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Caser Report

Successful single stage management of trifocal femoral fracture associated with distal medial condyle and Hoffa's component by a novel technique

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ABSTRACT

Isolated fractures of the shaft of the femur are relatively common injuries. Ipsilateral multifocal fractures of the femur are less common with an additional proximal femoral fracture estimated to occur in up to 5% of diaphyseal fractures and additional distal femoral fracture occurring in 3-4%. Trifocal femoral fractures consisting of ipsilateral fractures of the proximal, diaphyseal, and distal femur are extremely rare. These fracture patterns are seen in the young adult population following high velocity trauma such as fall from height and road traffic accidents. The sequence of fracture type to be fixed first and the type of implant to be used are questions yet to be answered as one implant used for fixation of one fracture may not be amenable for fixation of the other fracture. These fractures are associated with significant complications and delayed rehabilitation. We describe a novel method in one such trifocal fracture pattern where the distal femoral intra-articular medial condyle with a hoffas element was stabilised by open reduction with a 4.5 proximal tibial ipsi-lateral anterolateral LCP and 2 inter-fragmentary compression screws which has not been reported in literature before. The advantages of such an implant is easy contour ability to the medial femoral condyle and adequate strength and achieving satisfactory absolute stability with options of using uni-cortical locking screws, all of which facilitates early knee ROM and rehabilitation.

Keywords: Trifocal fracture, Locking compression plate, Intra-medullary interlocking nail, Hoffa's fracture

INTRODUCTION

Trifocal fractures are those fractures involving the proximal, diaphyseal and distal end of the femur which are unique patterns that pose a technical challenge as the implant options are still undefined and the order of fixation is still un-answered. This pattern of fracture was first described in 1993 by Käch.[1] There have been 18 such cases reported in literature till date with only 2 cases of distal femur involving the medial condyle. The distal femur fracture in a trifocal fracture pattern has usually been reported involving extra-articular metaphyseal type or bicondylar intra articular or uni condylar involvement of the lateral femoral condyle.[1,3,4,6,11] Most of the currently available implants for the distal femur are pre contoured lateral femoral condyle LCP and retrograde IMIL nail or 95-degree dynamic condylar screw or angled blade plate or cannulated screws. However, there are no customised implants available for stabilisation of uni condylar medial femoral fracture. Hence, fixation of medial femoral condyle fracture is amenable only to screw fixation or by the use of various plate options not specifically designed for this purpose.[13]

It is important to look for signs of fractures of the proximal and distal femur on radiographs, especially when injuries are associated with high-energy trauma.[3] Due to the rarity of such injuries and the heterogeneity of the fracture patterns there is minimal consensus on their optimal management.[3] There are different possibilities and the

choice of implants and sequence of fixation is determined mainly by the fracture pattern and the general overall condition of the patient.[3] We hereby present one such trifocal fracture pattern with distal femoral medial condyle with a hoffa's element being stabilised with an anterolateral ipsi-lateral 4.5 proximal tibial LCP and interfragmentary compression screws by maintaining the principles of absolute stability and the diaphyseal and the proximal segment being stabilised using antegrade cephalo-medullary IMIL nail by relative stability, which to best of our knowledge has not been reported in literature to date. We proceeded with stabilisation of the distal femur fracture as a priority to achieve anatomical articular congruity and prevent early secondary osteoarthritis. The patient provided written informed consent for print and electronic publication of the case report.

CASE REPORT

A 36-year-old male businessman by profession without any known significant previous medical records presented with history of a vehicular accident involving a two-wheeler in our ER department. On arrival, the patient was haemodynamically stable. A primary trauma survey was conducted which revealed no head injury, or any other life-threatening organ injuries. The patient complained of pain in his left hip, thigh, knee and ipsilateral leg with a wound over the mid leg. Physical examination revealed external rotation deformity of the left lower limb with shortening and no distal neuro vascular deficits. Range of movements could not be ascertained due to pain. Radiology revealed left femur trifocal fracture with displaced intertrochanteric fracture (AO type A3.3) (Figure 1 and 2.) and diaphyseal displaced comminuted fracture (AO type 32.B2) (Figure 2 and 3.) and distal medial condyle fracture (AO type 33.B2) (Figure 3). Lateral view could not be done in view of pain. Radiology of the leg showed mid-shaft minimally displaced fracture fibula. Compound midshaft fracture of left fibula with type 3-B wound left leg measuring 10×5 cm was managed with debridement and primary closure of the wound and the fracture was managed conservatively.

Figure 1: Preoperative radiograph showing displaced intertrochanteric fracture left hip (AO-type A3.3) AP view and displaced comminuted shaft of femur fracture (AO type 32.B2) AP view.

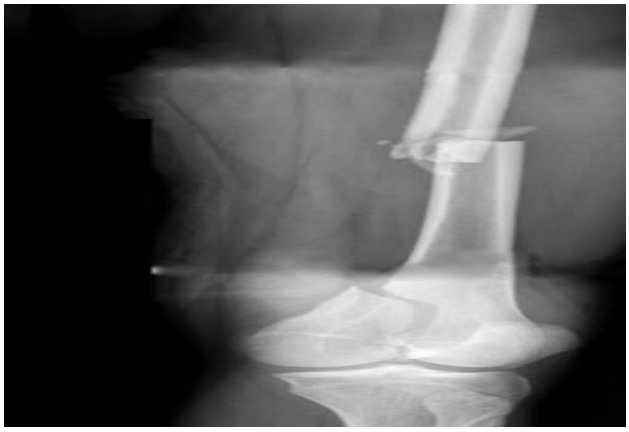

Figure 2: Preoperative radiograph showing intra articular displaced fracture of medial condyle of femur (AO type 33.B2) AP view.

Procedure

After confirmation of normal preoperative assessment by anaesthesiologist, patient was operated on the same day of presentation under combined spinal spidural-anaesthesia in supine position on a standard radiolucent fracture table. He was prepped and draped in a sterile fashion exposing the ipsilateral hip, thigh and knee. As the distal femur fracture was intra articular which warranted absolute stability we proceeded with stabilising that first, using midline incision and by medial parapatellar approach. During the open reduction we noticed a Hoffa's extension of the medial condyle fracture in the coronal plane which was reduced anatomically and stabilised by 2 anteroposterior interfragmentary compression screws. This was followed by anatomical reduction of the medial condyle, provisional stabilisation with K-wires and definitive fixation with pre-contoured 6 hole 4.5 proximal antero-lateral ipsilateral tibia LCP (Smith and Nephew) (Figure 6).

The patient was then put on gentle traction and we noticed that the proximal peri-trochanteric fracture was acceptably aligned. Two K-wires were passed in inter trochanteric region anteriorly to provisionally stabilise the reduction. Using the joystick reduction manoeuvre with unicortical shanz pin for the middle segment and by gentle external manipulation and by closed reduction a ball tipped guide wire was passed antegrade till sufficient length beyond the diaphyseal fracture ending just proximal to the medial condyle fracture. Intramedullary canal was reamed using a cannulated flexible reamer making sure under image intensifier that there was no distraction or displacement of any of the fractures. AO Synthes A2FN 9×340 mm nail was then passed over the guidewire till appropriate length bypassing the uni cortical screws of the distal femur LCP. 2 cephalo-medullary screws and 2 distal locking bolts were applied, following release of traction. The whole procedure and fracture reduction assessment was monitored under C-arm guidance. All wounds were irrigated and sutured in layers and sterile dressing was

applied. At the end of the procedure, stability of the knee was assessed in sagittal and coronal plane and no instability was noted.

Postoperative protocol

Immediate postoperatively, patient was shifted to the ward as he was maintaining haemodynamic stability. From the post-operative day 1 he was started with anti DVT exercises, chest physiotherapy, isometric quadriceps, hemi pelvic bridging exercises and gradual passive hip and knee range of movement which progressed to active range of movement and assisted SLR as per pain tolerance. He was made to ambulate non weight bearing with walker support which continued for 6 weeks. Early post-operative recovery and wound management was uneventful. He was discharged from hospital 4 days post-surgery. Partial weight bearing ambulation was started with elbow crutch at the end of 6 weeks, gradually progressing, and was made to do full weight bearing unaided by the end of 12 weeks post operatively. Patient achieved complete hip and knee range of movements by 9 weeks. Patient was reviewed in follow-up at 3 weeks, 6 weeks, 9 weeks, 3 months, 6 months, 9 months, 1 year and 2 years post operatively in our outpatient clinic. satisfactory radiological and clinical union was achieved by 9 months post operatively. Patient had excellent results with complete hip and knee range of movements with painless independent ambulation with no Trendelenburg gait and with no limb length discrepancy and no knee instability and no clinical or radiological evidence of secondary osteoarthritis of knee, with good thigh muscle tone and bulk at 24 months post- operative period. He underwent all implants exit at 28 months postoperatively. Presently, he is able to do all activities comfortably as before his pre injury status.

Figure 3: Post operative radiograph of intertrochanteric fracture with A2 FN nail *in situ*, AP view.

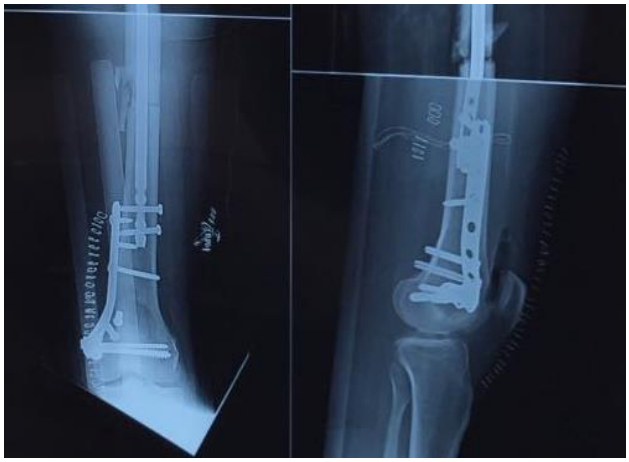

Figure 4: Post operative radiograph of shaft of femur and distal femur with A2 FN nail and proximal tibial ICP *in situ*, AP and lateral-view.

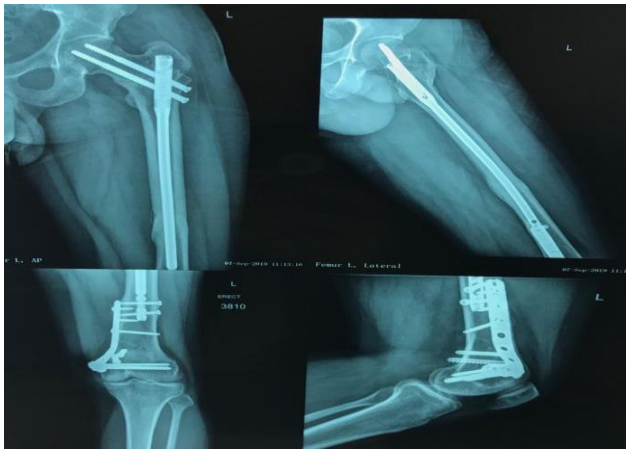

Figure 5: 24 months follow up x-ray showing united trifocal fracture of femur, with implants *in situ*, AP and lateral view.

Figure 6: 28 months post operative radiograph of united shaft of femur and distal femur fracture status post implant removal, AP-view.

Figure 7: 4 years post operative, pelvis with both hips, AP view.

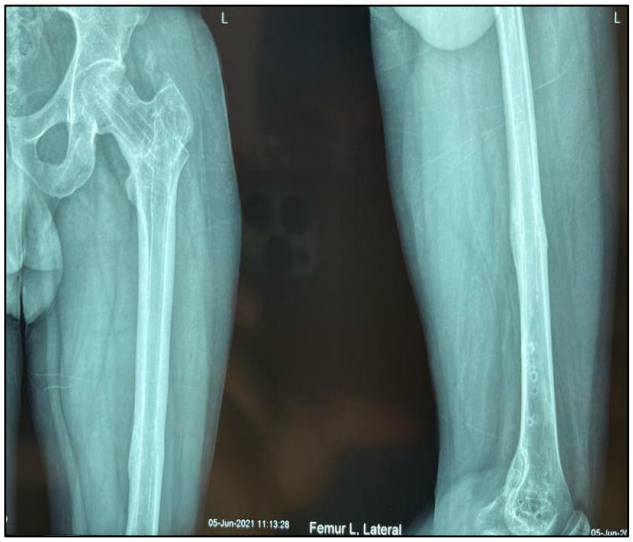

Figure 8: 4 years post operative radiograph of shaft femur fracture, AP and lateral view.

Figure 9: Clinical picture showing hip and knee flexion.

Figure 10: Clinical picture of squatting.

DISCUSSION

The combination of fractures to both, proximal femur and femoral shaft is an infrequent injury. It was first described in 1951 by Becher as a result of high-energy trauma.[11] The situation in which these two ipsilateral femoral fractures are further complicated by a distal femoral fracture is extremely rare.

The first one was described by Käch in 1993.[1]

Very few cases of such fracture pattern have been reported in literature to date.

Trifocal fractures of the femur are difficult and challenging injuries to manage as the operative techniques and implants employed to manage one of the three fractures could compromise optimal management of the other fractures.[4] Basic principles suggest that a distal intra-articular fracture should be managed by anatomic reduction and rigid fixation producing absolute stability, which enables early knee ROM and prevention of stiffness which facilitates early recovery and also by restoring articular congruity, complications such as secondary osteoarthritis is minimised.[9] Extracapsular proximal femur fractures can be fixed by principles of relative stability, as can diaphyseal fractures which is known to promote biological healing and decrease chances of delayed, non-union.[10,12,14,15] There is a wide range of operative techniques that could provide appropriate stability and fixation for individual fractures, however, difficulty lies in combining techniques to provide optimal fixation for all three fractures.[4] Previous reports have agreed that it is appropriate to use two implants only, with the diaphyseal fracture being stabilised with either the proximal or distal fracture.[4,6] Given the rarity of trifocal fractures and the heterogeneity in fracture configurations, there is little consensus in literature as to what implants should be used and in what order stabilisation should take place.[3] Priority should be given to injuries associated with worse outcomes if left untreated or mal- reduced.[4] A range of previous techniques have been described to manage the proximal

component of trifocal fractures including the usage of cannulated screws, DHS and antegrade intramedullary hip nails and the management of the distal fractures have included retrograde intramedullary nailing for extra-articular type A fractures and cannulated screws for type B fractures and 95 degrees blade plate, distal femoral pre-contoured LCP for type C fractures.[1,3,4,8]

The ipsilateral proximal femur, diaphysis, and distal femoral fractures are quite rare in any available literature.[1] Proximal fractures usually involve the Basi-cervical neck of femur fractures with a vertical extension or less commonly, peri-trochanteric fractures and distal fractures usually involve lateral condyle in sagittal plane, Hoffa's fractures in coronal plane or extraarticular metaphyseal fractures or bicondylar fractures.[1,4,6,7] Fixation of type C distal femur fractures are most difficult and challenging. Implant options for fixation of the proximal and distal fractures depend on the fracture pattern and configuration and degree of communition of the articular surface.[1,3,4,6,16]

Tsai et al reported multiple complications rate with fixation of ipsilateral femur shaft and neck fractures with cephalo-medullary nail.[8]

Palarčík et al described a stable peri-trochanteric fracture in combination with a transverse diaphyseal fracture and a non-displaced T-shaped fracture of a distal femur. Here, the peri-trochanteric and diaphyseal fractures were stabilized using a reconstruction nail, and the distal fracture was treated using screws that locked the nail at the same time. However, varus deformity of the peri-trochanteric fracture occurred during healing and a second procedure was necessary.[7]

Bartoníček et al described a combination of a stable peri-trochanteric fracture with a diaphyseal fracture and a T-shaped fracture of the distal femur, together with a fracture of the ipsilateral patella, treatment involved a reconstruction nail and 95° blade plate.[6]

There is a strong consensus for an individualized approach to the treatment of these injuries, as the heterogeneity of fracture configurations means treatment must be tailored to the individual personality of the fractures and variable implant options.[3,6-8] The goal of the surgeon should be the anatomical and stable restoration of the fractures, paying maximum attention to achieve articular congruity, avoiding rotational problems and preserving the soft tissues.[17]

In our case report, our patient had type C distal femur intra-articular displaced medial condyle fracture AO type 33.B2 with Hoffa's element AO type 33.B3, the fracture pattern, for the distal femur, has not been reported in literature till date to the best of our knowledge. There are no customised available implants described for management of such a complex fracture pattern. We used a novel technique for fixation of the medial condyle fracture with Hoffa's element using Smith and Nephew anterolateral ipsilateral proximal tibia 4.5 LCP and inter fragmentary compression screws by open reduction and we were able to achieve anatomical reduction, articular congruity and absolute stability. Advantages of using this plate is having low profile with easy contour-ability to the medial femoral condyle with adequate strength and options of usage of uni-cortical locking screws, all of which facilitated early rehabilitation. The proximal peri trochanteric femur fracture (AO type 31.A3.3) and midshaft fracture (AO type 32.B2) was stabilised using Synthes A2 FN antegrade nail by closed reduction technique, using principles of relative stability which promoted biological healing. Union of fractures was assessed radiologically and clinically at 3 weeks, 6 weeks, 9 weeks, 3 months, 6 months and 9 months. Complete union was evident radiologically at the end 9 months. Patient was able to achieve complete painless hip and knee range of movements by 9 weeks and the patient started full weight bearing ambulation unaided at 3 months post-operatively. Our patient achieved excellent clinical outcome without the need for re-intervention with no evidence of significant complications such as stiffness of hip and knee, restriction of movements and thigh muscle wasting, knee instability, secondary osteoarthritis of knee, malunion of peri-trochanteric fracture and non-union of midshaft fracture, limb length discrepancy, Trendelenburg gait. He also underwent all implants exit at 28 months post-surgery. Presently 4 years post-surgery, patient is able to do all his activities as his pre injury status, such as impact activities like running, jumping and low impact activities like cycling with no complaints whatsoever.

CONCLUSION

Ipsilateral fractures of the diaphysis and both ends of the femur are extremely rare. The operative stabilisation of trifocal femur fractures is considered an urgent/emergency procedure. Surgical stabilisation of these complex fractures is technically challenging and associated with significant rate of complications. It is imperative to deliberately look for signs of fractures to the proximal and distal femur on radiographs in injuries associated with high velocity trauma. CT scan for the fracture extending intra-articularly helps in better fracture assessment and pre-operative planning.

It is important to also exclude other injuries such as fractures to the ipsilateral patella and leg. After stabilization of the trifocal fracture, a thorough examination to exclude possible ligament injuries around the knee is important. As these injuries are extremely rare and since there is no established general consensus regarding order of fixation and specific implants to be used, all such cases with successful treatment outcomes should be reported and published for management to be scrutinised and further improved .We hereby report a trifocal fracture pattern where-in the distal femur involving intra-articular medial condyle with Hoffa's component took priority to achieve absolute stability and anatomical open reduction with the usage of ipsilateral

anterolateral 4.5 proximal tibial LCP and interfragmentary compression screws and the proximal and diaphyseal femur fracture was stabilised by relative stability by closed reduction with antegrade intramedullary A2FN. The proximal tibial LCP has the advantage of having low profile with easy contour-ability with adequate strength and options of usage of uni-cortical locking screws. Further studies with larger sample size are required to prove the effectiveness of this construct for such complex fracture patterns.

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