Vancouver Type-B1 Periprosthetic Femoral Fractures Fixation with Locking Compression Plate

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***Abstract**: Twelve (12) consecutive patients (Twelve hips) with a Vancouver type-B1 periprosthetic femoral fracture were treated with a locking compression plate. There were seven men and five women with an average age of 68 years at the time of fracture. All of the fractures occurred after a total hip arthroplasty performed with cement. In addition to the plate, cortical strut allografts were used to stabilize five fractures. The patients were assessed clinically and radiographically. The average duration of follow-up was twenty months. Nine fractures healed uneventfully at an average of 5.4 months. Two treatment constructs failed because of breakage of plate and one because of plate pullout within twelve months after surgery. Out of 3, 2 failures occurred in constructs in which a cortical strut allograft had not been utilized. On the basis of the success rate in this study of patients having type-B1 periprosthetic femoral fractures it can be concluded that as locking plates have the potential to preserve the cement mantle, the locked screws appear to offer good pullout resistance in this fracture type specially when supplemented with bone allografts and circlage wires.*

INTRODUCTION

The treatment of periprosthetic femoral fractures is challenging. Because of the diversity of these fractures, they cannot be treated by a single approach. Vancouver type-B1 periprosthetic fractures, defined as a fracture occurring at or near the distal tip of a prosthesis with a stable femoral stem, are associated with the most complications of all of the fracture types because of the inherently unstable fracture pattern[1-3]. Surgical treatment has included open reduction and internal fixation with different types of plates and strut allografts alone or in combination with plates[4-8]. However, proximal screws may violate the bone-prosthesis interface, may lead to cement fracture and loosening, and/or may act as stress risers increasing the risk of a later fracture[9]. Replacing the femoral component with a long stem that bypasses the fracture line is another option. Locking compression plates have been introduced as an alternative method of fracture fixation. Screws that lock into the plate allow multiple points of unicortical fixation. Biomechanical studies have shown these plates to be more stable than unlocked devices[10]. This feature may be associated with a low risk of damaging the cement mantle or a stable uncemented femoral stem in the treatment of a periprosthetic femoral fracture.

The purpose of this study was to analyze clinically and radiographically a group of patients with a type-B1 periprosthetic femoral fracture treated with open reduction and internal fixation with use of a locking compression plate.

MATERIALS AND METHODS

We retrospectively reviewed a consecutive series of twelve patients of Vancouver type-B1 periprosthetic femoral fractures who were treated with a locking compression plate from November 2008 to May 2011[1]. There are seven men and five women with an average age of sixty-eight years (range, thirty-four to eighty-eight years).

The fracture involved the right side in seven patients and the left side in five. All fractures occurred after a total hip arthroplasty performed with cement. The primary diagnosis was osteoarthritis in nine patients, femoral neck fracture in two, and osteonecrosis in one patient. The injury mechanism was a low-energy fall in all twelve patients, and all fractures were closed. All of the patients sustained isolated injuries.

The fractures were subdivided according to the fracture pattern into oblique (short or long) and transverse as well as undisplaced or displaced fractures. The distal portion of the cement mantle was part of the fracture site in all patients. All patients had epidural anesthesia. The average interval from the injury until the operation was 2.7 days (range, one to five days). After fracture reduction under direct vision, locking compression plates were utilized in combination with strut allografts (nine patients) or alone (three patients). We strictly followed the general techniques that have been described for the insertion of these devices[10-11]. Circlage wires were used in ten patients out of 12 patients. Cancellous bone allograft was used in all patients. The average operative time was 101 minutes (range, sixty-five to 130 minutes).

Patients were evaluated clinically and radiographically with use of the Merle d'Aubigné and Postel functional score which measures pain, function and motion with maximum score of 6 for each used at 15,45,90 and 180 days postoperatively and then yearly thereafter[12].

The rehabilitation protocol included early mobilization and walking with two crutches or a walker and toe-touch weight-bearing on the involved side for forty-five days. If there was no pain and no radiographic change in alignment, a cane was used until the patient was fully able to walk.

RESULTS

The average duration of follow-up for the twelve patients was twenty months (range, ten to thirty months). Nine fractures healed uneventfully (shown in fig.) at an average of 5.4 months (range, three to twelve months). Two fractures failed to unite (involving displaced transverse fractures) with a breakage of the plate occurring in patients at 8 and 10 months postoperatively.

Preoperative X-rays showing Vancouver Type B1 periprosthetic fracture

Postoperative X-rays showing fixation of Periprosthetic Vancouver Type B1 fractures

The patients were bearing weight and walking without aids and without symptoms until the time of the plate fracture, and there was no history of trauma in any of these patients. They were managed with another operation, performed with the patient under hypotensive epidural anesthesia and through the same surgical approach. After removal of the broken device, we utilized a new locking compression plate fixed with screws and adding strut allografts secured with circlage wires. After use of the previous rehabilitation protocol, fracture-healing was observed at six and eight months, respectively.

An additional one patient presented with plate pullout (involving a short oblique

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undisplaced fracture) who was earlier fixed with locking plate with cancellous bone grafting 8 months back. This patient was treated nonoperatively as they had radiographic evidence of callus formation.

Two of the three failures were observed in patients in whom a cortical strut allograft had not been used. In the patients with fractures that united, the average postoperative Merle d'Aubigné and Postel12 score was 5.8 points for pain, 5.4 points for mobility, and 5 points for gait and union rate was 85%.

DISCUSSION

The inherently unstable Vancouver type-B1 periprosthetic fracture is especially challenging in hip arthroplasty performed with cement, which was the type of femoral stem fixation used in all twelve of these patients. It is important to note that these were complex cases.

It is worth noting that pullout was not observed in the patients in which circlage wires with bone graft fixation were used. These wires may help to prevent plate pullout. The loss of endosteal healing potential and the soft-tissue stripping required for the placement of struts, wires, and plates could have played an important role in some cases of delayed union. The addition of strut allografts may provide immediate mechanical stability, and they may enhance fracture-healing and increase bone stock[7,8,13]. It has been stated that regardless of the method of fixation, the fracture site should be treated with cancellous bone graft[5]. In a recent study by O'Toole et al.[16], a series of nineteen patients with a femoral fracture adjacent to the site of a stable hip or knee arthroplasty had a 5% complication rate. Only one of those fractures was complicated by hardware pullout. Several authors have reported a union rate ranging from 33% to 100% with different surgical approaches[6,8,9] but in our case it was 85% . Recent biomechanical studies have shown that locking plates are stiffer in axial loading and torsion than conventional cable plate fixation used to stabilize periprosthetic femoral fractures[18]. Analysis of the results in the present group of patients demonstrated that a more stable construct under axial loading and torsion was obtained when strut allografts with circlage wiring were utilized in combination with the locking compression plate. Locking plates represent a valuable advance in fracture treatment since they provide angular stability, help to preserve the vascular supply, allow for the possibility of the use of minimally invasive insertion techniques, and need less plate-contouring compared with conventional plates[11].

We currently treat these types of fractures with locking compression plates fixed with bicortical screws wherever possible with bone grafting.

CONCLUSION

As the cement mantle remained intact, we observed that the locked screws did offer good pullout resistance in Vancouver type-B1 periprosthetic femoral fractures and provide better results when used alongwith circlage wires and bone grafts.

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