CASE REPORT

Successful Outcomes Using Interlocking Prostheses for Periprosthetic Fractures with Loose Femoral Components

Takahiko Tsutsui[1], Tomohiro Goto[1], Daisuke Hamada[1], Ichiro Tonogai[1], Kazuaki Mineta[1], Mitsunobu Abe[1], Tetsuya Matsuura[1], Naoto Suzue[1], Shoji Fukuta[2], and Koichi Sairyo[1]

[1]*Department of Orthopedics, Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan,* [2]*Department of Orthopedics, Kochi Health Science Center, Kochi, Japan*

Abstract : Periprosthetic femoral fractures with implant loosening are difficult to treat, especially when accompanied by severe bone loss. We report here the treatment outcomes of 4 patients (1 man, 3 women ; age range 69-86 years) with periprosthetic femoral fractures and implant loosening after bipolar hemiarthroplasty. Fractures were classified according to the Vancouver classification as type B2 and B3, with adequate or compromised bone stock, respectively. One patient was initially treated conservatively but symptoms due to implant loosening persisted and revision surgery was required. All patients underwent revision using a long-stem cementless implant with interlocking screws as well as a cancellous allograft to augment the bone stock. At final follow-up (mean, 25 months), all patients had stable implant fixation, bony union of the fracture, and marked recovery of the proximal femoral bone stock through allograft use. This revision procedure achieved implant fixation and fracture healing with reconstitution of the femur even in the short term and even in cases with severe bone deficiency. J. Med. Invest. 62 : 242-244, August, 2015

Keywords **:** *Interlocking prosthesis, Periprosthetic fracture, Aseptic loosening, Bipolar hemiarthroplasty, Total hip arthroplasty*

INTRODUCTION

Periprosthetic femoral fracture is a serious complication of hip arthroplasty that is challenging to treat, particularly when accompanied by implant loosening. Although the risk for periprosthetic fracture is increased by numerous specific factors such as increased age, cortical bone loss, and infection, the most frequent cause is loosening of the femoral prosthesis, which is noted on approximately 80% of all pre-fracture radiographs (1, 2).

The Vancouver classification developed by Duncan and Masri is the most common guide for surgeons during preoperative planning (3). The stability of the femoral component on the proximal fragment is the basic criterion for this classification, with the B2 and B3 types defined as a periprosthetic fracture around the implant with a loose prosthesis and adequate (B2) or compromised (B3) bone stock. These two fracture types are very complicated to treat, and management remains controversial. Among the surgical options available are open reduction and internal fixation, revision arthroplasty using cemented or cementless long stems, and total femur arthroplasty with megaprosthesis.

We report here 4 cases with a Vancouver type B2 or B3 periprosthetic femoral fracture treated by revision arthroplasty using a cementless long stem with an interlocking system.

CASE PRESENTATIONS

Case 1

An 86-year-old man who had undergone bipolar hemiarthroplasty for a right femoral neck fracture at a local hospital 7 years earlier fell while cycling and fractured his right femur. Radiographs showed a periprosthetic femoral fracture at the tip of the stem. Although the proximal bone stock was maintained, clear lines hole around the stem and stem subsidence were observed ; therefore, a Vancouver type B2 fracture was diagnosed (Fig. 1A).

Revision bipolar hemiarthroplasty was performed using a long-stem cementless implant with interlocking screws. To augment bone stock, a cancellous allograft was applied to the fracture site and proximal bone defect. After the operation, he had rehabilitation, range of motion and gait training. He was allowed to walk with full weight bearing. At final examination 18 months after surgery, radiographs showed bony union of the fracture and no evidence of stress shielding (Fig. 1B, C). The patient recovered and

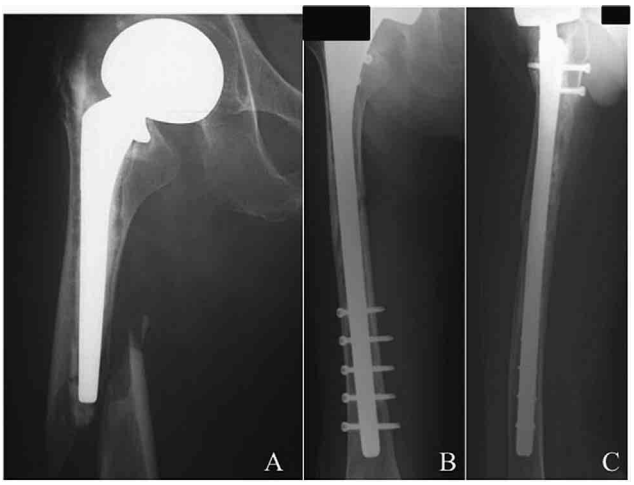

Figure 1. Plain radiographs in Case 1. (A) Preoperative radiograph shows a periprosthetic femoral fracture with stem loosening (Vancouver type B2). (B, C) Postoperative radiographs after 18 months show bony union of the fracture and no stress shielding.

Received for publication December 4, 2014 ; accepted February 4, 2015.

Address correspondence and reprint requests to Tomohiro Goto, MD, PhD, Department of Orthopedics, Institute of Biomedical Sciences, Tokushima University Graduate School 3-18-15 Kuramoto, Tokushima 770-8503, Japan and Fax : +81-88-633-0178.

was able to manage daily life activities independently.

Case 2

A 76-year-old woman had undergone bipolar hemiarthroplasty for a right femoral neck fracture 17 years earlier but loosening of the femoral implant was pointed out on radiographs 3 years earlier. She had complained of mild but continuous right thigh pain. She fell and suffered a right femoral periprosthetic fracture. The initial radiograph showed an oblique femoral fracture around the tip of the implant with a loose stem. She had severe osteoporosis and the proximal femoral bone stock was poor : Therefore, a Vancouver type B3 fracture was diagnosed (Fig. 2A).

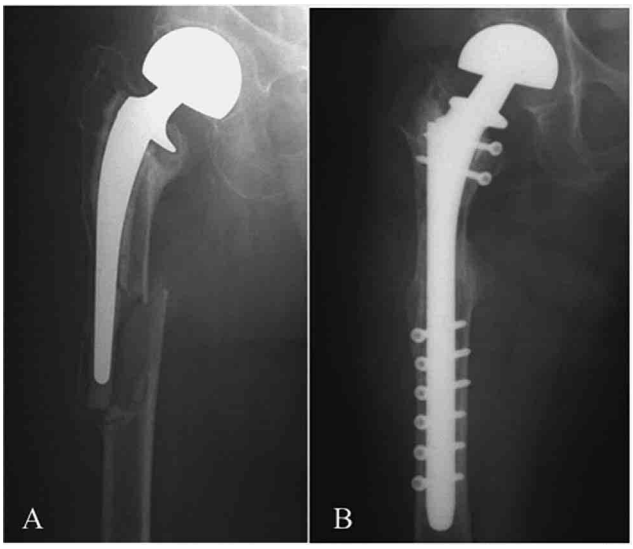

Figure 2. Plain radiographs in Case 2. (A) Preoperative radiograph shows a periprosthetic femoral fracture around the tip of the stem with implant loosening and poor bone stock (Vancouver type B3). (B) Postoperative radiograph after 21 months shows union of the fracture and a stable implant. Stress shielding is not evident and proximal bone stock is maintained.

Revision hemiarthroplasty using a cementless long stem with interlocking screws was performed. A cancellous allograft was applied to the fracture site and proximal bone defect to recover bone stock. She started postoperative rehabilitation, hip range of motion exercises, and gait training 2 days after surgery with no limitation on weight bearing. Radiographs taken 21 months after surgery showed bony union of the fracture and no stress shielding (Fig. 2B). The patient recovered and was able to walk with a cane and manage daily life activities by herself.

Case 3

An 82-year-old woman who had undergone bipolar hemiarthroplasty 6 years earlier for a left femoral neck fracture fell and complained of severe left thigh pain. Radiographs showed a periprosthetic femoral fracture at the tip of the stem accompanied by implant loosening and poor bone stock at the proximal side of the femur. A Vancouver type B3 fracture was diagnosed. Osteosynthesis was performed using plates and screws in another hospital : however, displacement of the fracture was apparent 3 months after osteosynthesis (Fig. 3A) and the patient was referred to our department.

Revision hemiarthroplasty using a long-stem cementless implant with interlocking screws was performed and a cancellous allograft was placed on the fracture site and proximal femoral bone defect. She started gait training 2 days after surgery with partial weight bearing until 10 kg. Weight bearing increased according to her left hip and thigh pain. At final examination 18 months after the revision surgery, radiographs showed bony union of the fracture, good condition of the proximal femoral bone stock as a result of the allograft, and no evidence of stress shielding (Fig. 3B).

Figure 3. Plain radiographs in Case 3. (A) Initial radiograph taken 3 months after osteosynthesis shows nonunion and displacement of the fracture. (B) Postoperative radiograph after 18 months shows bony union without evident stress shielding.

Case 4

A 69-year-old woman had undergone right bipolar hemiarthroplasty for a femoral neck fracture 20 years earlier. Although early postoperative recovery was uneventful, she had complained of right hip pain and shortening of the right lower limb 5 years earlier. She subsequently fell and sustained a periprosthetic femoral fracture with migration and loosening of the implant (Fig. 4A). The fracture was treated conservatively and bony union was observed (Fig. 4B). However, she had persistent pain in the right hip and discomfort in the right thigh. It was presumed these symptoms were caused by instability of the loosened implant and a revision total hip arthroplasty using an interlocking stem with cancellous allograft was performed. She started postoperative rehabilitation, hip range of motion exercises, and gait training with no limitation on weight bearing. Forty-five months later, the right hip and thigh pain was relieved and the patient was able to walk asymptomatically. Radiographs showed bony stability both in the stem and cup. Local reactive lines were noted proximal to the stem but no subsidence was observed (Fig. 4C).

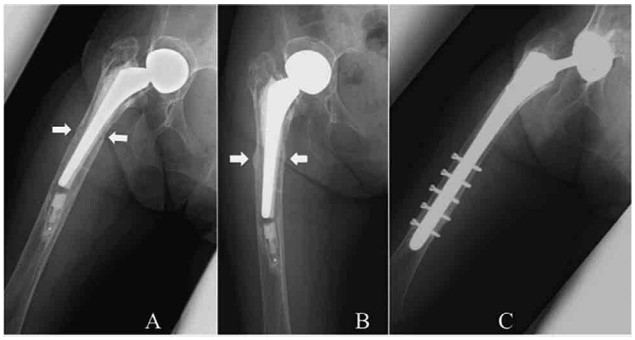

Figure 4. Serial radiographs in Case 4. (A) A periprostethic femoral fracture (white arrow), a loose stem, and poor bone stock in the proximal femur (Vancouver type B3). (B) Conservative treatment resulted in bony union (white arrow) but right thigh pain due to poor implant stability persists. (C) Postoperative radiograph 45 months after revision total hip arthroplasty shows bony stability of the implant and integrity of the screws. Reactive lines around the stem are apparent but with no evidence of subsidence.

DISCUSSION

Periprosthetic femoral fractures are uncommon and their prevalence has been reported to range from 0.1% to 5% (2, 4). However, the incidence of these fractures is growing as a result of the increasing elderly population undergoing hip arthroplasty. Treatment of these fractures is difficult, and improved techniques or definitive treatment protocols are necessary. The goal of treatment is to obtain stable fixation of the implanted prosthesis at the fracture site to preserve hip function.

The grade and type of bony defects on the proximal femur are important factors for optimal preoperative planning. Vancouver type B fractures have been reported to represent around 80% of all periprosthetic fractures (2) ; they are located around or at the tip of stem and are further sub-classified according to implant stability and bone stock. Management of type B2 and B3 fractures is most challenging because these fractures occur around loose implants with adequate or compromised bone stock, respectively. Revision arthroplasty is recommended for both types of fracture (5). However, poor results of revision surgery using cemented long stems have been reported due to insufficient remaining bone in the proximal femur to make an adequate micro-interlock of the cement to the bone (6). Also, cement extrusion into the fracture site can lead to nonunion. Impaction bone grafting is a useful technique to apply during revision using cemented long stems but it is technically demanding and carries a risk of intraoperative fracture, especially if the cortical bone is thin (7). Moreover, the use of a megaprosthesis is highly invasive and has high rates of infection, muscle weakness, and dislocation (8, 9).

To perform revision surgery using cementless stems, it is essential to obtain reliable biological fixation in the diaphyseal bone ; however, the proximal femur is often deficient and provides a poor biological and mechanical environment for proximal ingrowth. The extensively porous-coated implants that bypass the fracture site achieve rigid stability in the diaphyseal bone. While it has been reported that revisions using such implants offer good long-term clinical outcomes, distal fixation comes at the expense of proximal stress shielding, thigh pain, and significant bone loss.

Another option for cementless revision arthroplasty is to use cementless long stems with distal interlocking screws. The screws provide axial and rotational stability to the implant. Mahomed *et al.* reported that distal interlocking screws increase torsion and axial stability but are only accessory abutments that cannot be used alone to stabilize the stem (10). The efficacy of the interlocking screws contributes to the temporal stability during initial fixation and might inhibit micromotion at the stem-bone interface to promote bone in- or on-growth to the stem interface. Age is an important factor in the clinical results achieved. In patients aged over 70, the cumulative survival at 15 years was 92% compared with 68% in those aged under 70.

We treated 3 cases of periprosthetic femoral fractures and 1 case of loosening with massive bone loss through revision surgeries using cementless long stems with distal interlocking screws and cancellous allografts. Stable femoral stem fixation, bone union at the fracture sites, and good reconstitution of proximal femoral bone stock were achieved in all cases. No revision surgery was needed during the follow-up period and no subsidence of the femoral implants or radiological signs of stem loosening were evident after a minimum of 18 months of follow up.

The use of cementless long stems with distal locking screws could represent an easy and strong initial fixation technique even in cases with massive bone deficiency. This technique is indicated for complex femoral revisions of periprosthetic femoral fractures with implant loosening, especially in elderly patients. Risks of screw breakage, stress shielding and stem loosening exist, and therefore careful long-term follow up is required.

DECLARATION OF INTEREST

The authors report no conflicts of interest.

REFERENCES

1. Corten K, Vanrykel F, Bellemans J, Frederix PR, Simon J-P, Broos PLO : An algorithm for the surgical treatment of periprosthetic fractures of the femur around a well-fixed femoral component. J Bone Joint Surg Br 91 : 1424-1430, 2009
2. Lindahl H, Malchau H, Herberts P, Garellick G : Periprosthetic femoral fractures classification and demographics of 1049 periprosthetic femoral fractures from the Swedish National Hip Arthroplasty Register. Journal of Arthroplasty 20 : 857-865, 2005
3. Duncan CP, Masri BA : Fractures of the femur after hip replacement. Instr Course Lect 44 : 293-304, 1995
4. Meek RMD, Norwood T, Smith R, Brenkel IJ, Howie CR : The risk of peri-prosthetic fracture after primary and revision total hip and knee replacement. J Bone Joint Surg Br 93 : 96-101, 2011
5. Sledge JB, Abiri A : An algorithm for the treatment of Vancouver type B2 periprosthetic proximal femoral fractures. Journal of Arthroplasty 17 : 887-892, 2002
6. Eisler T, Svensson O, Iyer V, Wejkner B, Schmalholz A, Larsson H, Elmstedt E : Revision total hip arthroplasty using third-generation cementing technique. Journal of Arthroplasty 15 : 974-981, 2000
7. Pekkarinen J, Alho A, Lepistö J, Ylikoski M, Ylinen P, Paavilainen T : Impaction bone grafting in revision hip surgery. A high incidence of complications. J Bone Joint Surg Br 82 : 103-107, 2000
8. Parvizi J, Tarity TD, Slenker N, Wade F, Trappler R, Hozack WJ, Sim FH : Proximal femoral replacement in patients with non-neoplastic conditions. J Bone Joint Surg Am 89 : 1036-1043, 2007
9. Friesecke C, Plutat J, Block A : Revision arthroplasty with use of a total femur prosthesis. J Bone Joint Surg Am 87 : 2693-2701, 2005
10. Mahomed N, Schatzker J, Hearn T : Biomechanical analysis of a distally interlocked press-fit femoral total hip prosthesis. Journal of Arthroplasty 8 : 129-132, 1993