Double Level Fractures of the Femur Treated with Closed Intramedullary Nailing

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Abstract

The treatment of segmental multilevel fractures of the femur is problematic. Open methods of fracture fixation which strip the soft tissue attachments from the bone cause devascularisation of the middle segment. Mechanical fixation using 2 separate plates results in a stress riser. The use of closed intramedullary nail addresses some of the problems in this difficult group of fractures, preserving the soft tissue envelope and eliminating stress risers. However, vascularity of the middle segment may still be compromised.

Six cases of fractures of the femur that were segmental in nature or associated with a fracture around the hip were treated with a closed intramedullary locked nail. The average operating time was 123 minutes and there were no infections. Average time to union was 7.2 months. Two cases required re-operation, one to correct a residual internal rotation deformity and one required dynamisation to eliminate the gap at the fracture site.

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Introduction

Closed locked intramedullary nailing of the femur has become the accepted means of treating fractures of the femur. The use of locking nails has extended the technique from stable diaphyseal fracture patterns to nearly all fractures of the femur except for fractures at the very end of the bone and intra-articular fractures. The segmental nature of the fracture also poses technical challenges to fracture fixation. We review 6 cases of double level fractures treated bv this method.

Methods and Materials

Six cases of double level fractures of the femur were treated with closed locked intramedullary nailing of the femur. Data on the clinical and radiological follow-up till time of union was available for 5 of the 6 patients. In 1 case, a foreigner was lost to follow up. Four of the 6 fractures were sustained in an accident abroad. Early clinical data were available on all the patients.

Three of the cases were segmental fractures of the shaft. Two cases were a combination of a fracture of the shaft associated with a fracture of the trochanteric region and 1 case was a three level fracture comprising a trochanteric fracture and a segmental shaft fracture. (Figs. 1 & 2)

There were 4 male and 2 female patients. All cases were a result of high velocity road traffic accidents. Three of the patients were riding a motorcycle at the time of the accident while the remaining 3 were in an automobile. Three patients had other injuries. Two of the fractures were open. These were treated with an initial debridement, intravenous antibiotics and a delayed closed nailing. The average time from admission to definitive fracture stabilisation ranged from 6 hours to 8 days with an average of 3.2 days.

All cases were operated in a supine position on a standard traction table using a portable image intensifier. All cases were done by the closed method using a locked nail. None of the cases required open reduction. The 3 cases with a hip fracture were stabilised with a reconstruction nail (Russel-Taylor) in 2 cases and an AO Universal femoral nail with a spiral blade plate in 1 case. The remaining cases were fixed with a standard AO or Russel-Taylor nail. In 2 of the cases reaming of the medullary canal was done. In all cases the segmental fragment was stabilised with a Schanz screw to prevent rotation and aid in reduction.

The following criteria are similar to those used by Wiss.[1] The time to union was defined as the time to full weight bearing and the presence of bridging callus on the X-rays in 2 projections. Union was considered to be delayed if there was no bridging callus at 9 months. Non-union was defined as pain at the fracture site with need for continued external support and radiological absence

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Fig. 1. Combined segmental fracture of the femur with associated trochantericfracture.

Fig. 2. Fracture fixation with a reconstruction nail

of callus at 1 year after the injury. Mal-union was considered when there was a shortening or lengthening of more than 1 cm, 10° of angulation in any plane or more than 15° of rotation.

Results

One patient was lost to follow up. The remaining 5 patients were followed up from 6 to 15 months (the average follow-up was 10.8 months).

The operating time varied from 1 hour 25 minutes to 3 hours 25 minutes (average operating time was 2 hours and 3 minutes). There were no early or late infections in any of the patients. The average drop of haemoglobin in the postoperative period was 3.0 gms%. One patient needed blood during the operation. Hospital stay ranged from 6 days to 23 days with an average of 14.1 days.

Two cases had suspected fat embolism with oxygen saturation of less than 70 mmHg. These patients were treated with supportive oxygen therapy and then recovered without further complications. One case had a residual internal rotation deformity of the femur that was noted in the immediate postoperative period. This required a second operation during the same admission to correct the deformity. One case without other injuries developed a bleeding duodenal ulcer on the fourth postoperative day. The diagnosis was confirmed with a gastroscopy.

Average time to radiological union was 7.2 months (range 2 to 15 months). Average time to full weight bearing was 7.8 months (range 3 to 13 months). The trochanteric fractures all healed before the diaphyseal fractures.

One patient required a dynamisation at 10 weeks because of a persistent gap at the fracture site. It was 15 months before this patient was totally pain free despite callus formation on the radiographs earlier. There were no non-unions in this series.

Discussion

Double level fractures of the femur are a difficult fracture pattern to treat. They are usually a result of high velocity trauma and are often associated with injuries to other organ systems.[2-4] It is estimated that only 6% to 8% of fractures of the femur are segmental or double level.[4-9]

Fracture fixation in this group is difficult because plating of these fractures would lead to stripping of large amounts of soft tissue from the bone, impairing the blood supply. This leads to delayed fracture healing and

Fig. 3. Double level fracture with distal fracture close to the knee joint.

a higher infection rate. The middle segment of the fracture, which would be spanned in its entire length by a plate, is usually devascularised. If 2 plates are used, an abnormal stress riser could result in a fracture between the plates.[10,11]

The use of a locked closed intramedullary nail solves some of these problems. A locking nail provides stability in rotation and prevents telescoping. Nailing done in a closed fashion results in minimal injury to the soft tissues at the fracture site. The fracture haematoma is not disturbed and this results in faster healing. Intramedullary nails are also stronger devices as they are in the axis of weight transmission compared to plates. This allows a greater number of loading cycles before a fatigue fracture occurs in the nail.

These new generation nails allow proximal control of the hip fractures with 2 screws or a blade plate directed up the femoral neck. This allows very proximal fractures to be stabilised with a single device.

For distal fractures, 2 bolts are required for stability of the distal fragment. Using standard nails, fractures to within 6 cm from the knee joint can be stabilised (Figs. 3 & 4). In very distal fractures it is possible to cut the tip of the nail just distal to the last bolt hole to allow even more distal fracture fixation.

Fig. 4. Distal locking of short distal fragment with 2 distal bolts.

Fig. 5. Segmental fracture stabilised with an unreamed nail. Note the hole where a Schanz screw was used to stabilise the fracture.

Many of the newer nails are solid unreamed nails. Preservation of the endosteal blood supply by not reaming may result in even higher union rates.

The procedure is technically difficult and time consuming compared to open reduction and internal

fixation with plates and screws but has a lower complication rate.

Intramedullary nailing does however have problems. The intermediate fragment needs to be stabilised if it is short to prevent "spinning" of the fragment and subsequent devascularisation[12-17] (Fig. 5). This is usually done with a Schanz screw placed in the middle segment by a closed method. This screw also serves as a "joystick" and helps in the reduction of the fragments. Ideally these fractures should be nailed without reaming to protect the blood supply of the middle fragment However, the use of a solid unreamed nail poses technical difficulties as passage of the nail is more difficult without a guide wire. This can partially be circumvented by passing a bent tip ball guide wire through both fracture sites and memorising the reduction manoeuvres required before actually passing the nail through the fracture site.

Fractures involving the neck of the femur must be stabilised before nailing to prevent displacement of the neck fracture and subsequent avascular necrosis. Fractures in the proximal femur are often missed because the initial radiographs often do not include the entire femur. A separate view of the hip should always be done if the initial radiographs are deemed inadequate. In this series, the proximal fractures were either basal neck or trochanteric fractures with a lower risk of avascular necrosis of the femoral head.

The average operating time was a little over 2 hours. This is an acceptable time for this variety of fractures. None of the patients was unstable during the operation. The average drop in haemoglobin postoperatively was 3 gms%. This was due to a combination of blood loss during the surgery as well as the bleeding into the fracture site as the double level of the fracture also results in a higher blood loss. Two cases were suspected to have fat embolism. Frequent blood gas monitoring is necessary and a pulse oximeter should be used in the early postoperative period.

There were no early or late wound infections. This reflected minimal devascularisation of the soft tissues inherent in this procedure. Open fractures can be treated with a closed locked nail after initial wound debridement.

All fractures united after an average of 7 months. One case still had only partial bridging callus on X-rays but was walking full weight bearing at the time of the last review at 15 months. The average time to union in these fractures was longer than those seen in single level fractures. The severity of the initial injury probably accounts for this. Except for the single case that required an early repeat surgery to correct a residual internal rotation deformity, there were no clinically significant problems with rotation, varus/valgus deformity or limb length discrepancy. Early dynamisation of the nail does help to close a small gap seen at the fracture site as was done in 1 patient.

Closed locked intramedullary nailing is an excellent method of treatment for this difficult group of fractures. This provides a reliable method of fracture fixation with minimal morbidity. Patients are able to bear full weight and are ambulatory before callus formation or consolidation is seen on radiographs. The technique is technically demanding but the functional end result is excellent.

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