Xiao-Dong Chen · James P. Waddell · Jane Morton ·
Emil H. Schemitsch

Isolated acetabular revision after total hip arthroplasty: results at 5–9 years of follow-up

Received: 6 April 2005 / Accepted: 25 April 2005 / Published online: 11 August 2005
© Springer-Verlag 2005

Abstract The purpose of the study was to determine whether isolated revision of the acetabular component can be successfully performed without disturbing the femoral stem and to determine the fate of the unrevised femoral stem following revision. Fifty-seven hips in 55 patients underwent isolated acetabular revision without removal of the femoral component. Thirty-three hips with minimal acetabular deficiency required no bone grafting; the remaining 24 hips were treated by morselized or structural allograft in addition to a new acetabular component. Twenty-two of these 24 hips demonstrated incorporation of the bone graft. A mean follow-up of 5.8 (5–9) years, all femoral and acetabular components were judged to be stable and well fixed.

Résumé Le but de l'étude est de déterminer si la révision isolée du composant acétabulaire peut être exécutée avec succès sans déranger la tige fémorale et, deuxièmement, de

déterminer l'avenir de la tige fémorale laissée en place, après cette révision. Cinquante-sept hanches chez cinquante-cinq malades ont subi une révision acétabulaire isolée sans ablation du composant fémoral. Trente-trois hanches avec une déficience acétabulaire minime n'ont exigé aucune greffe osseuse; les 24 hanches restantes ont été traitées par une allogreffe morcelée ou structurale associée à un nouveau composant acétabulaire. Vingt-deux de ces 24 hanches ont montré une incorporation de la greffe d'os. A un suivi moyen de 5,8 ans (5 à 9 ans) tout les composants fémoraux et acétabulaires ont été jugés stables et bien fixés.

Introduction

The major cause of failure in total hip arthroplasty is aseptic loosening, which requires revision. Although the pathophysiology of osteolysis is likely to be the same at acetabular and femoral component interfaces [23], the mechanism of aseptic loosening is likely to be different in the femur and the acetabulum [12, 21]. It has been demonstrated that the rate of revision due to aseptic loosening of acetabular components is much higher than that of femoral components in cemented total hip arthroplasty [4, 22]. Cementless acetabular components have also shown a high rate of osteolysis and revision at 5 years or more after total hip replacement [1, 18]. As a result, the surgeon may be faced with a failed acetabular component but a well-fixed femoral component. Isolated loosening of the acetabular component has been reported to account for as many as 27% of all revision total hip arthroplasties performed [20]. Removal of a femoral component may provide extensive exposure to the acetabulum, but combined femoral and acetabular revision is associated with increased complication rate, surgical time, blood loss, and cost [3, 11].

The purpose of this study was to determine whether revision of an isolated loose acetabular component without the removal of a well-fixed femoral stem can be successfully performed without compromising the final result. We also wished to determine the fate of unrevised femoral stems after revision of the acetabular component.

X.-D. Chen
Department of Orthopaedic Surgery,
Xinhu Hospital Affiliated to Shanghai
Second Medical University,
1665 Kongjiang Road,
Shanghai, 200092, People's Republic of China

J. P. Waddell (✉)
Division of Orthopaedic Surgery,
St. Michael's Hospital,
30 Bond, Street,
Toronto, Ontario, M5B 1W8, Canada
e-mail: waddellj@smh.toronto.on.ca
Tel.: +1-416-8645048
Fax: +1-416-8646010

J. Morton
Orthopaedic Research Office,
St. Michael's Hospital,
38 Shuter Street Annex, Room 3011,
Toronto, Ontario, M5B 1A6, Canada

E. H. Schemitsch
St. Michael's Orthopaedic Associates,
55 Queen Street East, Suite 800,
Toronto, Ontario, M5C 1R6, Canada

Materials and methods

From March 1995 to August 1999, 201 consecutive revision total hip arthroplasties were performed in 168 patients; 63 patients with 65 hips requiring revision of the acetabular component only were identified. Criteria for inclusion in the study were aseptic loosening of an uncemented or cemented acetabular component with a well-fixed femoral component. There were six patients lost to clinical follow-up; two patients died of causes unrelated to acetabular revision. The average time from revision of acetabular component to the latest follow-up examination was 5.8 (range 5–9) years in 55 patients (57 hips). The average time from primary total hip arthroplasty to revision of an acetabular component was 10 (range 1–18) years. The average duration of the femoral component service was 16 (range 6–25) years. The average age of the 55 patients at the time of index revision was 64 (range 29–92) years. There were 25 women and 30 men and 28 left hips and 29 right hips. The indication for acetabular revision was painful aseptic acetabular component loosening in 50 hips and dislocations in seven.

The diagnosis for the index operation was primary osteoarthritis in 29 hips, avascular necrosis in 13, congenital dislocation in six, rheumatoid arthritis in five, acute femoral-neck fracture in two, arthritis secondary to Paget's disease in one, and Legg-Perthes' disease in one.

Fifty-two revised acetabular components were cementless and five were cemented. The femoral components were extensively porous-coated uncemented stems (Lord, Howmedica, Rutherford, NJ, USA) in nine, proximal porous-coated uncemented stems (St. Michael's; Howmedica) in 42, cemented stems in four, and porous-coated anatomic (PCA) (Howmedica) stems in two. There were eight monolithic (monoblock) femoral components with a fixed head size and neck length, and a modular femoral head in 49. All uncemented femoral components were determined to be osteointegrated and stable before revision by the radiographic criteria described by Engh et al [8]. All cemented femoral components were noted to be well fixed and had no radiographic evidence of loosening, using the criteria of Harris and McCann [10].

Acetabular deficiencies were classified according to the system established by the American Academy of Orthopaedic Surgeons Committee [6]. There were 33 hips with minimal acetabular deficiency, one with a type I defect (segmental) 13 with a type II defect (cavitary), and ten with a type III defect (both segmental and cavitary). Bone grafting was performed in 26 hips: 24 of the 26 received a bone graft in the acetabulum, in which cementless hemispheric acetabular components were used. Morselized fresh-frozen allograft was used in nine. Combined structural and morselized fresh-frozen allografts were used in 11, and autogenous morselized bone harvested from the reamer was impacted into the dome of the acetabulum in four. Two proximal femurs with osteolytic lesions were debrided and grafted with bone from reaming of the acetabulum.

The posterior approach was used in all hips. If the femoral component was modular, the head was removed to enhance exposure. The femoral component with proximal

femur was moved anteriorly and superiorly for adequate exposure of the acetabulum. Twenty acetabular components were revised to porous-coated cups, 26 were revised to hydroxyapatite (HA)-coated cups, two were revised to cemented cups, and an acetabular ring with cemented cup was used in nine. Clinical evaluations, including determination of leg-length discrepancy, function, range of motion, and the Harris hip score [9], were performed at each follow-up examination. Routine anteroposterior radiographs of the pelvis and proximal aspect of the femur and lateral radiographs of the hip were made and reviewed before surgery, immediately after surgery, 3 and 6 months after surgery, and yearly thereafter. Definite acetabular loosening was defined as a change in the opening angle of the component of more than 3° [5], linear change more than 2 mm in either the medial or the superior direction, or both [7]. For cementless femoral components, fixation was defined using the method of Engh et al. [8]. Definite loosening was indicated by subsidence greater than 5 mm.

Results

The average Harris hip and pain scores were 55 and 19 points, respectively, before the acetabular revision and 88 and 41 points, respectively, at the most recent follow-up examination. The average leg-length inequality was 7 (range 0–40) mm preoperatively and 4 (range 0–40) mm postoperatively. The mean outer diameter of the acetabular metal shell was 50 (range 42–58) mm before and 58 (range 52–72) mm after revision total hip arthroplasty.

No acetabular component had been re-revised for loosening at the latest follow-up. Isolated radiolucent lines were present in acetabular zone 1 in four hips, five had radiolucent lines in two zones, and one acetabular prosthesis had circumferential lucency. All radiolucencies were non-progressive, and radiolucent lines were 1 mm or less. Medial migration was present in three acetabular components and was less than 2 mm. Migration was non-progressive after 1 year and appeared stable at the latest follow-up. Twenty-one of 24 hips with bone grafts demonstrated full incorporation. All primary femoral components were evaluated to be stable and well fixed at the latest follow-up. Of 57 stable femoral components, four were cemented and 53 were porous coated. At the latest evaluation, these femoral components had been followed up for an average of 16 (range 6–25) years since the time of implantation. None of them had circumferential radiolucent lines or any signs of subsidence. There were no potential or pending revisions in femoral components.

Loss of proximal femoral density [2, 13] was observed on the radiography of 37 hips. Rounding of the calcar femorale appeared in 35 hips. Two hips presented focal osteolysis in the proximal femur in Gruen zone 2 (one hip) and Gruen zone 7 (one hip); they were treated by debridement of the osteolytic lesion and morselized autograft from reaming of the acetabulum. Focal osteolysis in the proximal femur of two hips was judged to have disappeared by the latest follow-up.

There were no nerve palsies, vascular injuries, or intraoperative fractures. Three dislocations occurred postoperatively; two were managed by closed reduction. The third hip developed infection 4 months after re-revision of the acetabular component for recurrent dislocation and a Girdlestone excision was performed. The patient has mild pain in weight bearing and has refused a repeat revision.

Discussion

The decision to retain or remove a well-fixed femoral component for acetabular revision depends on the exposure of the acetabulum achieved at surgery. Several reports have described a technique in which a well-fixed cemented femoral component is removed and then reinserted into its cement mantle following acetabular revision [2, 17]. Only a cemented femoral component with minimal curvature and without a textured or precoated surface can be removed without destroying the cement mantle. There were only four hips with cemented femoral components in the current study. This technique is not applicable for cemented stems with a rough surface or pre-coating and cannot be used in stems stabilized by biological fixation, which accounted for 53 hips in this series.

The posterior approach was used in all revisions. The femoral head was removed in all hips with modular stems. Adequate exposure could be obtained when the proximal femur was retracted anteriorly and superiorly, and this was sufficient for reconstruction of the acetabulum with bone grafts or reinforcement ring. No nerve or vascular impairment appeared. The Harris hip score and pain score increased by 33 and 22 points, respectively, in the most recent follow-up. Thirty patients had a contralateral hip or knee problem that may compromise the final Harris hip scores. No pain or mild pain existed in the revised hip.

Although removal of a femoral component improves the exposure during acetabular revision, this may result in intraoperative femoral perforation or fracture, which has been reported to be as high as 23% [24]. Operation time and blood loss are higher when the femoral component is removed [3, 11], so little benefit would have been gained by removing a well-fixed femoral component in this situation.

Bone deficiency existed in all acetabular revisions. If the bone defect is small, a larger acetabular component can be used to improve contact of socket surface to host bone. This can increase acetabular component stability and eliminate the potential failure of the bone graft. If a large bone defect exists, a larger acetabular component can decrease the amount of bone graft required. In this study, the mean outer diameter of the acetabular component was 50 (range 42–58) mm in the primary total hip arthroplasty, and it increased to 58 (range 52–72) mm in the acetabular revision. Of 57 acetabuli, 24 required bone grafts (nine morselized allografts, 11 both structural and morselized allografts, and four morselized autografts). Twenty-one of 24 hips demonstrated incorporation of the bone grafts at follow-up. Revision acetabuloplasty using a cementless

hemispheric acetabular component with bone grafting has had good mid- to long-term results [14, 19]. The results of this study compared favourably with these reports. No loosening was observed during an average time of 5.8 years of follow-up. Although radiolucencies existed in ten hips, they were less than 2 mm wide and were non-progressive. No acetabular component was re-revised for loosening.

In this series, femoral components had been in place for 1–18 years prior to acetabular revision. Femoral components have remained well fixed for an additional 5–9 years. The average duration of service of the femoral component was 16 (range 6–25) years. Radiographic findings demonstrated evidence of proximal stress shielding, which occurred in 37/57 hips. All the porous-coated (both proximal- and extensive-coated) and cemented femoral components presented as well fixed and stable. No evidence of circumferential radiolucent lines or sign of subsidence was observed after acetabular revision at the most recent follow-up. The results in this series were in accord with those reported in other studies [15, 16, 20].

The current study thus shows satisfactory outcome: no recurrent loosening occurred in revised acetabular components, all femoral components were stable, dislocation rate was acceptable, and the complication rate was low. We recommend that this technique be used in case of a loose cup with a solid stem.

References

1. Aston DJ, Saluan P, Stulberg BN, Rimnac CM, Li S (1996) The porous-coated anatomic total hip prosthesis: failure of the metal-backed acetabular component. *J Bone Joint Surg Am* 78 (5):755–766
2. Bands R, Pelker RR, Shine J, Bradburn H, Margolis R, Leach J (1991) The noncemented porous-coated hip prosthesis. A three-year clinical follow-up study and roentgenographic analysis. *Clin Orthop* 269:209–219
3. Barrack RL, Folgueras AJ (1995) Revision total hip arthroplasty: the femoral component. *J Am Acad Orthop Surg* 3 (2):79–85
4. Callaghan JJ, Forest EE, Olejniczak JP, Goetz DD, Johnston RC (1998) Charnley total hip arthroplasty in patients less than fifty years old. A twenty to twenty-five-year follow-up note. *J Bone Joint Surg Am* 80(5):704–714
5. Callaghan JJ, Salvati EA, Pellicci PM, Wilson PD Jr, Ranawat CS (1985) Results of revision for mechanical failure after cemented total hip replacement, 1979 to 1982. A two to five-year follow-up. *J Bone Joint Surg Am* 67(7):1074–1085
6. D'Antonio JA, Capello WN, Borden LS, Bargar WL, Bierbaum BF, Boettcher WG, Steinberg ME, Stulberg SD, Wedge JH (1989) Classification and management of acetabular abnormalities in total hip arthroplasty. *Clin Orthop* 243:126–137
7. Dorr LD, Wan Z (1996) Comparative results of a distal modular sleeve, circumferential coating, and stiffness relief using the anatomic porous replacement II. *J Arthroplast* 11(4):419–428
8. Engh CA, Massin P, Suthers KE (1990) Roentgenographic assessment of the biologic fixation of porous-surfaced femoral components. *Clin Orthop* 257:107–128
9. Harris WH (1969) Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am* 51(4):737–755

10. Harris WH, McGann WA (1986) Loosening of the femoral component after use of the medullary-plug cementing technique. Follow-up note with a minimum five-year follow-up. *J Bone Joint Surg Am* 68(7):1064–1066
11. Kershaw CJ, Atkins RM, Dodd CA, Bulstrode CJ (1991) Revision total hip arthroplasty for aseptic failure. A review of 276 cases. *J Bone Joint Surg Br* 73(4):564–568
12. Maloney WJ, Jasty M, Burke DW, O'Connor DO, Zalenski EB, Bragdon C, Harris WH (1989) Biomechanical and histologic investigation of cemented total hip arthroplasties. A study of autopsy-retrieved femurs after in vivo cycling. *Clin Ortop* 249:129–140
13. Meding JB, Ritter MA, Keating EM, Faris PM (1994) Clinical and radiographic evaluation of long-stem femoral components following revision total hip arthroplasty. *J Arthroplast* 9(4):399–408
14. Garbuz D, Morsi E, Gross AE (1996) Revision of the acetabular component of a total hip arthroplasty with a massive structural allograft. Study with a minimum five-year follow-up. *J Bone Joint Surg Am* 78(5):693–697
15. Moskal JT, Danisa OA, Shaffrey CI (1997) Isolated revision acetabuloplasty using a porous-coated cementless acetabular component without removal of a well-fixed femoral component. A 3- to 9-year follow-up study. *J Arthroplast* 12(7):719–727
16. Moskal JT, Shen FH, Brown TE (2002) The fate of stable femoral components retained during isolated acetabular revision: a six-to-twelve-year follow-up study. *J Bone Joint Surg Am* 84(2):250–255
17. Nabors ED, Liebelt R, Mattingly DA, Bierbaum BE (1996) Removal and reinsertion of cemented femoral components during acetabular revision. *J Arthroplast* 11(2):146–152
18. Owen TD, Moran CG, Smith SR, Pinder IM (1994) Results of uncemented porous-coated anatomic total hip replacement. *J Bone Joint Surg Br* 76(2):258–262
19. Paprosky WG, Magnus RE (1994) Principles of bone grafting in revision total hip arthroplasty. Acetabular technique. *Clin Ortop* 298:147–155
20. Poon ED, Lachiewicz PF (1998) Results of isolated acetabular revisions: the fate of the unrevised femoral component. *J Arthroplast* 13(1):42–49
21. Schmalzried TP, Kwong LM, Jasty M, Sedlacek RC, Haire TC, O'Connor DO, Bragdon CR, Kabo JM, Malcolm AJ, Harris WH (1992) The mechanism of loosening of cemented acetabular components in total hip arthroplasty. Analysis of specimens retrieved at autopsy. *Clin Ortop* 274:60–78
22. Schulte KR, Callaghan JJ, Kelley SS, Johnston RC (1993) The outcome of Charnley total hip arthroplasty with cement after a minimum twenty-year follow-up. The results of one surgeon. *J Bone Joint Surg Am* 75(7):961–975
23. Sinha RK, Shanbhag AS, Maloney WJ, Hasselman CT, Rubash HE (1998) Osteolysis: cause and effect. *Instr Course Lect* 47:307–320
24. Turner RH, Mattingly DA, Scheller A (1987) Femoral revision total hip arthroplasty using a long-stem femoral component. Clinical and radiographic analysis. *J Arthroplast* 2(3):247–258