Global reconstruction of type IIIA open comminuted femoral shaft fracture with segmental bone loss in an 11-year-old girl

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ABSTRACT

An 11-year-old girl with type IIIA open fracture of the femoral shaft and 4.5 cm bone loss, was treated by global reconstruction using a reamed, interlocking, intramedullary titanium nail, following meticulous primary debridement with pulsed lavage irrigation. The nail entry was carefully chosen at the lateral transtrochanteric point in order to avoid any vascular damage to the head of femur. The osteophilic nature of the titanium nail, in addition to the thick periosteum of the paediatric bone, helped satisfactory union despite a hostile environment. The child had 0-90 degrees flexion of the knee without any extensor lag at the last follow-up. To our knowledge, this is the first case described in the literature that proves the efficacy of nailing for such a fracture.

Keywords: bone loss, femoral fracture, intramedullary nailing, open fracture, paediatric fracture

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INTRODUCTION

Surgical treatment of fractured shaft of the femur in children was limited in the past to open fractures or to those associated with head injury or polytrauma[1,2]. Recently, there has been a growing trend towards surgery with expanding indications to include isolated femoral fractures[3,4]. The methods included external fixation[5,6], compression plating[7,8] and intramedullary nailing with either rigid[9-11] or flexible nails[12,13].

Open type IIIA fracture of the femoral shaft with segmental bone loss is rare, and its occurrence poses a difficult problem in its management. The rarity of such an injury and the complexity of its management are more interesting in children. We report such a case managed effectively with global reconstruction using delayed reamed nailing, resulting in a good clinical outcome. We maintain that such fractures, managed aggressively with meticulous primary debridement followed by nailing, have a better chance of healing from the periosteal new bone formation in children. In this case, the normal physiology of the child has been successfully taken advantage of. To our knowledge, this is the first reported case of a paediatric type IIIA open fracture of the femoral shaft with bone loss that has been successfully treated using a reamed, rigid, interlocking, intramedullary titanium nail.

CASE REPORT

An 11-year-old girl sustained a type IIIA open fracture of the left femur with segmental bone loss of 4.5 cm following a road traffic accident. She presented to us four hours later. She had no major distal neurovascular deficit. There was severe degloving of the thigh with loss of butterfly fragment of bone at the site of accident (Figs. 1 & 2). There was severe contamination of the fracture with crush injury to the muscles. The knee joint had a torn lateral parapatellar retinaculum and the remaining intra-articular structures were intact. In view of the bone loss, soft tissue loss, and severity of contamination, the fracture was graded as type IIIA as per the Gustilo-Anderson classification.

She underwent emergency debridement of the fracture with copious saline irrigation using pulsed lavage. The muscles were closed in layers over a drain and the thigh wound was left open. She was put on upper tibial pin traction post-operatively, in addition to the above-knee posterior plaster slab. After 48 hours, re-debridement with excision of necrotic skin margins was done. The wound was fairly clean and the fracture could be well covered by the overlying muscles. The torn quadriceps was sutured together to achieve anatomical continuity as far as possible. Hence, reamed, intramedullary, interlocking titanium nailing of femur across the bone defect was planned to maintain the limb length.

The nail entry point was chosen slightly

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lateral to the tip of the greater trochanter on the antero-posterior radiograph and at the midpoint on the lateral radiograph. The nail length was measured by templating the opposite femur and was stopped just short of the distal femoral physis. The nail was interlocked on either end by screws. This was followed by split skin grafting of the raw area in the same sitting. 90% of the skin graft had taken up at the end of seven days, and the patient was mobilised non-weight bearing with the use of bilateral axillary crutches. Small areas of raw wound were epithelialised with alternate day dressings. There was no limb length discrepancy or rotational malalignment. The knee mobilisation was started three weeks after injury, with the assumption that the sutured quadriceps had healed. She was discharged home a month after the injury, and was followed-up every six weeks for the first six months, and then every three months for the next two years.

At the follow-up, she had gradual improvement in her knee function. She achieved 90° knee flexion with no extensor lag at the end of three months and was then allowed full weight-bearing. The anteromedial bone gap had started forming new bone by this time, and the weight bearing was thought to enhance the rate of bone growth by way of micro-motion. She was advised to have bone grafting at the end of one year in view of the slow rate of fracture healing and a large bone defect, but the patient did not agree to undergo another surgery. At the last follow-up at 42 months, she had knee flexion of up to 90º and no extensor lag (Fig. 3). The knee was stable. She did not have any discharging sinuses and there was no limb length discrepancy. There were no features of change in the neck-shaft angle. Two cortices had trabeculae crossing the fracture site (Fig. 4). Analysis of the serial radiographs revealed definite evidence of reduction in the size of the bone gap with time. However, the possibility of implant failure remains in this growing child, until solid fracture union is achieved in the future.

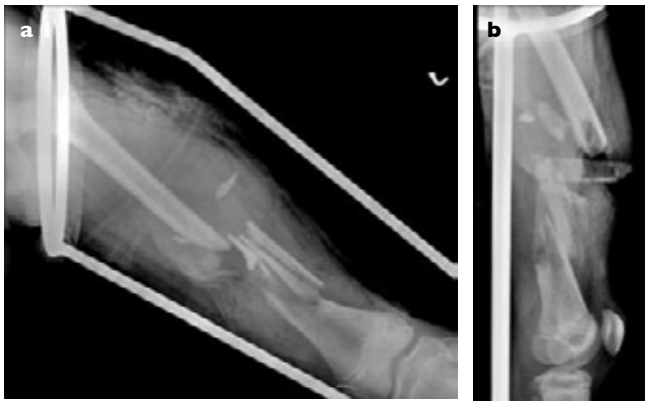

Fig. 1 Preoperative (a) anteroposterior and (b) lateral radiographs show a severely comminuted fracture of the shaft of the femur with bone loss.

Fig. 2 Clinical photographs of the injured limb (a) before and (b) after debridement along with the free bone fragments (inset).

DISCUSSION

Open fractures in children are rare, particularly of the femur. The femur, by virtue of being covered by bulky muscles, can tolerate a significant amount of degloving. It has less chance of bone loss for the same reason. The case we described had sustained high-energy trauma, with severe soft tissue injury and segmental bone loss. Children have a thick periosteal cover around the bone with good regenerating capacity. Even if the bone is fractured in a child, the tough periosteal sleeve remains intact and aids in fracture healing. Although numerous modalities of treatment of open fractures have been described, the principles of treatment remain the same. There is no substitute for initial meticulous debridement in any form of treatment. Pulsed lavage irrigation aids in clearing contaminants from the wound, especially in highly-contaminated wounds. Although the fear exists that the lavage fluid may force contaminants deeper into the tissues, we found better results after its introduction in the management of open fractures and joint replacements.

The second important aspect of limb salvage in this case was to maintain the limb length. We had the options of using an external fixator, flexible nail or standard interlocking (either stainless steel or titanium) nail. External fixator was discouraged for the present case due to the high likelihood of pin tract infection. The external fixator also needs to cross the knee joint to achieve a stable fixation, resulting in delayed weight bearing. The option of using flexible nails was rejected as this would not achieve stable fixation in a difficult case with 4.5 cm of bone loss. For the third option, the choice

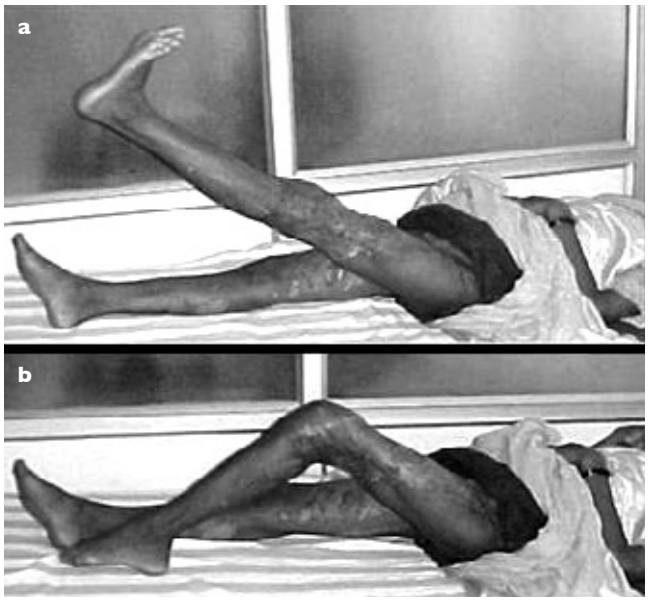

Fig. 3 Clinical photographs (a,b) show knee flexion 0-90° without extensor lag at last follow-up.

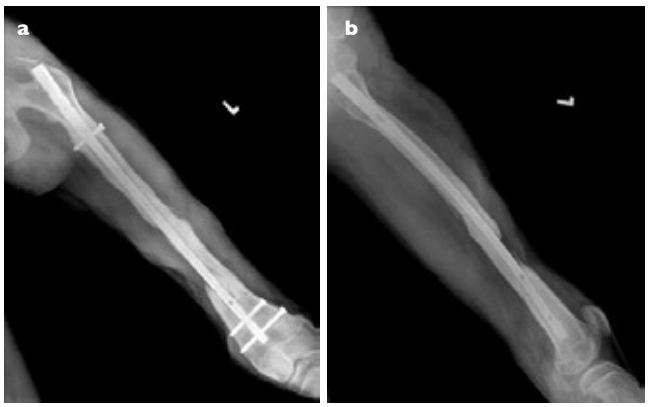

Fig. 4 Postoperative (a) anteroposterior and (b) lateral radiographs show solid fracture union.

between using stainless steel and titanium nails was easy, in view of the proposed increased fracture-healing property of titanium nails[14]. The AO nail would also have been an option in the present case because of its low cost. The acceptable limb length was achieved by templating the opposite femur in choosing the implant size. The reaming of the medulla would also have produced some osteogenic reamed material at the fracture site, enhancing union. Although there is a risk of trochanteric growth plate damage due to reaming, we did not encounter this.

Although numerous modalities (such as external fixators for bone transport) have been advocated for bone loss in open fractures, this is the first reported case where the reamed titanium nail used to maintain the limb length has also helped fracture union. The ideal treatment for the antero-medial bone gap would have been bone grafting. There is always a risk of implant failure in the future, unless the fracture completely unites. Complications (including osteonecrosis of the femoral head) have been reported in children, leading to recommendations against the use of the piriformis fossa as an entry point for intramedullary nailing[15,16]. The nail that was passed from the lateral transtrochanteric approach and the trochanteric ossification centre did not show premature closure or overgrowth producing coxa vara or valga.

We conclude that global reconstruction with delayed primary nailing of type IIIA open fracture of femur in adolescents undertaken following meticulous primary debridement can be expected to have good results due to the good muscle sleeve around the femur. Although extensive scarring is unavoidable, the early rehabilitation programme with this modality of treatment will help the patient psychologically. We believe that this is the first case of type IIIA open fracture of a child treated by global reconstruction with delayed primary nailing using a titanium interlocked intramedullary nails to be reported in the literature.

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