



## Management of ununited intracapsular femoral neck fractures by using quadratus femoris muscle pedicle bone grafting in young patients

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**Objectives:** Intracapsular femoral neck fracture with delayed presentation in young patients can pose surgical challenge. Such scenarios are rare in developed countries, but common in developing countries.

**Methods:** We retrospectively reviewed the records and radiographs of 42 patients (28 males and 14 females) with ununited intracapsular femoral neck fracture who presented late to our unit. These subjects were managed by open reduction and internal fixation that was supplemented with cortico-cancellous bone graft from posterior iliac crest as well as quadratus femoris muscle pedicle bone graft.

**Results:** The mean delay in presentation was 9 months (range 3-18 months) after the fracture. The mean age of the patients at index procedure was 34 years (range 24-51 years). Radiological union occurred on average at 6 months (range 3-13 months). Thirty-six hip fractures (86%) proceeded to union. Six patients (14%) had non-union and needed revision surgery. Complications included varus union in 9 patients and leg length discrepancy with a mean of 1.5 cm (range 1 to 2.5 cm) in 10 patients.

**Conclusion:** For the ununited intracapsular femoral neck fracture, favorable results can be achieved by anatomical reduction of the fracture, cortico-cancellous bone grafting to reconstruct the femoral neck, internal fixation with cancellous screws, and augmentation with quadratus femoris muscle pedicle bone graft.

**Key words:** Bone grafting; femoral neck fractures; fractures/bone; quadratus femoris muscle.

Intracapsular femoral neck fracture with delayed presentation in young patients can be a surgical challenge to any orthopedic surgeon. The problem is compounded by resorption of the femoral neck and avascular necrosis of femoral head. Such scenarios are rare in developed countries, but common in developing countries because of poverty, ignorance, and lack of medical facilities.<sup>[1,2]</sup>

It is desirable to retain the femoral head in order to achieve a stable, painless, and mobile hip joint. In

patients where anatomical restoration of femoral head and neck is desirable, treatment of ununited fracture neck of femur involves osteosynthesis, augmented with muscle pedicle bone grafting or osteotomy to convert shearing forces in to compressive forces.<sup>[3]</sup> We favored quadratus femoris muscle pedicle bone grafting advocated by Judet<sup>[4]</sup> and popularized by Meyers et al.<sup>[5,6]</sup> A posterior iliac cortico-cancellous bone graft was used to restore the femoral neck length. Our primary aim was to report union rate following osteosynthesis of ununited fracture neck of

femur using a modification of original technique, and secondary aim was to highlight the complications.

### Patients and methods

We retrospectively reviewed medical records and radiographs of all 42 consecutive patients with an ununited fracture of the neck of the femur presented late to our department between 1993 and 1999 (Fig. 1a). During this 6-year period, 42 patients (28 males and 14 females) were treated by open reduction and internal fixation and supplemented with a quadratus femoris muscle pedicle bone graft by the senior author (VSR). The mean delay in presentation to our department after sustaining fracture was 9 months (range 3-18 months). The mean age of the patients was 34 years (range 24 to 51 years). All the patients were followed at least 3 years after the index procedure. The mean follow-up duration was 5 years and 3 months (range 3-7 years).

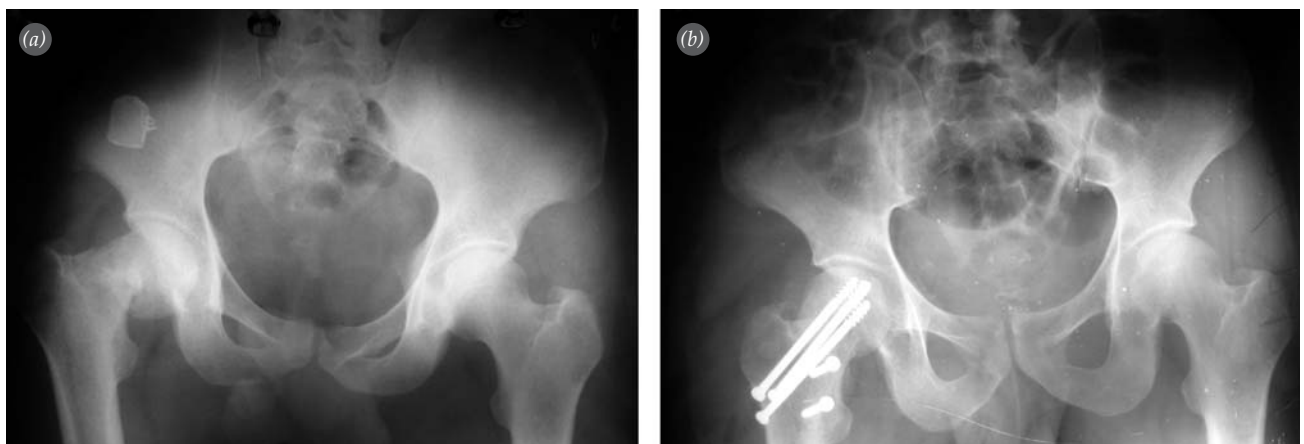
All patients had an anteroposterior radiograph of the hip in 15° internal rotation to assess the amount of neck resorption apart from standard anteroposterior and lateral radiographs. Twenty-five patients with preoperative shortening of more than 2 cm had preparatory skin traction for 5-7 days to help stretch the contracted soft tissues around the hip joint. Avascular necrosis was identified only on plain radiographs, as there is no magnetic resonance imaging (MRI) or bone scan unit available.

### Technique

All patients were operated either under general or spinal anesthesia depending on patient's choice and

anesthetist's preference. The affected limb was cleaned and draped with the patient in lateral position on a standard operating table. A posterior approach was used in all cases. The gluteus maximus was split along its fibers. The quadratus femoris muscle and its insertion into the trochanteric crest were identified and harvested with a saw and osteotome. The tendons of the short external rotators (gemelli and obturator internus) were transfixed, cut close to insertion, and elevated medially. The hip joint was entered after an inverted T shaped capsulotomy (short leg distal). All patients had significant posterior comminution justifying a posterior approach. The fracture edges were freshened till bleeding. A cortico-cancellous bone graft was harvested from the posterior iliac crest through a separate incision, and was used to reconstruct the neck length. The fracture was fixed with 4 Moore's pins in 17 cases and 3 AO type cancellous screws in the remaining 25 cases. A gutter was made in the femoral head and neck posteriorly in the long axis to receive the muscle pedicle graft, and fixed to the neck with 2 cortical screws. The wound was closed in layers over a suction drain. An image intensifier was not used, as the fracture was reduced under direct vision.

When control radiographs are satisfactory, patients were encouraged to mobilize non-weight bearing postoperatively. They were followed up with 6 weeks intervals until bony union was evident on radiographs, and later every 6 months until 3 years for any evidence of avascular necrosis.



**Fig. 1.** (a) Radiograph of 42-year-old patient presented 4 months after the injury. (b) Two-year follow-up radiograph of the patient with bony union and absence of avascular necrosis.

Fractures were considered to be united clinically by the ability to weight bear without pain and radiologically by formation of bony bridge across the fracture site. The patients were advised to bear full weight once there was evidence of clinical and radiological union. Functional recovery was assessed by gait and ability to squat on the floor.

## Results

The mean time to clinical and radiological union was 6 months (range 3-13 months). All patients had varying degrees of neck resorption, but 25 patients with short limb incidentally had more neck resorption confirmed at surgery. Thirty-six patients (86%) proceeded to clinical and radiological union (Fig. 1b). All failures seen in our study occurred during the early phase. Majority of the well-accepted clinical and functional outcome scoring systems for the hip joint were irrelevant to patients from rural India. All of patients were able to weight bear fully and function without any discomfort at final follow-up.

## Complications

There were 6 failures (14%). Of the 6 failures, 2 patients had failed Moore pins and needed a revision fixation with cancellous screws. The remaining 4 patients had a valgus osteotomy to achieve bony union. There were 3 cases of superficial wound infection settled with oral antibiotics. We noted varus union in 9 patients (Fig. 2) (6 fixed with Moore pins, and 3 fixed with cancellous screws). Leg length discrepancy was noted in the group of patients with significant resorption of the femoral neck, who sought medical attention late. In spite of reconstruction of the femoral neck using cortico-cancellous iliac crest graft 10 patients eventually ended up with a shortening of 1.5 cm (range 1-2.5 cm). Four patients of this group had a shortening of 2.5 cm and varus malunion due to early weight bearing against advice before bony union.

## Avascular necrosis

Six patients demonstrated increased density or lucency in the femoral head (grade 2 of Ficat<sup>[7]</sup>) pre-operatively. At final follow-up only one patient had progression with irregularity of femoral head (grade 3) and the remaining five patients revascularized radiographically without collapse (Fig. 3).

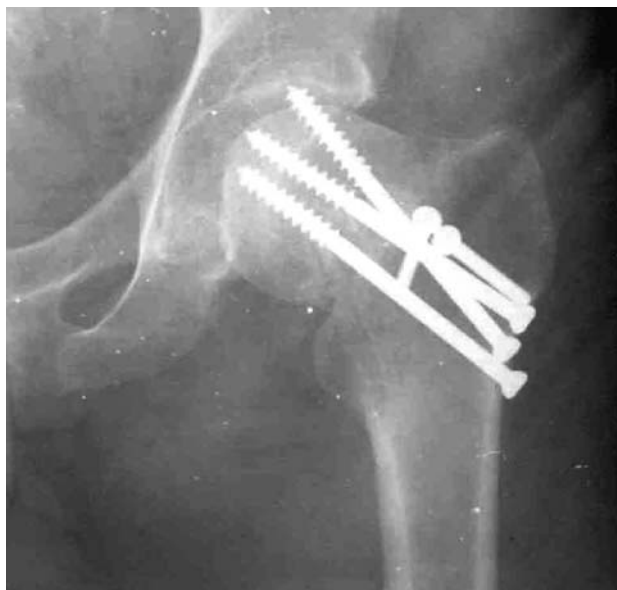


Fig. 2. Radiograph at 1-year follow-up of a patient with varus union.



Fig. 3. Radiograph at 18-month follow-up of a patient with evidence of avascular necrosis after bony union.

## Discussion

In developing countries, it is not uncommon for patients to seek medical support late due to poor medical facilities and ignorance. Massie<sup>[8]</sup> demonstrated a direct relationship between the delay of treatment and incidence of non-union and avascular necrosis after a displaced femoral neck fracture.

Konishiike et al.<sup>[9]</sup> studied the perfusion of the femoral head by dynamic MRI after an acute fracture of the neck of the femur. They found that the perfusion of the femoral head was unchanged in undisplaced fractures, but in displaced fractures all except few had impaired or absent perfusion. Marti et al.<sup>[3]</sup> achieved encouraging results with valgus intertrochanteric osteotomy to convert shearing forces into compressive forces for non-union. In 1953, Dickson<sup>[10]</sup> reported good results with valgus osteotomy and cancellous bone grafting in the management of non-union of fractured neck of femur. Gallie and Lewis<sup>[11]</sup> in 1940 reported 1 failure due to technical failure among 15 cases treated with a nail placed low in the neck and augmented with a bone graft harvested from the ilium, tibia or fibula inserted into a hole drilled in the femoral neck.

Beginning with Judet,<sup>[4]</sup> several authors have used the quadratus femoris muscle based bone graft in the management of displaced, delayed subcapital fractures and avascular necrosis.<sup>[5,6,12-17]</sup> Meyers<sup>[17]</sup> achieved 89% (121/136) union with muscle pedicle graft. Since 1970 the defect in the posterior aspect of the femoral neck was filled with iliac crest bone grafts and 97% (64/66) union was achieved. Baksi<sup>[12]</sup> achieved a 82% (46/56) union rate using a muscle pedicle graft. He reported encouraging results with multiple drilling and muscle pedicle bone grafting in the treatment of various stages of osteonecrosis of the femoral head.<sup>[13]</sup> Nagi et al.<sup>[18]</sup> reported 95% (38/40) union using fibular autograft in the management of neglected fractures of the femoral neck. Seven of eight femoral heads, which were avascular preoperatively, were revascularized at final follow-up. Gupta<sup>[14]</sup> reported 100% (20/20) union using quadratus femoris muscle pedicle grafting in the management of ununited fractures of the femoral neck. At final follow-up, in 6 patients there was no progression of osteonecrosis evident on plain radiographs preoperatively.

Our experience shows that preservation of the femoral head in patients with ununited fractures of the femoral neck is achievable. We achieved 86% (36/42) bony union at a mean of 6 months. Six failures occurred in cases operated in the initial stages before the technique was perfected and can be attributed to learning curve and use of Moore pins rather than cancellous screws. Five of six patients with

avascular changes in the femoral head preoperatively, revascularized at final follow-up.

All of our patients were positioned laterally on an ordinary operating table, and posterior approach was used. This is another alternative to having the patient prone on the fracture table. The assistant surgeon plays an important role in positioning the limb, so that adequate fracture reduction and reasonable neck length are obtained. Other authors have described their procedures in prone position on traction table using a posterior approach.<sup>[14,15]</sup> Having a patient prone on a fracture table with foot held in a footplate can pose considerable restriction to a surgeon who is not used to this procedure. Whilst an image intensifier could be used in conjunction with fracture table, we did not use image intensification as the open reduction, bone grafting and internal fixation with Moores pins/cancellous screws. None of the patients were immobilized postoperatively on contrary to other reports.<sup>[12,14]</sup>

There are other surgical options to manage this difficult case scenario. Whilst, Dickson<sup>[10]</sup> has suggested valgus osteotomy and cancellous bone grafting, Nagi et al.<sup>[11]</sup> have used fibular autograft after open reduction and internal fixation of the neglected fractured of the femoral neck. Valgus osteotomy and cancellous bone grafting is probably widely used in this situation as it is based on sound biomechanical principles. Fibular autografting provides structural support to the femoral neck during the fracture healing. The disadvantages for this option would be donor site morbidity and lack of additional blood supply to the femoral head. Free vascularized pedicle grafts have been used with excellent results. Our series showed very low rate of avascular necrosis using muscle pedicle grafting implying augmentation of local blood flow.<sup>[19]</sup> Free vascularized grafting requires microvascular expertise and adequate resources which may not be feasible in developing world. We are of opinion that a muscle-pedicle bone graft helps promote fracture union and whilst maintaining the vascularity of the femoral head.

We are reporting a retrospective case series of consecutive patients (level VI evidence). The success rate improved with usage of cancellous screws. It would have been ideal if the patients had a preoperative and postoperative bone scan or MRI to demonstrate the vascularity of the femoral head.

Such investigations are not routinely performed in our institute and would add considerable cost to the patient and hospital, which could not be affordable in public health care system.

As a conclusion, we believe that irrespective of the status of the femoral head in an ununited intracapsular femoral neck fracture, favorable results can be achieved by anatomical reduction, cortico-cancellous bone grafting to reconstruct neck, internal fixation with cancellous screws, and augmentation with quadratus femoris muscle pedicle bone graft.

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