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Reverse LISS plates for unstable proximal femoral fractures

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ABSTRACT

The best treatment for unstable proximal femoral fractures is controversial. In this prospective study, we assessed the outcomes of reverse less invasive stabilisation system (LISS) plates for treatment of unstable proximal femoral fractures that are expected to be difficult to nail.

From April 2004 to January 2007, 20 patients with unstable proximal femoral fractures that were assessed to be difficult to nail were managed with reverse less invasive stabilisation system–distal femur (LISS–DF) plates, which included (1) subtrochanteric fractures with extension into the piriform fossa, (2) short skeletons with narrow femoral canals, (3) adolescents with open physes and (4) severely bowed or deformed femurs. These patients were enrolled in this study. There were 11 females and nine males, with a median age of 58 years (range, 14–95 years).

The average follow-up period was 24 (range, 12–32) months. Functional recovery (Parker and Palmer mobility score), pain, bony union, varus deformity, implant failure and leg length discrepancy were assessed. The fractures united at a median of 7 months (range, 3–15 months) postoperatively. Parker and Palmer mobility scores were 9 points for 17 patients and 6 points for three patients. Pain was absent in 15, mild in three, and moderate in two patients. Patients with poor quality of reduction were more likely to have pain results ($p = 0.009$). Although patients with advanced age were not more likely to have pain results, they were more likely to have 'delayed union' radiographic results ($p = 0.033$). Two limbs were shortened by 1.5 and 2 cm, respectively.

Reverse LISS plate fixation led to complete union of unstable proximal femoral fractures without additional procedures. The surgical technique was simple and safe. We recommend considering the use of this locked-plate device as the alternative management of unstable proximal femoral fractures that are unsuitable for nailing procedures.

Trochanteric fractures continue to be one of the most common orthopaedic injuries, with significant cost to the individual and society. According to the AO/Association for the Study of Internal Fixation (AO/ASIF) classification, these fractures are classified into stable fractures (31-A1) and unstable fractures (31-A2, 31-A3).[22] Internal fixation is the standard treatment for these fractures, allowing for early mobilisation. Many different implant designs are available to treat these fractures.[10,27,33] They include either some forms of intramedullary nail or extramedullary fixation, with plates and screws. Extramedullary devices, such as the sliding hip screw, dynamic condylar screw and angular blade plates are widely used in the treatment of proximal femoral fractures.[28,35,37] From the biomechanical point of view, intramedullary nailing devices are more stable under loading,[15] have a shorter lever arm and are recommended for unstable proximal femoral fractures.[1,4,21] But some intramedullary nailing devices are associated with significant numbers of femoral shaft fractures below the nail, resulting in technical failures.[11] Therefore, the best treatment for unstable proximal femoral fractures is controversial.

Some unstable proximal femoral fractures are assessed to be difficult to nail. These include subtrochanteric fractures with extension into the piriform fossa,[34] patients with short skeletons and narrow femoral canals, adolescents with open physes[5] and patients with severely bowed or deformed femurs. In these situations, extramedullary fixation with plates and screws is recommended.

The less invasive stabilisation system–distal femur (LISS–DF, Synthes, Paoli, PA, USA) was designed for treatment of distal femoral fractures according to the principles of 'minimally invasive' surgery. A plate, pre-contoured to the distal femur anatomy, is inserted through a small incision into the epiperiosteal space by means of an aiming device after indirect, closed fracture reduction. The LISS behaves as an internal splint, and, thus, its biomechanics are inherently different from conventional plates. The LISS plate has been used extensively to manage distal femoral fractures with satisfactory results.[18,29] Sidhom et al.[30] reported using a left-side 'upside-down' LISS plate to successfully unite a right proximal femoral fracture. Reverse LISS plates were used

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'upside down' for stabilising injured femurs. Through a small lateral incision, an LISS plate was introduced on its jig, with minimal periosteal stripping. The reverse LISS plate employs the fixation mechanism as a fixed-angular plate and screw aiming device applied via a stab wound. This allows the surgeon to easily fix the unstable proximal femoral fracture, which would be difficult to do with convention plates and screws.

We report our experience in using reverse LISS plates with minimally invasive surgical techniques for treatment of 20 patients with unstable proximal femoral fractures that were assessed to be difficult to nail.

Patients and methods

From April 2004 to January 2007, we treated 153 patients with unstable proximal femoral fractures at our institute. Twenty patients with unstable proximal femoral fractures, including (1) subtrochanteric fractures with extension into piriform fossa ($n = 13$), (2) short skeletons with narrow femoral canals ($n = 4$), (3) adolescents with open physes ($n = 2$) or (4) severely bowed or deformed femurs ($n = 1$), were treated by surgeons using percutaneous fracture stabilisation and LISS–DF locking devices. A reverse LISS plate was used 'upside down' to stabilise the injured femur (Fig. 1). Because using reverse LISS–DF is an off-label use, review of patient records and radiographs and appropriate informed consent from patients were approved by the institutional review board. There were nine males and 11 females. The left femur was involved in 11 patients and the right in nine. Patient age averaged 58 years (range, 14–95 years). Of the 20 fractures, 18 were stabilised within 3 days after injury. Two fractures were stabilised more than 1 week after admission, secondary to the treatments for associated injuries.

The mechanisms of injuries consisted of falls at ground level in six patients, motor vehicle accidents in 12 patients and bicycle accidents in two patients. All patients were evaluated preoperatively with standard antero-posterior (AP) radiographs of the pelvis, and AP and lateral views of the affected hip. Computer tomography was done in one patient with a pathologic fracture. As recommended by the AO/ASIF, the fractures were classified on the basis of the preoperative radiographs as 31-A1 (zero stable peritrochanteric fractures), 31-A2 (five patients) and 31-A3 (15 patients).

Surgical technique

Surgery was conducted under either general or spinal anaesthesia, with the patient in the supine position on a traction table. Traction was applied to the injured leg by a padded holder on the foot. A padded perineal post was used to counter traction. The unaffected limb was placed in hip abduction and knee flexion. An accurate closed reduction was done under fluoroscopic control, and maintained by traction with a boot.

The LISS–DF lengths are available in right and left varieties and in lengths with 5, 9 and 13 holes proximal to the distal plate. The LISS–DF plate is preshaped to account for the anterior bow of the shaft zone of the femur. In this study, we most commonly used 9 and 13 holes and a contralateral side LISS–DF plate used 'upside down' for stabilisation of the proximal femoral fracture (Fig. 1). Depending on the patient's body habitus, a 2.5- to 8-cm incision was made just proximal to the greater trochanter, and taken to the level of the fascia, which was not violated. A submuscular plane was developed under the vastus lateralis and the LISS plate was inserted submuscularly across the fracture site while maintaining slight contact with the bone. The position of the LISS on the lateral femoral shaft and proximal femur was checked radiographically. After ensuring optimal placement of the plate on the femur, it was temporarily fixed to the bone with Kirschner wires via the proximal and distal connector trocars (Fig. 2). In closed procedures, the position of the LISS was checked again radiographically before screwing the plate to the femur. Thereafter, self-drilling and self-cutting screws were inserted through the trocar sleeve and via the stab incisions, using a drill. To ensure secure fixation, four to six screws were placed into the proximal component of the fracture. Optimal placement and screw length was ensured under fluoroscopy in two planes. The parallel of the several locking head screws in the AP plane and the divergence in the lateral plane allowed an angular-stable buttress that increased the stability of the fracture fixation. Three or four screws were placed into the distal component of the fracture. Finally, the incisions in the vastus fascia and stab wounds were closed, without drainage, in the standard fashion.

Postoperative protocol

Postoperative management consisted of active exercise of the quadriceps and early ambulation unless associated other injuries or poor general condition precluded ambulation. Partial weight bearing began with 10–15 kg for approximate 6 weeks, with gradual increases in weight bearing as tolerated. Full weight bearing was encouraged after 3–6 months of partial and increasing weight bearing, based on the degree of comminution of the fractures and the evidence of callus formation on radiographs.

Fig. 1. Photograph of the LISS fixator with aiming device inserted in a femur.

Fig. 2. Intra-operative photograph shows the LISS fixator was inserted in a submuscular manner and temporarily fixed with Kirschner wires via the proximal and distal connector trocars.