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The outcome of unstable proximal femoral fracture treated with reverse LISS plates

Shih-Jie Lin[a], Kuo-Chin Huang[a,b], Po-Yao Chuang[a], Chien-Yin Lee[a], Tsan-Wen Huang[a,b,*], Mel S. Lee[b,c,**], Robert Wen-Wei Hsu[a,b]

[a] Department of Orthopedic Surgery, Chang Gung Memorial Hospital, Chiayi, Taiwan
[b] Change Gung University, Taoyuan, Taiwan
[c] Department of Orthopedic Surgery, Kaohsiung Chang Gung Memorial Hospital, Taiwan

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ABSTRACT

Background: The Russel-Taylor type 2B fractures compromised the trochanteric region and medial buttress of proximal femur. This fracture pattern limits the choice of implants and raises the risk of adverse outcomes. We aimed to (i) determine the outcome of Russel-Taylor type 2B fractures treated using reverse less invasive stabilization system plates (LISS-DF) and to (ii) learn what factors affected outcomes after osteosynthesis with reverse LISS plates.
Design: A retrospective study
Setting: The study was conducted at a Level III trauma center in Taiwan.
Methods: Twenty-five consecutive patients presenting with a Russel-Taylor type 2B fracture were enrolled. All cases were treated with reverse LISS plates. A Modified Radiographic Union Scale for Femur (RUSF), Radiographic parameters, functional scores, and complications were assessed.
Results: Union occurred in 21 cases at an average of 18.8 weeks. The average immediate postoperative neck-shaft angle was 130° (range: 122–135°) compared with 139° (range: 135–141°, $p = 0.05$) on the contralateral side. Two cases had complications of proximal screws cutting out and two cases had broken implants. Finally, all 4 cases required repeated surgeries (16%). Malunion occurred in 4 patients and early mechanical failure (proximal screws cut out) occurred in 2. There was a significant difference in the purchase index of the proximal screws between cases with redisplacement and those without (26.4 mm and 98.6 mm, $p = 0.01$).
Conclusions: The use of reverse LISS plate appeared to be an alternative procedure for the specific pattern in the present study. We recommend using this reverse locking plate to treat unstable proximal femoral fractures with meticulous techniques of placing plates. Adequate purchase of the proximal locking screws might decrease the risks of complications.

Introduction

Unstable proximal femoral fractures are not uncommon and remain the most challenging problem of orthopedic trauma. Intertrochanteric and subtrochanteric fractures account for nearly 50% of all fractures of the proximal femur. Despite improved techniques and devices, fixation failure is still a problem in unstable pertrochanteric femoral fractures [1]. Especially in the fracture pattern of Russel-Taylor type 2B, a subtrochanteric fracture involving piriformis fossa and lacking of stability of medial femoral cortex, fractures compromised to the so-called "entry point of the sliding hip screw and intramedullary nail", and limit the choices of implants and raise the risk of adverse outcomes. High compressive and tensile stresses across this region are related to nonunion, and a shortage of cancellous bone and the poor vascularity of cortical bone are known to delay union [2–4]. This challenging fracture pattern, Russel-Taylor type 2B, is difficult to treat with either extramedullary (EM) or intramedullary (IM) devices. EM devices, such as the sliding hip screw, dynamic condylar screw, and angular blade plates, are widely used in to treat proximal femoral fractures [5–7]. However, these implants have some limitations when used to treat this unstable fracture

* Corresponding author at: Department of Orthopedic Surgery, Chang Gung Memorial Hospital, Chiayi, No. 6, west section, Chia-Pu Road, Puzih City 613, Taiwan.
** Corresponding author at: Chang Gung University, Taiwan, Department of Orthopedic Surgery, Kaohsiung Change Gung Memorial Hospital, 123 Dapi Road, Niaosong Dist Kaohsiung City 83301, Taiwan.
E-mail addresses: b8601081@cgmh.org.tw (T.-W. Huang), bone@doctor.com (M.S. Lee).

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pattern. With the biomechanical advantage of a shorter lever arm, IM nailing devices are more stable under a load [8] and are the treatment of choices for unstable proximal femoral fractures [9]. However, in the specific Russel-Taylor type 2B fracture, which is associated with a compromised trochanter region and piriformis fossa, IM nailing might be a technical failure from the entry point of the trochanter [10].

Extramedullary fixation using a reverse less invasive stabilization system for distal femur fractures (LISS-DF plates; DePuy Synthes, Paoli, PA, USA) has been accepted as an alternative treatment option for proximal femoral fractures in this decade [11–14]. When treating proximal femoral fractures, the minimally invasive plate osteosynthesis (MIPO) method used with this reverse locking plate provides greater fixation strength and axial loading than do other EM devices [15] and it preserves tissue vascularity for biological bone healing [16]. However, the best indications, surgical techniques, and risk factors of outcome need to be investigated. Several series [12,17,18] have reported treating subtrochanteric fractures with reverse LISS-DF plates. However, Russel-Taylor type 2B fracture, were not well analyzed for outcomes when this method and this implant were used. In the present study, a series of this specific type of fracture treated using MIPO with a reverse LISS-DF plate in our hospital was reviewed to investigate the outcome of this technique.

Methods

Patients and grouping criteria

From January 2010 through December 2012, patients in our hospital with unstable proximal femoral fractures treated with osteosynthesis using reverse LISS-DF plates were enrolled and retrospectively evaluated. After obtaining approval from our Institutional Review Board (IRB), cases were identified by matching the *International Statistical Classification of Diseases and Related Health Problems, 9th Revision, Clinical Modification* (ICD-9-CM) codes specific for "Fracture of intertrochanteric or neck of femur" (820.0–820.9) in our computerized registry database. All clinical and radiographic records from admission to final follow-up were reviewed. Inclusion criteria were: (a) $\geq$18 years old, (b) Russel-Taylor type 2B fracture, and (c) able to walk without assistance before the fracture. Exclusion criteria were: (a) polytrauma with hip fractures requiring prolonged intensive care, (b) pathological fractures, (c) prior proximal femoral fractures, (d) bilateral hip fractures.

Surgical technique

The patient was positioned in the supine position on a traction table under general or spinal anesthesia. A padded perineal post was used to counter traction. The unaffected limb was positioned in hip abduction and knee flexion. A meticulous closed reduction was done under fluoroscopic guidance and provisionally maintained using traction. Acceptable reduction was defined as <2–5 mm displacement on the antero-posterior and lateral plain radiograph, $\leqq$5° varus to 25° valgus on the antero-posterior plain radiograph and 10–20° on the lateral plain radiograph [19,20]. A contralateral side LISS-DF plate was used upside down for plate osteosynthesis of the proximal femoral fracture. A skin incision was made over the trochanteric region and the femur was laterally approached. A submuscular plane under the vastus lateralis was created for plate insertion. The optimal placement of the LISS plate, and especially the axial plane alignment of the plate in relation to the femoral neck, was checked and confirmed using an image intensifier with biplanar-controls. To ensure a secure fixation, several proximal screws were placed in the femoral head and neck, and four to six screws were placed in the distal femoral shaft.

Postoperative protocol and assessment

Physical rehabilitation courses consisted of immediately postoperative active exercise of the quadriceps, early ambulation with partial weight bearing for approximately 8 weeks, and full weight bearing after 3–6 months of protected weight bearing, based on the degree of comminution of the fractures and radiographic evidence of callus formation. Follow-up examinations with a complete radiographic and clinical evaluation were done at 1, 3, 6, 9, and 12 months, and annually thereafter. All patients were followed until there was a solid union of the fracture or a reoperation was done.

Outcome parameters

An independent reviewer performed the radiographic and functional assessments. Postoperative radiographs were analyzed for the position of proximal fragment screws over the femoral head (purchase index), the quality of the reduction, the complicated varus collapse, and the fracture union.

Purchase index (screw-tip purchase over femoral head)

The location, number, and length of the proximal fragment screws within the femoral head were also evaluated to investigate the optimal screw position. The baseline was defined as a tangent to the superior and inferior femoral necks (Fig. 1). The screw-tip purchase over the head was defined as the total distance from baseline to screw tips which, in an anteroposterior view, passed the baseline.

Quality of reduction & complicated varus collapse

In neck-shaft angle of proximal femur, it was stratified into three categories: none/mild (< 5°), moderate (5° to 10°) and severe (>10°) by comparison with the contralateral hip on all postoperative radiographs [21]. The neck-shaft angle of proximal femur was used to evaluate the re-displacement in osteosynthesis of pertrochanteric fractures. Cases that had more than 10° decreased than the contra-lateral hip were grouped as re-displacement.

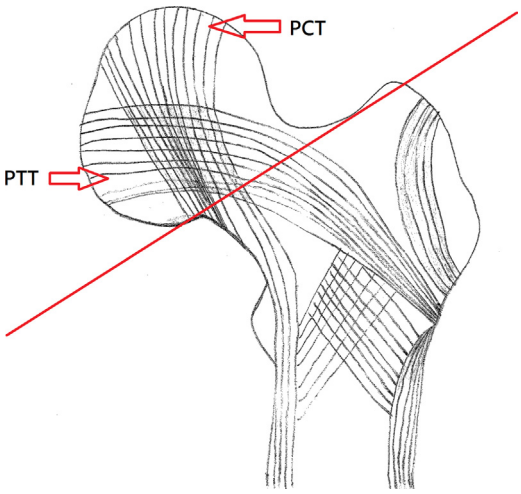

Fig. 1. The baseline is defined as a line drawn tangent to the superior and inferior femoral necks in an anteroposterior view. PCT—Principal compressive trabeculae, PTT—Principal tensile trabeculae.