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Predictive outcomes of revision total hip replacement—A consecutive series of 1176 patients with a minimum 10-year follow-up

A. Philpott[a], J.S. Weston-Simons[a,*], G. Grammatopoulos[a], P. Bejon[b], H.S. Gill[c], P. Mclardy-Smith[b], R. Gundle[b], D.W. Murray[a,b], H. Pandit[a,b]

[a] Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Windmill Road, Headington, Oxford OX3 7LD, UK
[b] Nuffield Orthopaedic Centre, Headington, Oxford, UK
[c] Department of Mechanical Engineering, University of Bath, UK

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ABSTRACT

The burden of revision total hip replacement (THR) surgery is increasing. With an increasing life expectancy and younger age of primary surgery this trend is set to continue. There are few data on the long-term outcome of revision THR. This retrospective study of 1176 consecutive revision THRs with a minimum 10-year follow-up from a University Teaching Hospital was undertaken to review implant survival and patient reported outcomes.

Mean follow-up was 11 years with implant survival at 10 years of 82% (CI: 80–85). Implant survival varied between 58% (unexplained pain) to 84% (aseptic loosening) depending on the indication for revision surgery. Positive predictors of survival were age greater than 70 at the time of surgery ($p = 0.011$), revision for aseptic loosening ($p < 0.01$) and revision of both components or just the acetabular component ($p < 0.01$). At the last review, mean Oxford Hip Score (OHS) was 34 (SD: 11.3) and 92% of the living patients with unrevised hips were satisfied with the outcome of revision surgery.

This long term study has demonstrated that positive predictors of survival and outcome of revision THR surgery are age greater than 70 years, revision for aseptic loosening and component revision. This should aid surgeons in their counselling of patients prior to surgery.

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1. Introduction

The introduction of a well functioning primary total hip replacement (THR) by Charnley in 1962 has led to THR today providing excellent clinical outcomes and survival for those with a variety of hip pathologies [1,2]. Furthermore, multiple series are available which allow clinicians to give predictions of outcome with different implants [3–5]. However, the constant growth in the number of THRs performed every year, the increasing number of primary surgeries being performed at a younger age and increased life expectancy have contributed to a significant increase in the revision burden [6,7].

Survivorship of revision hip surgery has been well documented but is usually in the form of small single surgeon series. We are aware of only two published series with greater than 1000 cases that quote 10-year survival, (72%–82%) [8,9].

Patient reported outcome measures (PROMs) are increasingly being used to document implant success, as well as being used as a tool to define treatment options [11]. Evidence to support predicting functional outcome post revision is limited and, when available, the data usually reflect small numbers and short follow-up [12,13].

The aim of this retrospective observational study was to assess patients with a minimum of 10 year follow-up who had a revision THR performed at a single tertiary referral unit (University Teaching Hospital) to assess what factors, if any, were the predictors of survival, function and patient satisfaction.

2. Materials and methods

Theatre logbooks between 1996 and 2002 at the Nuffield Orthopaedic Centre, Oxford, UK were retrieved. All revision THRs were identified and the operative notes examined to obtain relevant data in a standardised fashion. Cases were excluded if the primary procedure was not a THR or if the revision procedure was not the first revision surgery on that joint, (thus cases of conversion of hemiarthroplasty and hip resurfacing, Girdlestone procedures and re-revision were excluded).

* Corresponding author at: Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, UK. Tel.: +44 01865 227610; fax: +44 01865 227671.
E-mail addresses: samwestonsimons@yahoo.co.uk, john.weston-simons@nhs.net (J.S. Weston-Simons).

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The revisions were further defined according to the components revised. Revisions involving exchange of the cup and stem were classified as revisions of "both components." Acetabular cup revision was classified as "cup only", stem alone revision was classified as "stem only", head and/or liner exchange as "isolated head/liner" revision and those requiring a two-stage revision of both components as "two-stage revision".

Following the identification of appropriate patients, the components revised and indications for revision surgery were obtained from medical notes and clinic letters. Component loosening, with or without instability, was defined as "aseptic loosening" with revision for dislocation or subluxation classified as "instability". Revision for fracture in the absence of infection was classified as "peri-prosthetic fracture" and other diagnoses for revision, for example prosthesis fracture, heterotopic ossification and leg length discrepancy, were classified as "other". Pain in the absence of any of the previously mentioned causes was defined as "unexplained pain". In the cases of revision for suspected infection, the clinical suspicion was confirmed by histological and microbiological investigation with the infecting organism identified where possible. Isolation of the same organism(s) in more than three separate samples and/or the presence of more than five white blood cells per high power microscopy field in any of the histology samples were considered diagnostic of infection [14,15]. If the patient presented with a sinus tract, the case was considered to be infected even in the absence of positive microbiology or histology [16]. These cases formed the "infected group".

Local ethics committee confirmed that no formal approval was necessary for this study. All patients were contacted to assess their functional outcome with the Oxford Hip Score (OHS) [17,18] and a study specific questionnaire. If one or two OHS questions were unanswered, a mean value representing all other responses was calculated and used for missing values [17]. OHS questionnaires with three or more missing responses were deemed invalid [17]. Patient reported satisfaction was defined using a nominal scale (1: Very displeased, 2: Not very pleased, 3: Fairly pleased, 4: Very pleased). Patients who responded as either "very displeased" or "not very pleased" were classified as "unsatisfied", with the remaining responses deemed to be "satisfied".

All patient responses were compared with all hospital documentation to check for discrepancies and, in the case of deceased patients, for implant failure. Non-responders were sent follow-up letters and, in the case of those who did not reply, their General Practitioner was contacted. All patients who were either lost to follow-up or who had died were utilised in the analysis and were censored at either the time of death or when their last documented review.

2.1. Statistical analysis

Statistical analysis of the data was carried out using SPSS for Windows v 18.0 (SPSS Inc., Chicago, Illinois). Covariates tested were: gender, patient age at revision, the revision undertaken, the indication for revision and the method of fixation. Patients were divided into two age groups: those under 70 years at the time of surgery formed the "young" group, with the remaining patients defined as being in the "old" group.

Survival data were obtained by Kaplan–Meier analysis [19]. Survival was calculated with a failure defined as any operation in which a component was exchanged or removed. Significant differences in survivorship were established using Log-rank tests and significant variables were then analysed using a multivariate Cox model, taking into account interaction terms, in order to estimate the true magnitude of influence of each covariate on implant survivorship.

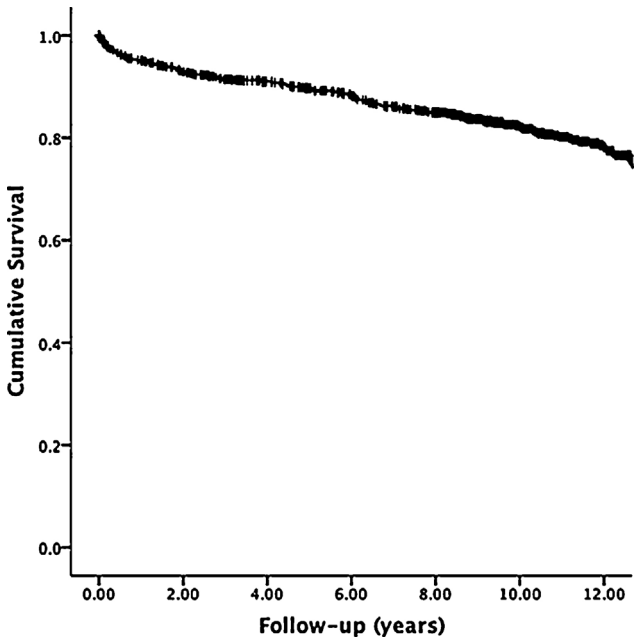

Fig. 1. A graph demonstrating implant survivorship of the entire cohort of revision hips.

The Mann–Whitney-*U* test assessed the influence of each covariate upon patient reported outcome. A significance level of $p < 0.05$ was used throughout.

3. Results

A total of 1336 hip revision procedures were identified of which 1176 cases were the first revision of a THR. 1054 (90%) were performed by five orthopaedic surgeons with a specialist interest in arthroplasty surgery. Of these 1109 patients, 67 had bilateral revisions. The mean age at surgery was 68 years, (range 23–97 years) and mean follow up was 11 years (range 2–14 years). 632 patients were female and 26 patients were lost to follow up. Functional questionnaires were returned in 79% of living patients.

Both components were revised in 576 hips (49%); the acetabular cup alone was revised in 306 cases (26%); the stem only in 188 cases (16%). A two-stage revision was performed in 94 cases (8%) and there was an isolated head/liner exchange in 12 cases (1%). In total, 14 different types of acetabular cup and 12 different stems were implanted. All revised stems were cemented with 278 of the revised acetabular cups being uncemented,

Revision was performed for aseptic loosening in 843 cases (72%), infection in 111 cases (9%), periprosthetic fracture in 92 cases (8%), instability in 64 cases (5%), "unexplained pain" in 19 cases (2%) and for "other" reasons in 47 cases (4%).

Of the 111 cases revised for infection, 66 cases had a two-stage revision. 16 patients, (16 cases), were not deemed to be fit enough for a two-stage procedure and so had a single-stage revision. Additionally, a further 29 hips who had a single-stage revision were retrospectively identified through microbiological or histological findings as having an underlying infection and so were also included in the "infected" group.

3.1. Survival

The 10-year survivorship of all-cause revision was 82% (95% CI: 80–85) (Fig. 1). At mean follow-up of 11 years, 440 hips were deceased of which 56 had been re-revised prior to death. Of the

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