CLINICAL ARTICLE

Treatment of Middle-up Part Long-segment Femoral Fracture with Long Proximal Femoral Nail Antirotation

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Objective: To investigate the outcomes of treating middle-up part long-segment fractures of the femur by long proximal femoral nail antirotation (PFNA-long).

Methods: From June 2006 to December 2013, 139 cases (35 women, 104 men; mean age 48.8, range, 18–86 years) of long-segment femoral fracture in middle-up part were treated with long proximal femoral nail antirotation (PFNA, 320–380 mm) by minimally invasive percutaneous fixation and autogenous iliac bone graft. Fifty-eight cases were graded as type IA long-segment femoral fractures (41.73%), 25 type IB (17.99%), four type IC (2.88%), 28 type II (20.14%), 12 type IIIA (8.63%), five type IIIB (3.60%), and seven type IV (5.04%). Clinical efficacy was evaluated with Harris hip function scores and postoperative pain with visual analogue scale.

Results: The operative time was 35–90 min (mean, 45 min) and mean intraoperative blood loss 78.6 mL (range 30–200 mL). Most patients were walking with assistance 4–10 days postoperatively. All patients were followed up for 3–37 months (mean, 19 months). There were no serious complications. All fractures healed after 2.8–6.8 months (mean, 3.9 months). According to Harris criteria, the clinical results were excellent in 108 patients, good in 22, fair in eight and poor in one. Ninety-three cases had no pain, 33 mild pain, 13 moderate pain and 25 occasionally needed non-steroidal analgesics.

Conclusion: Closed reduction or limited open reduction with PFNA-long is an effective treatment for long-segment femoral fracture in middle-up part, with good strength in fixation, high rate of fracture union, early functional recovery and low rate of complications.

Key words: Femoral fracture; Fracture fixation; Internal fixator; Intramedullary

Introduction

Enninghorst *et al.* reported that 48.4% of femoral fractures are caused by high energy trauma¹. These types of fractures always involve the femur neck, trochanter region, and upper-middle part of the femur, which are in close relationship and interact with each other. Injury mechanisms for the different parts of the femur should be taken into consideration during treatment. Surgeons should choose the appropriate operative procedure according to the fracture classification. However,

specific fracture classifications aiming at a single part of the femur do not always reflect the injury mechanisms of these types of fractures. In accordance with the characteristics of fractures caused by high energy trauma, we call them long-segment proximal femoral fractures. We originally classified this type of fracture in 2010 using the then current classification². Based on previous research, we have reclassified type I fractures as types IA, IB and IC and type III as types IIIA and IIIB.

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Long proximal femoral nail antirotation (PFNA-long) can fix fractures involving two (or more) parts of the femur, especially when they involve the femoral neck, trochanter region and femoral shaft. Intramedullary fixation can effectively control the length and rotation of the extremity³. Recent clinical studies have shown that PFNA is the appropriate choice for unstable proximal femur fractures⁴. Minimally invasive fixation with PFNA avoids extensive peeling of soft tissue and periosteum. Intraoperative traction takes full advantage of the hinge effect to achieve reduction of the fracture. Strict anatomical reduction is not required; rather, observing the concepts of biological internal fixation and fully protecting the blood supply increases the fracture healing rate and reduces postoperative complications⁴.

From June 2006, we treated 139 cases of long-segment fractures in the upper-middle part of the femur by closed reduction with C arm surgical imaging and fixation using PFNA-long. In this study, we retrospectively analyzed these cases to improve fracture classification of long-segmental proximal femur fractures, summarize the therapeutic effect of using PFNA-long fixation with closed reduction via a minimally invasive procedure and investigate the optimal therapeutic procedure for such patients.

Material and Methods

From June 2006 to December 2013, 139 cases of long-segmental fractures in the upper-middle part of the femur were treated by closed reduction or, in few cases, limited open reduction and fixation with PFNA-long, at the Department of Orthopedics at the Fuzhou Second Hospital (China). Inclusion criteria were age over 18 years and unilateral closed femoral fractures. Thirty-five patients were female and 104 male. The average age was 48.8 (range, 18 to 86) years. Traffic accidents accounted for 63 cases, falls from heights 51, and simple falls 25. According to our classification of fractures of the proximal and upper-middle parts of the femur, 58 cases were type IA (41.73%), 25 type IB (17.99%), four type IC (2.88%), 28 type II (20.14%), 12 type IIIA (8.63%), five type IIIB (3.60%) and seven type IV (5.04%). Three patients had associated mandibular fractures, three forehead trauma, four rib fractures with mild pulmonary contusion and minimal hemopneumothorax, seven splenic contusions and hematoma of the splenic capsule, four renal contusions and one acute hemorrhagic shock caused by splenic rupture. Eighteen poly-trauma patients also had multiple fractures, including six with ipsilateral calcaneal fractures, four with lumbar fractures, three with acetabular fractures and one with an ipsilateral fracture of the radial head. Three patients had distal radial fractures and one had contralateral fractures of the radius and ulna.

The mean interval between injury and surgery was 6.2 days (3 h–18 days). One patient underwent emergency surgery and the others elective surgery.

Preoperative Preparation

Preoperatively, the affected limb was subjected to tubercle tibial traction. Comorbidities diseases and associated

complication were treated to prepare the patients for surgery. Intramedullary cavity size and femur length were measured by X-raying to enable selection of the appropriate implant. A mobile radiographic machine was used to acquire anterior–posterior and lateral radiographs of the femur to evaluate fracture reduction and adjust the traction weight. Pain was evaluated and relieved by tibial tubercle traction and oral pain killers. Prophylactic antibiotics were administered 2 h before surgery in older patients and those with comorbidities.

Surface Positioning Markers

Location of Three Longitudinal Axes with the Leg in a Neutral Position

The following three longitudinal axes were located: i) force axis, line connecting the centers of the femoral head and patella; ii) auxiliary incision axis, line connecting the anterior superior iliac spine and lateral margin of the patella; and iii) primary incision axis, lateral line along the femoral shaft (Fig. 1a).

Incision for Insertion of the Pin

Intersecting lines were drawn from the anterior superior iliac spine perpendicular to the floor and along the axis of the femur. The first 3 cm incision for inserting the intramedullary nail was marked with a 15° angle and the intersection as the mid-point (Fig. 1b).

Incision for Insertion of the Blade

With the surgeon's thumb and forefinger spread apart and the forefinger located on the anterior superior iliac spine, the intersection point of the thumb and the lateral line along the femoral shaft was the point of insertion of a spiral blade and the mid-point of the subsequent 2 cm horizontal incision (Fig. 1c).

Surgical Procedure

The patient was subjected to general anesthesia or combined spinal–epidural anesthesia and placed in a supine position on a fluoroscopy operating table or traction table. A traction bed was used in 36 patients, whereas the ipsilateral upper limbs of the remaining 103 patients were suspended anteriorly from the thorax with a hand bracket. The lower limb was pulled on by an assistant to maintain its length and control rotation.

Preoperatively, a precise incision position was marked on the skin. Intersecting lines were drawn from the anterior superior iliac spine perpendicular to the floor and along the axis of the femur. The first 3 cm incision, which was used to insert the intramedullary nail, was marked with a 15° angle and the intersection of these lines as the mid-point. The second (2 cm) incision was positioned by the aiming arm for inserting the antirotation blade. The skin, superficial fascia and fascia lata were then incised in turn. The insertion of the nail was positioned on the tip of a greater trochanter, 1 cm anterior to the posterior edge of the greater trochanter. A guide wire was inserted from this position and advanced into the femoral

Fig. 1 Preoperative anatomical landmarks on body surface. (A) Three longitudinal axes are determined with the affected limb under traction and in the neutral position, namely: (i) the axis of the force, from the junction of the medial and central third of the inguinal ligament to the midpoint of the patella; (ii) the axis of the anterior lateral auxiliary incision, a line from the anterior superior iliac spine to the lateral border of the patella; and (iii) the axis of the primary incision, the median line of the lateral femur. (B) The first incision, used to insert the intramedullary nail. A three cm line is marked at a 15° oblique angle behind the center of a line from the anterior superior iliac spine to the cranial end of the median line of the lateral femur. (C) The spread thumb and forefinger are used to locate the position for incision with a spiral blade. The index finger touches the anterior superior iliac spine and the thumb is spread down: the intersection of the thumb and femoral lateral half-way line is selected as the spiral blade entry point; it is taken as the central point and a 2 cm marker is drawn at this level.

anteroposterior plane and in the frog position. A central position in the femoral head was confirmed in frog position views. The PFNA blade length was then measured and attached to the inserter. The outer cortex was opened with a drill and the PFNA blade inserted by lightly tapping it with a hammer. Once the PFNA blade was satisfactorily positioned in the femoral head, the inserter was rotated clockwise to lock the PFNA blade. Distal locking is performed via a third incision (1 cm) by using the jig for standard PFNA.

It was difficult to achieve closed reduction in some patients with complicated displaced fractures. In these patients, reduction was achieved by finger touch with the assistance of fluoroscopy through a minimal incision and the periosteum of the fracture segments preserved^{2,5}.

Associated fractures were fixed simultaneously under the same anesthetic. Four patients with kidney contusions and six with ipsilateral calcaneal fractures underwent simultaneous closed reduction and Kirschner wire fixation. Four patients with lumbar fractures were treated conservatively. Two of three patients with acetabular fractures underwent synchronous open reduction and posterior approach plating fixation. One patient with an ipsilateral radial head fracture underwent simultaneous open reduction and screw fixation. Three patients with distal radial fractures underwent manipulative reduction and plaster fixation. One patient with contralateral ulnar and radial fractures underwent synchronous open reduction and plate and screw fixation.

Postoperative Management

All patients commenced quadriceps isometric contraction exercises, hip and knee joint flexion and extension exercises on the second day after the surgery, performing three to four groups of exercises a day, 10–20 times per group. Active isometric quadriceps-strengthening contraction exercises were recommended on the first follow-up visit and continued thereafter. Patients with closed fractures began crutch walking on

medullary cavity, this being visually confirmed in the anteroposterior plane. With a soft-tissue protector, the proximal femur was opened manually with a reamer. An aiming arm was attached to the insertion handle; then the appropriate length nail was mounted on the insertion handle and introduced manually into the femur. The guide wire for the PFNA blade was inserted through the second incision, the guide wire's position being confirmed lower in the femoral head in the

Fig. 2 Male, 37-year-old, damage caused by fall from high place. (A, B) Preoperative X-ray film of long segmental fracture in upper-middle part of left femur (Type IV): long segmental comminuted fracture in upper-middle part of femur with displacement of long fragment and without major damage to the greater trochanter. (C, D) Closed reduction and fixation with a 360 mm long PFNA, postoperative anteroposterior and lateral X-ray views showing good reduction with no significant shortening or rotation. (e) AP view 6 months after surgery showing good callus formation and indistinct fracture lines.

the fourth day. Aggressive postoperative pain control was achieved as follows: flurbiprofen 50 mg b.i.d. 4–5 h for 1–2 days postoperatively followed by celecoxib 200 mg b.i.d. for seven days. Care was taken to ensure that foundation exercises were performed minimal or no pain. Patients with type IA and III fractures were gradually allowed to walk with weight bearing, whereas walking was delayed in those with type II and IV fractures. Permission to weight-bear was varied for patients with associated complications according to the degree of damage, fracture type, age, and degree of obesity.

Criteria for Evaluation of Efficacy

Function was evaluated by assessing range of motion (ROM) of the hip joint, degree of pain, gait, and sitting down and walking upstairs using the Harris hip joint functional assessment⁶ and radiographic examinations. A visual analog scale (VAS) was used to evaluate severity of pain as follows⁷: none, 0 points; mild, 1–3 points; moderate, 4–5 points; severe, 6–7 points; and very severe, 8–10 points.

Follow-up

Follow-ups were performed at 1, 2, 3, 6, 9 and 12 months postoperatively and at least once a year thereafter. Anteroposterior and lateral radiographies of the upper-middle part of the femur were taken at each outpatient follow-up visit. All results presented herein include findings at final follow-up.

Results

General Results

The fractures of four of the 139 patients were fixed with 320 mm long PFNAs, 45 with 340 mm PFNAs, 37 with 360 mm PFNAs and 53 with 380 mm PFNAs. The duration of surgery was 35–90 min, (mean 45 min). Blood loss was

30–200 mL (mean 78.6 mL). All except for 16 patients with complicated long-segmental comminuted fractures (types IC, IIIB, and IV) began crutch walking from the fourth to the tenth postoperative day. All patients received complete follow-up for from 9 to 37 months (mean 19 months).

Therapeutic Evaluation

Harris Hip Functional Scores ranged from 65 to 98, 108 cases achieving scores of excellent, 22 good, eight fair, and one poor (Figs 2, 3). The overall success (excellent and good) rate was 93.53% (130/139). The average VAS pain score was 0.8 (range 0 to 6). Ninety-three patients had no pain, 33 mild pain and 13 moderate pain. Twenty-five patients required non-steroidal anti-inflammatory drugs for pain relief.

Fracture Reduction and Healing

Closed reduction and pin fixation was performed in 87 cases; the other 52 cases had complicated comminuted fractures requiring reduction through a minimal incision and one stage auto-bone grafts. All fractures had healed by final follow-up; average healing time was 3.9 months (range 2.8–6.8 months).

Complications and Management

None patients in this series developed implant cut-out, local infection or thigh pain. Four cases of screw breakage with shortening and angular deformity because of phase I non-union healed after a second operation involving insertion of a long pin and auto-iliac bone graft. These patients had muscle atrophy and limited ROM of hip and knee joints. Another five patients developed mild external rotation of the hip joint and did not require further treatment Six patients doing bedside exercises developed internal hip rotation 1 to 10 days after surgery and required a second surgery to adjust distal screws. Two patients developed coxa vara with significant displace-

Fig. 3 Male, 36-year-old, damage caused by fall from high place. (A) Preoperative X-ray film of long segmental fracture in upper-middle part of right femur (Type IA), comminuted inter-trochanteric and subtrochanteric fracture, fracture line extends to approximately the mid-point of the femur. (B) Postoperative lateral X-ray film showing good reduction of fracture, no significant shortening or rotational deformity. (C) Lateral view one year after operation showing good callus formation and indistinct fracture lines.

ment of the trochanter one year after surgery and had hip pain, increasing limb contractures and partial limitation of ROM; however, these two patients refused a second surgery.

Discussion

Treatment of Long-segmental Fractures of Proximal and Upper-middle Part of the Femur

With long-segmental fractures of the proximal and upper-middle part of the femur (femoral neck, intertrochanteric and subtrochanteric regions and the shaft of the femur), the cross-regional bending moment is very large. The inner and outer crushing and defects of the bony cortex result in increased stress on the implants, which makes the choice of internal fixation difficult. Dynamic hip screw plate fixation, which usually involves longer dissection of the fracture ends, is likely to damage the soft tissue and periosteum and also more liable to cause relative concentration of stress. Therefore, nonunion and plate breaks frequently occur⁸. In addition, older patients often have osteoporosis, which reduces the force with which implants are held in the proximal femur, increasing the risk of cutting out of the spiral blade and of postoperative coxa vara and hip varus deformity. This is a cause of proximal femur fracture that will reduce the patients' quality of life and one of

the main causes of postoperative pain⁹. Most practitioners believe that intramedullary nailing fixation provides excellent biomechanical stability. Gamma nails and proximal femoral nails (PFNs) have been recommended for treating different kinds of pertrochanteric femoral fractures. However, their usefulness is limited by their high rate of intraoperative and postoperative complications. Therefore, the best choice of internal fixation method for treating long-segmental fractures of the proximal and upper-middle part of the femur is still controversial¹⁰.

For comminuted fractures that involve the lesser trochanter or femoral medial cortex, unstable fractures for which it is difficult to achieve complete anatomical repositioning, open reduction would increase the surgical trauma and make it difficult to maintain anatomical reattachment postoperatively.

At present, most authors advocate restoring the anatomic relationship of the femoral neck and femur for unstable fractures; however, strict anatomical reduction is not required.

Although PFNAs were designed for older patients with osteoporosis, they also have advantages in young patients. During "drive-into", the spiral blade of PFNA simultaneously accomplishes anti-rotation and support. The "drive-into", rather than "spin-into", of the spiral blade assures maximum pressure in the cancellous bone in the femoral head and is

Fig. 4 Classification of long-segmental fractures of proximal and upper-middle part of the femur. Type IA: Fracture in the intertrochanteric or subtrochanteric area or upper-middle part of the femoral shaft. No obvious large dislocated or displaced fragments. Type IB: Fracture in the basilar neck area, intertrochanteric or subtrochanteric area or upper-middle part of the femoral shaft. No obvious large dislocated or displaced fragments. Type IC: IA with femoral neck fracture. Type II: Fracture in the subtrochanteric area and middle part of the femoral shaft. The intertrochanteric area may be intact. No obvious large dislocated or displaced fragments. Type IIIA: Fracture in the intertrochanteric or subtrochanteric area and multiple fractures in the upper-middle part of the femoral shaft. Type IIIB: Type IIIA with femoral neck fracture. Type IV: The intertrochanteric part may or may not be fractured. Multiple fractures in the subtrochanteric part or long and comminuted fracture with large displaced fragments involving the middle part of the femoral shaft.

preferable to anchorage force. This is especially beneficial for patients with osteoporosis. Long reamers must be used first to expand the tunnel below the femoral head in young patients, thus avoiding damage to the femoral head cartilage.

Choice of Appropriate Fixation Technique According to Further Classification

We compared the fracture types of the 139 study patients and further classified Types I and III of the original classification based on fragments, displacement, and degree of damage to the proximal femur bony cortex. This improved classification helps to assess the mechanism and stability of fracture placement damage and thence choose intramedullary or extramedullary fixation preoperatively.

Our classification of long-segmental fractures of the proximal and upper-middle parts of the femur is now as follows (Fig. 4):

1. Type IA, fracture in the intertrochanteric or subtrochanteric area or the upper-middle part of the femoral shaft with no obvious large dislocated or displaced fragments.
2. Type IB, fracture in the basilar neck area, intertrochanteric, subtrochanteric area, or the upper-middle part of the femur shaft with no obvious large dislocated or displaced fragments.
3. Type IC, IA with femoral neck fracture.

4. Type II, fracture in the subtrochanteric area and middle part of the femoral shaft. The intertrochanteric area may be intact. No obvious large dislocated or displaced fragments.
5. Type IIIA, fracture in the intertrochanteric or subtrochanteric area and multiple fractures in the upper-middle part of the femoral shaft.
6. Type IIIB, Type IIIA with femoral neck fracture.
7. Type IV, the intertrochanteric part of the femur may or may not be fractured. Multiple fractures in the subtrochanteric part or long and comminuted fracture with a shift of large fragments involving the middle part of the femoral shaft.

Medullary-external fixation (a plate), which relies on the bone cortex to hold screws, appears to be unsuitable for Types IA (part of the longitudinal crack on the lateral cortex or defect), IB, IC (inner cortical defect) and most Type II and III fractures. However, intramedullary PFNAs can be used for all types of fracture and fixed with nails in a minimally invasive manner. For comminuted proximal lateral cortex fractures, attention should be given to protecting the limb and delaying weight-bearing.

In our experience, Type I fractures are easy to reduce using closed pin fixation. Type II fractures need to be percutaneously reduced by leverage in the proximal point of needle insertion. It is difficult to achieve closed reduction of Type III

fractures. However, reduction can be achieved by finger touch with the assistance of fluoroscopy through a minimal incision and the periosteum of the fracture segments preserved. With Type IV long-segmental comminuted fractures with contralateral leg exposure must be checked to prevent shortening and rotational deformity.

Key Points of Surgical Procedure

Traction Postures

Use of a bone traction bed can be convenient for maintaining resetting and avoiding shortening and is advantageous for intraoperative fluoroscopy imaging. However, we have found that the use of a bone traction bed had the following disadvantages:

1. It increases the anesthesia and surgery time by an average of 30 min.
2. The fixed position is not flexible and is inconvenient for intraoperative resets, especially with Type IC, II, IIIB and IV fractures. Auxiliary small incisions and flexible changing positions are needed to help with the fracture resetting and nailing.
3. Procedures on fixed obese or very small patients are difficult.
4. Traction is difficult to achieve in patients with knee arthritis with internal or external limb deformity or those with crus fractures with limb fixed traction. In addition, because of the great weight of the preoperative bone traction, most patients' fractures require resetting with the fracture ends subjected to traction under anesthesia. Using a horizontal position, we are able to adequately correct shortening, angulation, and rotation of the femur by slight adduction and internal rotation of the limb. Thus, we no longer use an orthopedic traction bed to assist traction; we used these beds only with our early cases.

Surgical Reduction and Fixed Order of Long-segmental Fractures of Proximal and Upper-middle Part of the Femur

Good reduction is the key to the surgical treatment of fractures. If reduction is inadequate, no matter what kind of internal fixation materials are chosen, it is difficult to achieve satisfactory repair. With stable fractures, anatomical restoration can be achieved by axial traction, slight adduction, and internal rotation of the limb (our Type I cases).

Because long-segmental fractures of the proximal and upper-middle parts of the femur can involve multiple segments and location^{11,12}, the sequence in which reduction and fixation are performed should be considered. According to many published reports, reduction and fixation of femoral neck fractures should be performed prior to treating femoral fractures^{11,12}; our study confirmed this. Even when there is no obvious displacement of a femoral neck fracture, reaming or insertion of a PFNA is often helpful. In particular, if insufficient reaming is performed, other fractures are likely to become more obvious. Tightening of the PFNA spiral blade after fixation causes fracture gaps to shrink or disappear

completely. Although the effect of this procedure on femoral neck fracture healing was not obvious in our study, healing was achieved in all cases and no femoral head necrosis occurred. However, some authors advise dealing with femoral fractures first because they believe that better femoral neck fracture reduction and fixation can be achieved if performed after femoral fracture reduction and fixation¹³: rotated and floating fracture ends of the proximal femur are difficult to reduce.

In our cases, we first reset the cervical and trochanteric fracture ends with Kirschner wires, thus correcting shifting and rotation of the proximal femur. Kirschner wires temporarily fix the femoral neck (and do not affect spiral blade location) and ensure that the proximal femur is normally aligned on X-ray images. The guide wire is easily inserted through the tip slightly lateral to the top of the greater trochanter. For fractures of the femoral subtrochanteric region and shaft, no matter how obvious the displacement and how long the fracture line, limited open reduction with a 2–3 cm incision over the lateral or anterolateral position of the fracture then allowed us to achieve good reduction. With the index finger assessing displacement of the fracture ends, we used curved nose pliers, Kirschner wires and a periosteal elevator to assist and maintain the reduction. We guided the needle through the distal fracture and, with an assistant maintaining traction, inserted a long PFNA intramedullary nail. It needs to be emphasized that the size of reamer for the proximal femur should be selected according to the size of the proximal PFNA intramedullary nail. We do not recommend reaming the middle and distal parts of the femur, especially in type III fractures, because such reaming can cause segmental rotation and make intramedullary nailing difficult. We therefore recommend plate fixation for type III fractures.

Small Incisions Helps to Reduce and Remove Bone Debris Generated by Reaming for Bone Grafting

Some Type II, III and IV cases (52 cases) were difficult to reduce by closed reduction and required poking reduction with the aid of an auxiliary small incision in the lateral or anterolateral thigh over the fracture area⁶. Attention should be paid to minimizing soft tissue peeling. Anatomic reduction is not required; however, good counterpoint and line jitter should be pursued. A small incision enables direct touching of the fracture site, which is beneficial for distinguishing the direction of displacement of the fragments, thus enormously reducing X-ray exposure and protecting both the doctor and patient. We also take advantage of the small incision for poking reduction to collect bone debris generated from reaming for bone grafting. The 52 patients who had these additional incisions all underwent this type of bone grafting and were found to have callus formation at the fracture site at the short-term follow-up. In our experience, this technique is easy to perform and the quality and amount of bone graft material is excellent, thus contributing to bone healing. We believe this procedure should be implemented more widely.

Intraoperative Fluoroscopy

The operation must be performed in the anteroposterior and frog positions under C-arm fluoroscopy to confirm the position of the spiral blade in the femoral head and neck and ensure accurate placement of the intramedullary nail. However, minimization of X-ray exposure to both doctor and patient must also be considered.

Timing of Surgery in Patients with associated Injuries

Long segmental fractures involving the proximal and upper-middle part of the femur are usually caused by high-energy trauma and are therefore usually accompanied by other injuries, which can include closed thoracic trauma that is easily misdiagnosed and difficult to treat. Such injuries often require intensive care unit management or combined therapy by other departments. Fracture management during this period is important. Manual repositioning and (or) traction reset should be performed as early as possible to correct long-segmental fractures of the proximal and upper-middle part of the femur and other associated fractures. Regular bedside radiographs and bone traction weight and alignment should be assessed in a timely manner to avoid malunion caused by mismanagement of the traction. In patients with stable vital signs, open reduction and internal fixation of fractures should

be performed as soon as possible. Kenzora *et al.* reported 406 patients with proximal femoral fractures and compared mortality after surgical and non-surgical treatment¹⁴. Mortality was notably greater when emergency surgeries were performed within 24 hrs of injury. These authors suggested the priority should be appropriate treatment of lung injuries lung and physical therapy and that it is safer to perform required surgery after 24 hrs. We timed surgery and anesthesia in accordance with the individual condition of each patient and in collaboration with the medicine, surgery, and anesthesia departments to minimize the risks. We believe that a delay of 72 hrs between trauma and surgery is safer and minimizes risks. During the first 12–24 hrs the patients should undergo comprehensive examination and have any abnormal pathophysiology corrected, including blood volume, oxygenation and medication for any pre-existing diseases. This delay is required to achieve hemodynamic stability and allow time for thorough preoperative planning and assessment of fitness for anesthesia.

Above all, the treatment of long-segmental fractures of the proximal and upper-middle part of the femur with long PFNA closed reduction or with an additional small incision and direct finger-guided auxiliary fracture reduction and intramedullary fixation technology provides optimal biomechanical stability.

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