Periprosthetic femoral fractures treated with a modular distally cemented stem

SH Zaki, S Sadiq, B Purbach, BM Wroblewski
John Charnley Research Institute, Wrightington Hospital, Appley Bridge, Wigan, United Kingdom

ABSTRACT

Purpose. To assess the treatment outcome of revision hip arthroplasty for Vancouver type B3 periprosthetic femoral fractures using a modular distally cemented stem.

Methods. 22 men and 14 women (37 hips) aged 66 to 79 (mean, 70) years underwent revision hip arthroplasty for Vancouver type B3 periprosthetic femoral fractures. The indication for surgery was periprosthetic fracture with stem loosening and loss of proximal bone stock. The patients were referred from other hospitals after previous surgeries had failed: 8 with 3 previous surgeries, 19 with 2, and 9 with one. Using a transtrochanteric approach, the existing prosthesis was removed and a modular proximal femoral replacement stem was inserted, bypassing the area of proximal femoral fracture and bone loss. The stem was distally cemented. Patients were immobilised within 48 hours of surgery.

Results. Patients were followed up for a mean of 14 (range, 8–18) years. The mean Harris hip score improved from 29 (range, 5–40) to 78 (range, 56–88); 24 patients attained excellent or good scores (>80), 10 attained fair, and 2 attained poor scores. The mean healing time was 7 (range, 6–14) months; there was no non-union. Improvement in proximal bone stock was noted on serial radiographs. None of the stems had cement fracture or migration, requiring revision. Two (5%) of the patients had dislocations.

Conclusion. Vancouver type B3 periprosthetic femoral fractures can be successfully treated with a distally cemented modular proximal femoral replacement prosthesis.

Key words: arthroplasty, replacement, hip; bone cements; femoral fractures

INTRODUCTION

The risk of periprosthetic femoral fracture is estimated to be 1.5 to 4%. Its incidence has increased and can be attributed to the increasing numbers of elderly patients undergoing primary and revision hip arthroplasties. Comminution and bone loss are common associations and pose fixation challenges. Treatment options include revision arthroplasty using cementless or...
cemented stems, cortical strut grafting, allograft-prosthetic composite, custom-made or off-the-shelf segmental replacement prostheses. In some cases, revision hip arthroplasty is especially difficult when the proximal femur is grossly comminuted or even absent.

We present our experience in the management of Vancouver type B3 periprosthetic femoral fractures by means of a distally cemented modular proximal femoral replacement stem.

MATERIALS AND METHODS

Between July 1985 and June 1996 inclusive, 22 men and 14 women (37 hips) aged 66 to 79 (mean, 70) years underwent revision hip arthroplasty for Vancouver type B3 periprosthetic femoral fractures with a distally cemented proximal femoral stem by a single surgeon. The patients were referred from other hospitals after previous surgeries had failed: 8 with 3 previous surgeries, 19 with 2, and 9 with one. The indications for primary hip arthroplasty were osteoarthritis (n=28), traumatic avascular necrosis (n=5), rheumatoid arthritis (n=2), developmental dysplasia of the hip (n=1), and Perthes disease (n=1). The original prostheses were McKee (n=4) and Charnley monoblock (n=33). The indications for proximal femoral stem replacement were periprosthetic fracture and proximal femoral bone loss.

A distally cemented modular proximal femoral replacement stem was used. It was based on the 40-mm offset Charnley stem (Ortron; DePuy, Leeds, UK). The polished stem has continuous double taper (medial to lateral, anteroposterior) in various lengths (200–250 mm). Each allows 100 to 150 mm for proximal femoral deficiency with a minimum of 100 mm of distal fixation with acrylic cement.

All operations were carried out in a Charnley-Howorth clean air enclosure with total body exhaust suits. All patients were operated on in a supine position using the transtrochanteric approach. The loose femoral component, along with the cement, was removed. As much of the proximal bone and soft tissue attachments were preserved as possible. No attempt was made to rigidly stabilise the fracture using any form of supplementary fixation. No form of bone grafting, strut or impaction, was performed. The acetabular component was exposed and examined; if loose or malpositioned (n=8), it was revised to another cemented component. The intact distal femoral canal was then prepared and a trial reduction undertaken. The hip was checked for soft tissue tension, stability, leg length, and reattachment of the greater trochanter. It is important to achieve adequate soft tissue tension so as to provide stability and prevent dislocation. We, therefore, accepted an increased leg length if the hip appeared stable. No patient had a leg length discrepancy of >2 cm.

Antibiotic-containing acrylic cement (Palacos; Biomet Merck, Swindon, UK) was used for cementation of the femoral component by either a 2-thumb method, if accessible, or a retrograde method using a cement gun. Because of the long distal femoral segment, a drain was used to vent the medullary canal proximally and the cement was inserted earlier than at primary surgery. The minimum length of distal cement fixation was 10 (mean, 11.7) cm.

Postoperatively, patients were allowed to mobilise and bear weight as tolerated with a walking frame. Some activities were avoided, including hip flexion to ≤90°, use of abduction wedge, leg crossing, sitting on a high chair or elevated toilet seat.

Patients were followed up at 6 weeks, 3 months, and then yearly. Functional assessment was performed using the Harris hip score. Radiographs were taken at each follow-up and analysed for radiolucent lines at the bone-cement interface, bony union, and improvement in proximal bone stock. A fracture was considered united if there was bridging of at least 3 of the 4 cortices. The femoral components were considered loose if there were progressive radiolucencies of ≥2 mm wide involving (1) >50% of the bone-cement interface, (2) cement column fractures surrounding the prosthesis, or (3) femoral component migration.

RESULTS

Patients were followed up for a mean of 14 (range, 8–18) years. No patients were lost to follow-up; 2 died of unrelated causes before the minimum 8-year follow-up. The mean Harris hip score improved from 29 (range, 5–40) to 78 (range, 56–88); 24 patients attained excellent or good scores (>80), 10 attained fair, and 2 attained poor scores. The mean healing time was 7 (range, 6–14) months; there were no non-unions. Improvement in proximal bone stock was seen on serial radiographs (Fig). Non-progressive radiolucencies of <2 mm were seen around Gruen zones 1, 2, and 3 in 10 patients and zones 4 and 5 in 5 patients. No stems revealed cement fractures or migration.

Complications included chest infection (n=1), postoperative confusion (n=1), atrial fibrillation (n=1), deep vein thrombosis (n=3), non-fatal pulmonary embolism (n=1), wound haematoma (n=3), and superficial wound infection (n=2).
was no intra-operative stem perforation. Two (5%) patients had dislocation: one at 8 years caused by a worn-out and loose socket; the other occurred 2 years postoperatively and the hip had become chronically unstable despite repeated closed reductions. The patient’s age and medical condition precluded further surgery. He is able to manage the condition using a brace and has remained pain free.

DISCUSSION

Severe proximal femoral bone loss associated with a periprosthetic fracture and a loose femoral stem is a challenging problem in reconstructive hip surgery. The management goal is to regain hip function, maintain a stable prosthesis, fracture union, and good long-term survivorship of the prosthesis. A single-stage procedure is preferable. The choice of the technique and the revision femoral prosthesis is based on the surgeon’s preference. Because of our extensive experience of cementation in both primary and revision hip arthroplasties, we achieved good results using cemented long stems. However, in younger and more active patients, we tended to combine cemented long stem revision with impaction bone grafting.

For cementless fixation, both extensively and proximally porous-coated stems have been used. The results of proximally porous-coated stems in the management of periprosthetic fractures with proximal bone loss have been disappointing, due to the unfavourable environment for bone ingrowth in the deficient and sclerotic proximal femur. The extensively porous-coated femoral stem has shown good long-term results.

Although cemented distal fixation is not a biological form of reconstruction, an improvement in proximal femoral bone on serial radiographs was noticed, despite the limitation of plain radiographs for qualitative and quantitative assessment of bone formation.

The proximal femoral replacement prosthesis avoids the potential morbidity associated with the longer and more complex reconstruction procedures. The revision component must be of optimum material and designed to allow for physical weight bearing. It bypasses the deficient proximal femur and the long stem provides a larger cement fixation surface area. The insertion of a long-stem revision component is technically challenging and there is a potential for stress shielding of an already compromised proximal femur. Our results are better than those reported in other studies, which show non-union rates of 15 to 33%, and dislocation rates higher than 5%.

Although satisfactory results were achieved with a distally cemented modular stem, it is suggested that a good primary procedure, regular follow-up, and early intervention for progressive radiographic changes may avoid the need for revision surgeries.

ACKNOWLEDGEMENTS

We wish to thank Paul Siney and Patricia Fleming of the John Charnley Research Institute for their help in preparing the manuscript.
REFERENCES

1. Kavanagh BF. Femoral fractures associated with total hip arthroplasty. Orthop Clin North Am 1992;23:249–57.
2. Garcia-Cimbrelo E, Munuera L, Gil-Garay E. Femoral shaft fractures after cemented total hip arthroplasty. Int Orthop 1992;16:97–100.
3. Lowenhielm G, Hansson LI, Karrholm J. Fracture of the lower extremity after total hip replacement. Arch Orthop Trauma Surg 1989;108:141–3.
4. Lewallen DG, Berry DJ. Periprosthetic fracture of the femur after total hip arthroplasty: treatment and results to date. Instr Course Lect 1998;47:243–9.
5. Wagner H. Revision of femora stem with important loss of bone stock. In: Gallinaro P, editor. European instructional course lectures (EORT). Vol 1. Mason; 1993.
6. Wagner H, Wagner M. Conical stem fixation for cementless hip prostheses for primary implantation and revisions, In: Morscher EW, editor. Endoprosthetics. Berlin: Springer; 1995:258.
7. Allan DG, Lavoie GJ, Rudan JF, Gross AE. The use of allograft bone in revision total hip arthroplasty. In: Friedlaender GE, Goldberg VM, editors. Bone and cartilage allografts: biology and clinical applications. Park Ridge: American Academy of Orthopaedic Surgeons; 1991:255–78.
8. Emerson RH Jr, Malinin TI, Cuellar AD, Peters PC. Cortical strut allografts in the reconstruction of the femur in revision total hip arthroplasty. A basic science and clinical study. Clin Orth Relat Res 1992;285:35–44.
9. Gross AE, Lavoie MV, McDermott P, Marks P. The use of allograft bone in revision of total hip arthroplasty. Clin Orth Relat Res 1985;197:115–22.
10. Sim FH, Chao EY. Hip salvage by proximal femoral replacement. J Bone Joint Surg Am 1981;63:1228–39.
11. Sim FH, Chao EY. Proximal femoral replacement. In: Morrey BF, editor. Joint replacement arthroplasty. New York: Churchill Livingstone; 1991:828.
12. Huddleston HD. Femoral lysis after cemented hip arthroplasty. J Arthroplasty 1988;3:285–97.
13. Crawford SA, Siney PD, Wroblewski BM. Revision of failed total hip arthroplasty with a proximal femoral modular cemented stem. J Bone Joint Surg Br 2000;82:684–8.
14. Haddad FS, Masri BA, Garbuz DS, Duncan CP. Femoral bone loss in total hip arthroplasty: classification and preoperative planning. Instr Course Lect 2000;49:83–96.
15. Harris WH. 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 1969;51:737–55.
16. Gruen TA, McNeice GM, Amstutz HC. ‘Modes of failure’ of cemented stem-type femoral components: a radiographic analysis of loosening. Clin Orth Relat Res 1979;141:17–27.
17. Roberson JR. Proximal femoral bone loss after total hip arthroplasty. Orthop Clin North Am 1992;23:291–302.
18. Mont MA, Maar DC. Fractures of the ipsilateral femur after hip arthroplasty. A statistical analysis of outcome based on 487 patients. J Arthroplasty 1994;9:511–9.
19. Wroblewski BM, Fleming PA, Siney PD. Charnley low-frictional torque arthroplasty of the hip. 20-to-30 year results. J Bone Joint Surg Br 1999;81:427–30.
20. Raut VV, Siney PD, Wroblewski BM. Outcome of revision for mechanical stem failure using the cemented Charnley’s stem. A study of 399 cases. J Arthroplasty 1996;11:405–10.
21. Gie GA, Linder L, Ling RS, Simon JP, Sloop TJ, Timperley AJ. Impacted cancellous allografts and cement for revision total hip arthroplasty. J Bone Joint Surg Br 1993;75:14–21.
22. Mulliken BD, Rorabeck CH, Bourne RB. Uncemented revision total hip arthroplasty: a 4-to-6-year review. Clin Orth Relat Res 1996;325:156–62.
23. Peters CL, Rivero DP, Kull LR, Jacobs JJ, Rosenberg AG, Galante JO. Revision total hip arthroplasty without cement: subsidence of proximally porous-coated femoral components. J Bone Joint Surg Am 1995;77:1217–26.
24. Krishnamurthy AB, MacDonald SJ, Paprosky WG. 5- to 13-year follow-up study on cementless femoral components in revision surgery. J Arthroplasty 1997;12:389–47.
25. Paprosky WG. Distal fixation with fully coated stems in femoral revision: a 16-year follow-up. Orthopedics 1998;21:993–5.
26. Scheller AD, D’Errico H. Hip biomechanics and prosthetic design and selection in revision total hip replacement. In: Turner RH, Scheller AD, editors. Revision total hip arthroplasty. New York: Grune & Stratton; 1982:49.
27. Turner RH, Emerson ER Jr. Femoral revision total hip arthroplasty. In: Turner RH, Scheller AD, editors. Revision total hip arthroplasty. New York: Grune & Stratton; 1982:75.
28. McLaughlin JR, Harris WH. Revision of the femoral component of a total hip arthroplasty with the calcar-replacement femoral component. Results after a mean of 10.8 years postoperatively. J Bone Joint Surg Am 1996;78:331–9.
29. Sinha RK, Kim SY, Rubash HE. Long-stem cemented calcar replacement arthroplasty for proximal femoral bone loss. J Arthroplasty 2004;19:141–50.
30. Woo RV, Morrey BF. Dislocations after total hip arthroplasty. J Bone Joint Surg Am 1982;64:1295–306.