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Revision hip arthroplasty with S-ROM prosthesis: a study of clinical outcomes and implant stability

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Abstract Revision total hip replacement has high rates of failure, which appear to be due in part to deficient bone stock that does not provide an adequate environment for implant fixation. We reviewed the clinical outcomes and implant stability following total hip revisions using the S-ROM implant. Between 1996 to 2001, we performed 62 cementless revision hip arthroplasties using the S-ROM prosthesis. Data on 54 patients were available for study, with a mean follow-up of 4.5 years (range, 4–6 years). Radiological analysis, patient satisfaction and Harris hip scores were assessed pre- and postoperatively. Overall, 85% of patients were satisfied with the results of surgery. Harris hip scores improved from a preoperative value of 40 to 80 points at the last available follow-up. 52 stems (96%) were radiologically stable on the final follow-up. Two had marked initial subsidence, but this later stabilised. There was no re-revision due to loosening. With improvement of the postoperative hip score by more than 40 points and absence of definite implant instability and re-revision at the final follow-up, the use of S-ROM prosthesis in the revision cases of this study seems to have been successful.

Key words Total hip arthroplasty • Revision • S-ROM • Stability

Introduction

The goals of revision hip arthroplasty are to relieve pain, restore biomechanical function and ensure stable fixation of the implant components. Restoration of biomechanical function entails correction of the centre of rotation as well as correction of the limb length discrepancy and femoral offset [1].

Aseptic loosening following cemented revision total hip arthroplasty (THA) has been well documented [2]. Many studies have reported rates of radiological instability ranging from 25% to 51% for the femoral component and from 9% to 37% for the acetabular side [3, 4]. On the other hand, subsequent reports of cementless femoral revisions have revealed lower loosening rates, ranging from 2% to 7% after 3–6 years [5–7]. Conventional one-piece cementless femoral implants may not provide complete bone contact due to the mismatch between the stem geometry and the damaged proximal femur [8]. Modularity allows the opportunity to optimise fixation stability, version and length [1].

This study reviews patients treated with the S-ROM system, assessing clinical outcomes and implant stability following revision surgery.

Materials and methods

Between 1996 and 2001, a total of 62 patients underwent cementless revision THA. All operation were performed by a single surgeon (DTM). Two patients died for reasons unrelated

Fig. 1 S-ROM stems: three neck styles

to the surgery, and another six were lost during the follow-up. This left 54 cases for the study.

All patients were assessed on the Harris hip scale [9, 10] and on a basic quality of life questionnaire. On this questionnaire, patients were asked to respond *Yes* or *No* to the questions: are you satisfied? has the operation increased your function? has it decreased pain? The assessment was done prior to revision surgery, after 6 months and then yearly in the postoperative period.

Revision surgery

All revisions were done using the S-ROM (DePuy International, Leeds, UK) prosthesis (Fig. 1). The femoral component consists of a circular fluted stem split distally in the coronal plane to reduce distal stiffness. A metaphyseal sleeve attaches to the stem by mortice taper. The sharp flutes provide distal implant rotational stability, and the proximal sleeve was rotated through 180° in order to engage in the best host bone.

All procedures were done in a clean air environment with body isolation suits. Most procedures were done via a Hardinge approach, with the patient in the lateral decubitus position. Trochanteric osteotomy was used in all 13 cases (24%) in whom it had been used previously in the index procedure. No structural bone graft was used in the acetabulum, but in 13 cases (24%), morcelized bone allograft was impacted in the areas of deficiency using manual impaction and reversed reaming technique.

Femoral structural strut allografts were required in 6 cases (11%). These were applied as onlay graft and fixed in place by multiple cerclage wires. Cerclage wiring was also used in another 28 cases in which either a window was made to retrieve cement or a minor proximal crack developed at the final seating of the stem.

Radiographic assessment

Pelvic anteroposterior radiographs obtained before surgery were used to assess the quality of the bone stock. Typically, the same views were obtained 48–72 hours after surgery, then at 6 weeks, 3 months, 6 months, and at yearly intervals thereafter. Pre- and postoperative radiographs were assessed by one orthopaedic surgeon (SZ) who was uninvolved in the care of the patients. We used the Endo-klinik classification of femoral bone deficiency [2], the American Academy of Orthopaedic Surgeons' classification for acetabular deficiency [11], and Greun's zonal distribution for areas of cortical osteolysis [12].

Immediate postoperative radiographs were assessed to determine the orientation of the implants and the extent of contact between the component and the prepared bony surfaces. The final radiographs were compared with the immediate postoperative films to assess implant stability and the osseous response to the prosthesis.

Implant stability was assessed using the criteria of Engh et al. [13] and Hedley et al. [14]. Femoral subsidence was measured from the lateral shoulder of the implant to any reproducible fixed landmark on the femur including the trochanteric wires, lesser trochanter or the tip of greater trochanter [13, 15]. Similarly, the acetabular component proximal-distal migration and the change of inclination were judged.

Results

A total of 54 patients (30 women) with age ranging from 44 to 89 years underwent revision THA. The primary procedures included cemented and cementless total hip replacement or hemiarthroplasty (Table 1). The main cause of failure was aseptic loosening.

Table 1 Index surgery and causes of failure, for 54 patients who underwent revision surgery

Index surgery	Cause of failure				Patients, n
	Aseptic loosening	Periprosthetic fractures	Infection	Recurrent dislocation	
Cemented THR	28	4	2	2	36
Uncemented THR	5	0	0	0	5
Cemented hemiarthroplasty	11	0	1	0	12
Uncemented Austin-Moore hemiarthroplasty	1	0	0	0	1

THR, total hip replacement

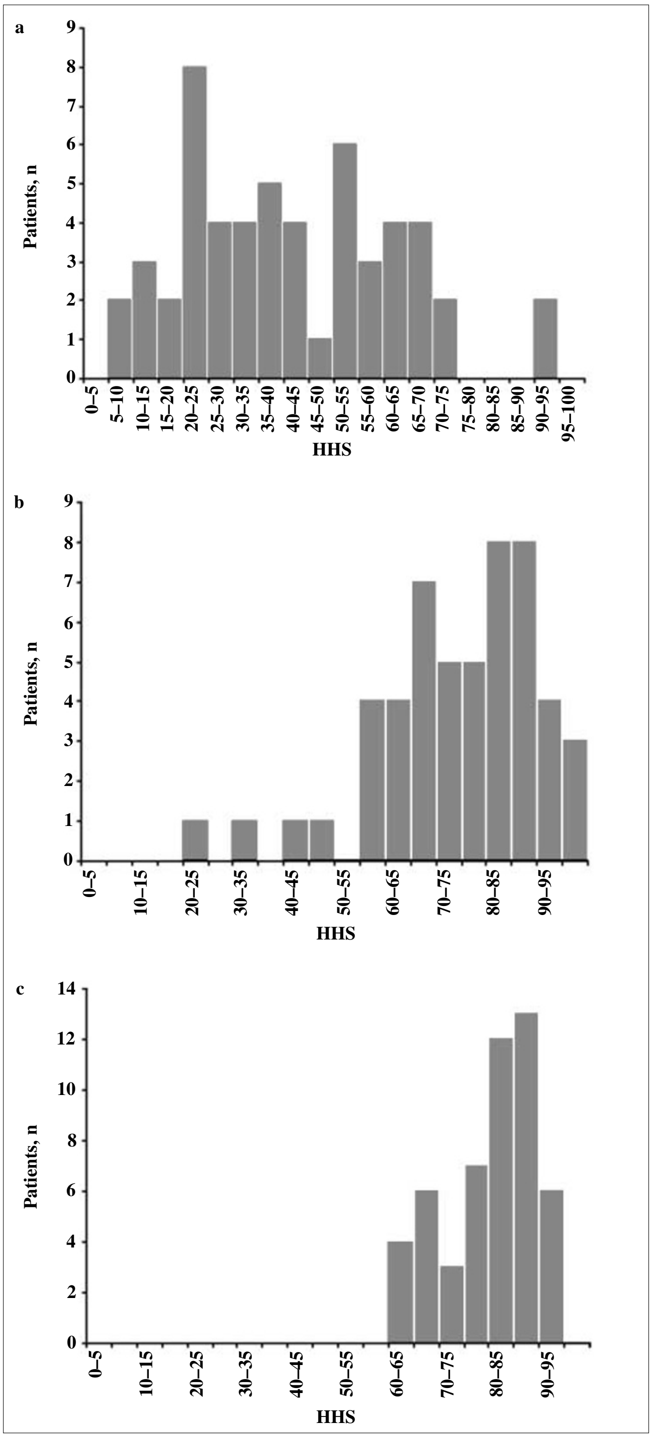

Fig. 2a-c *Distributions of Harris hip scores, before and after revision surgery, for 54 patients*. **a** Pre-operative scores. **b** Scores at the 6-month follow-up. **c** Scores at last available follow-up (mean, 4.5 years)

Preoperatively the mean Harris hip score was 40 (range, 6–92) (Fig. 2). This improved to 74.8 (range, 22–100) at the 6-month follow-up. At an average clinical follow-up of 4.5 years (range, 4–6 years), the mean Harris hip score was 80 (range, 48–94). These changes were significant ($p<0.0001$, Mann-Whitney test). The pain component of the postoperative Harris hip score revealed no or occasional mild pain in 47 hips (87%), moderate pain in 5 (9%) and severe pain in 2 (3.7%)

The basic quality of life questionnaire revealed that 46 patients (85%) were satisfied with the outcome. Increased function was reported by 40 patients (74%) and the decreased pain in 42 (77.7%). Four of the unsatisfied patients reported that the revision surgery did not resolve their preoperative limping; this caused slow mobility and continued mild to moderate pain.

Preoperative radiographic assessment showed that only 8 cases (15%) had intact femoral bone stock; the rest had variable bone loss (18, grade I; 10, grade II; 17, grade III and 1, grade IV). Moreover, 42 cases (77.7%) showed variable levels of acetabular deficiency (29 cavitary and 13 combined).

At a median radiological follow-up of 4.5 years (range, 3–8 years) 52 implants (96%) were radiologically stable; 32 femora (59%) showed filling of the osteolytic defect.

In the initial 3–6 months after surgery, 9 implants had an average of 6.4 mm subsidence (range, 2–15 mm). On further imaging all had stabilised and no further subsidence was noted. Definite instability was seen in another two hips (3.7%); both showed progressive subsidence on serial radiography. One of these patients died 4 months after surgery and one continued subsiding to 30 mm. Fearing dislocation due to significant distraction, we performed surgical exploration which showed that the stem had a strong fibrous union; therefore stem extraction was abandoned and the head was exchanged with a longer neck to improve the joint stability.

In spite of the initial instability in these 11 cases, there was no significant change in their clinical scores: their mean postoperative Harris hip score was 78.8 (range, 67–95) after 6 months and 76 (range, 64–84) at the last follow-up.

On the acetabular side, the cup was stable in 51 hips (94.5%) and there was minimal shift in only 3 cases.

There were 3 cases of deep venous thrombosis and 2 of trochanteric nonunion among the 13 patients with trochanteric osteotomies. Heterotopic bone formation was noted in 16 hips (29.6%). Cortical perforation occurred in three cases and minor crack fractures occurred in five cases. There were 2 postoperative dislocations (3.7%); both were reduced and caused no further problems afterwards.

Discussion

This study showed good to excellent results in most patients using cementless S-ROM implant for revision THA at the short-term follow-up. Earlier results of cemented revision THA proved to be disappointing [8, 9, 14]. In a series of 140 cemented total hip revisions, Hunter et al. [16] had excellent to good results in 24% and fair or poor results in 51%, with 22% of the patients ending with an excision arthroplasty. More recently, Hultmark et al. [17] reported encouraging results with cemented first-time revisions of femoral components; however, they noted an increase in re-revision rate with decreasing age. Furthermore, the risk of mechanical failure was increased by the severity of the bone defects. They concluded that this technique is suitable for the elderly population, while in young and active patients and especially in those with pronounced bone loss, cementless revision is preferred.

Cementless femoral revisions, on the other hand, have considerably lower rates of failure although they are still in the early to midterm stages of follow-up. Lawrence et al. [18] reported an 11% mechanical loosening rate at an average 9-year follow-up in a series of 93 femoral revisions using extensively porous-coated femoral stems. Only 5 of the 8 re-revised stems were for mechanical loosening, the rest were for other causes.

The S-ROM prosthesis is modular and provides good fit and fill, both proximally and distally, thus allowing stability, proper version and length. The metaphyseal sleeve can be adjusted independently of the stem orientation to give the best fit in the deficient proximal area. There are standard and calcar replacement stems with different offsets. They accept modular heads and as much as 6.8 cm proximal length can be gained.

The S-ROM system for femoral component revision has resulted in considerably lower rates of failure and subsidence. Christie et al. [19], in a series of 102 femoral revisions with a minimum 4-year follow-up, reported high patient satisfaction with improvements in Harris hip scores from an average of 47.7 to 87.5. There was only 1 case of re-revision (less than 1%) for mechanical loosening of the femoral component and an additional 2 cases of radiological instability manifested by progressive varus tilting and subsidence of the femoral component leading to an aseptic failure rate of 2.9%. Similarly, McCarthy et al. [20] noted a 1.5% re-revision rate at 5 years in a series of 133 S-ROM revision hips, with a 4% subsidence rate. Cameron [21] reported a 3% rate of radiological loosening in a series of 91 cementless hip revisions with S-ROM after a 3.5-year follow-up with no implant failure, loss of rotational stability, metallosis, or osteolysis. In our series, there was no re-revision and radiological stability was seen in 96% of cases.

Early subsidence followed by stability within the first 6–12 months after surgery is not uncommon [14]. We had 9 implants that showed early subsidence (average, 6.4 mm) that subsequently stabilised. One hip required surgical exploration for progressive subsidence, however intraoperatively the stem was found to be stable due to strong fibrous integration. Exchanging the head with a longer neck sufficed to stabilize the hip joint. We do not regard this case as a re-revision procedure, as the femoral stem was kept in situ and was functioning well afterwards, which was evident radiologically and clinically (Harris hip score, 64). By excluding this one case, the re-revision rate was nil during this period of follow-up.

Remarkably, the initial subsidence had no effects on the clinical outcome of surgery, as demonstrated by clinical scores in this small group of patients. Mean Harris hip scores for the 11 patients who had subsidence were 78.8 immediately after surgery and 76 at the last available follow-up.

Comparing this study to the other studies is difficult because of the different periods of follow-up and different patient cohorts. However, the outcome regarding patient satisfaction (85%), decreased pain (77.7%), and increased function (74%) are similar to those of studies by Bono et al. [1], Cameron [21], Chandler et al. [8], and Smith et al [22].

Overall, there has been a positive biologic response from the bone to this stem with excellent reconstruction of the cortex, and apparent hypertrophy in the areas of stress transfer in the metaphysis.

With improvement of the postoperative hip score by more than 40 points and absence of definite implant instability at the final follow-up, the use of S-ROM prosthesis in the revision cases of this study seems to have been successful. The follow-up is relatively short, but the experience derived from this work confirms the versatility of the S-ROM prosthesis in complex hip revision situations as well as its favourable mechanical and biologic impact on the adjacent osseous structures.

Disclosure of conflicts of interest We declare that there was no conflict of interest involving this product and no funding or grants were received for conducting this work.

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