice to use exclusively collared stems. No failures have been noted since this change in practice which represents 18.8% of the study population. The collar provides useful short term benefits and projects against early subsidence and fracture (10). Although there is no evidence showing a long-term difference between outcomes of collared or non-collared Corail stems, it has been proposed that collared uncemented stems have significantly greater immediate stability than collarless stems, and can withstand greater vertical and horizontal forces before the initiation of subsidence and subsequent fracture (11).

Metal-on-metal bearing surface complications are a well-recognised reason for revision arthroplasty and is observed in our small cohort with 2 out of 6 patients (33%) undergoing revision surgery, and one of the 4 stems revised due to loosening secondary to ALVAL. Multiple reports in the literature support the risk of revision associated with metal-on-metal bearing surfaces with increased metal ion levels, excessive bearing and taper wear, local soft tissue complications and possible risk of systemic issues all being reported (12). Stemmed metal-on-metal total hip replacements perform poorly in registry data and have not been shown to be superior to metal-on-polyethylene in comparison studies (13, 14).

Weaknesses of this study include that it is based on a single surgeon practice from a single institution dealing with elective arthroplasty, and that our numbers are low compared to data from joint registers therefore it is not possible to extrapolate our findings. However, the smaller size of the study and its single institution remit allows a more qualitative review of the reasons for failure, which is not possible when parsing the registry data alone. The Mean medullary canal cross-section in the population is unknown and may be smaller than the registry, which would account for the smaller mean size, however both populations are similar in ethnicity and geographically related.

In conclusion, our findings do not reflect the findings of Jameson in terms of the increased failure rate in smaller Corail stems (6). Four stems out of 53 stems had to be revised for aseptic loosening, fracture and metal-on metal complications. Though this represents a revision rate of 7.5%, only two cases required revision for aseptic loosening (3.8%). The other revision cases represent trauma and MOM complication which can be considered unrelated to the size of the femoral stem. Thus, a revision rate of 3.8% is more in keeping with the international published literature with an average time to revision of 101.5 months. We could not find any evidence of an increased revision rate related to the use of small sized Corail stems. Smaller femurs are often associated with challenging proximal femoral morphology, and sizing can be particularly difficult in Dorr A femurs, coxa vara femurs and in smaller female patients, who often have dysplastic hips. When templating pre-operatively, the surgeon who finds smaller sizes indicated must be wary of these potential difficulties and sequela, and have strategies ready if difficulties are encountered.

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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