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Locking Compression Plates for the Treatment of Periprosthetic Femoral Fractures Around Well-Fixed Total Hip and Knee Implants

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Abstract: There are currently few published studies examining the use of locking compression plates for the treatment of periprosthetic femoral fractures. Fifteen total hip or knee arthroplasty patients with 16 Vancouver type B1 and C fractures with an average age of 76 years were fixed and followed clinically and radiographically for 2 years. Fourteen patients achieved radiographic union by 6 months, and 13 patients were ambulatory by 6 months. There were no intraoperative complications. In summary, locking plates offer a viable treatment option for these difficult fractures. We advocate a minimum of 10 cortices of fixation (with unicortical or bicortical screws and cable combinations) above and below the fracture. Bone grafting should be used if the soft tissue envelope is violated with extensive dissection, and cortical struts should be considered in cases of failed hardware and revision fixation. **Keywords:** locking plates, periprosthetic, fracture, total hip arthroplasty, total knee arthroplasty.

Periprosthetic fracture fixation is a difficult and complex procedure. The incidence of such fractures is increasing due to the high prevalence of older patients with joint arthroplasty and osteoporosis [1-3]. Previously fixation of fractures around well-fixed implants were done using various compression plates, wires, and allograft or a combination thereof and was succeeded by the introduction of locking plates in the 1990s. The evolution of locking plates has led to a plethora of designs. The locking compression plate (LCP; AO group) was released for clinical application in 2000, with the first results reported in 2003 [4]. The use of these plates requires both a change in surgical technique and a new concept of internal "biological fixation" [5]. Despite their clinical use for close to 1 decade, there is little information in the literature regarding clinical results. In fact, some reports have suggested some mechanical failures associated with these implants [6-8].

The AO LCP has been available at our institution since 2002 and has undergone significant evolutions in design. In 2002, the condylar locking plate (Synthes 2002) was introduced for periarticular fracture fixation. In 2003, this system was developed further for use with the large fragment plates. In 2005, the curved condylar plate, the proximal femoral locking plate, and periprosthetic sets (consisting of the broad curved locking plates, short blunt periprosthetic screws, and dedicated cable instruments) were introduced. As this fracture fixation system has evolved, it has become our primary method of treatment for periprosthetic femoral fractures around well-fixed hip and knee implants. The purpose of this study was to report our indications and principles for its use and the complications and early clinical outcomes of this locking plate in a consecutive series of patients treated at our institution.

Materials and Methods

All patients who had fixation of a periprosthetic femoral fracture with the Synthes Locking Plate system at our institution between 2004 and 2006 were identified. Internal Research Ethics Board approval was received to further analyze and report on this cohort. Fifteen consecutive adult patients with 16 periprosthetic fractures around well-fixed hip and knee implants (Vancouver B1 and C fractures) had their relevant

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study data retrospectively collected. One patient who had a Vancouver B2 femoral fracture and was treated with revision total hip arthroplasty and adjuvant locking condylar plate fixation was excluded. No other type of plate fixation system was used at our institution during this period, and our institutional ethics review board approved the study.

The average age of our cohort was 76 years (range, 33-92 years). Eleven patients were older than 75 years. There were 10 females and 5 males, all of whom had sustained low-velocity fractures and whose average body mass index was 26 kg/m^2 (range, 16-38 kg/m^2).

Before fracture, there were 7 cemented and 9 uncemented arthroplasties, of which 10 were primary implants and 6 were revision prostheses. There were 11 periprosthetic hip fractures, 1 periprosthetic knee fracture, and 4 fractures between an ipsilateral hip and knee arthroplasty. The fracture pattern was comminuted in 4, oblique in 4, and spiral in 8 fractures. The 16 fractures were classified using the Vancouver classification as type B1 (around a well-fixed implant) in 9 and type C (remote from implant) in 7 [9].

There were 6 patients in our cohort who had a failure of their previous periprosthetic fracture fixation and whom required revision surgery. Three were failed less invasive stabilization system (LISS) plate fixations for 2 B1 and 1 type C periprosthetic fracture. Two were type C fractures after a long-stem revision of a B2 periprosthetic fracture, and the last required operative treatment of failed conservative management of a B1 fracture.

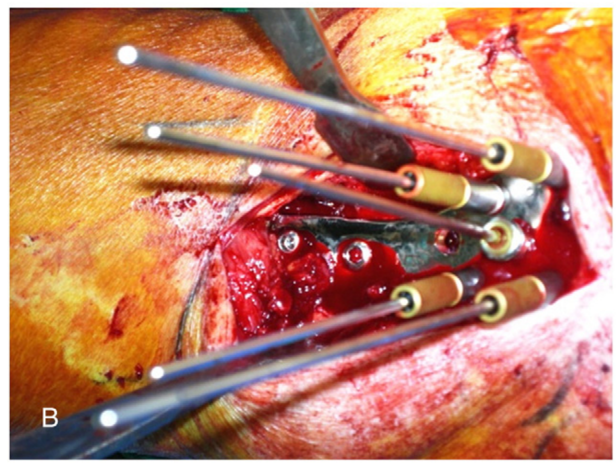

Fig. 1. (A) Percutaneous plate application to femur. (B) Percutaneous plate application showing guide wires for locking screws.

Operative Technique

All patients were positioned in the lateral decubitus position on a radiolucent table. A lateral position was used because we felt that this was the safest position to pass cables around the femur if this was required. The pelvis was stabilized by hip bolsters or an inflatable beanbag, depending on surgeon preference. Before surgery, a large C-arm was used to ensure adequate anteroposterior and lateral fluoroscopic images could be obtained. All patients received preoperative antibiotics. The entire extremity was draped out in sterile technique. A laterally based incision was used in all patients.

When a minimally invasive technique was used, 2 small incisions were created proximal and distal to the fracture under fluoroscopic guidance. Plate length was determined using fluoroscopic guidance with the aim of achieving at least 5 screw holes or 10 cortices above and below the fracture. Incision length and position were determined on the basis of the ability to achieve adequate screw fixation from one incision at either end of the plate. A large Cobb was used to elevate the vastus lateralis muscle off the lateral femur, and the plate was slid percutaneously under the vastus lateralis muscle (Fig. 1A, B). Fixation was then achieved in the distal segment, and indirect reduction techniques were used to reduce the construct to the proximal segment, where it was then stabilized. Indirect reduction techniques consisted of traction, the use of temporary wires, and the use of lag screws to reduce the plate to the femur and to reduce the distal fragment into alignment with the proximal segment. Fracture reduction and hardware position were verified at multiple time periods during the procedure using fluoroscopy.

In those cases of formal open reduction, a long skin incision was used. A subvastus approach to the lateral femur was used, with careful attention to cauterization of the profundus femoris perforating branches. A vastus splitting technique was avoided for fear of denervating the muscle. In cases of previously failed fixation, retained hardware was removed, and the fracture ends were identified. Care was taken to protect the periosteum and only retracted at the fracture edge to allow reduction before sliding the plate into position. In cases of severe comminution, provisional fixation of the fracture can be achieved with circumferential Luque wires. An appropriate plate length was then selected, usually from the vastus ridge proximally to the distal femoral condyle for condylar locking plates. On