A Case Report of Ipsilateral Multiple Long Bone Fractures with a Floating Knee Complicated by Compartment Syndrome: A Single-Theater Session, a Panacea for Early Mobilization and Rehabilitation

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Abstract

An ipsilateral femoral and segmental tibial fracture with floating knee is a complex injury that could occur following a fall from height and a compartment syndrome further complicates it. This report highlights the need for the availability of ready implant pack for the emergency surgical management of a complex injury in a single-theater session. A 15-year-old male presented to our level II surgical facility after a fall from the balcony of the 5th floor of a storey building. Clinical evidence of fractures of the left femur and tibia associated with flail knee was noted in addition to early features of compartment syndrome of the leg. Fasciotomy as well as internal fixations of the fractures followed by a quick, uneventful recovery was performed. The severity and type of injuries sustained from accidental falls from heights depend on the height of fall, the pattern of landing, and the hardness of the impact surface. Fractures associated with floating knee and compartment syndrome should be treated as surgical emergency, and the availability of a ready implant pack is absolutely necessary for full intervention in one theater session. Emergency combination of fasciotomy and internal fixation of fractures in floating knee ensures early mobilization and reduces the length of hospital stay.

Keywords: Compartment syndrome, floating knee, ipsilateral, long bones, multiple fractures

Introduction

Fall from height at home or workplace resulting in multiple long bones fractures is second to traffic accidents as cause of trauma-related burden of disease.[1] Any body system can be injured, and the dense bones are often fractured depending on the part that hits the ground and the forces acting during the fracturing moment. Following an intentional jump from a height, the jumper lands on the feet and the patho-mechanics result in the fracture of the calcaneum, tibial plateaus, or femoral condyles or even the hip and pelvis, especially if the jumper did not break the fall on landing, and depending on height of the fall. The fractures after a fall may involve the proximal metaphysis of the tibia and the distal metaphysis of the femur of the same limb resulting in a floating knee. Multiple long bone fractures in the same limb are not unusual following a high fall,[1] and when complicated by compartment syndrome in the presence of floating knee, they become enough reasons for operative treatment in an immature skeleton. Conventionally, conservative treatment of fractures is recommended in children and adolescents because their immature skeleton heals faster and remodels easily but some indications for operative treatment have also been described in the literature and more recently with the use of titanium elastic nailing system (TENS).[2]

This case report highlights the need for operative treatment of this complex injury in an adolescent patient and the importance of having a ready implant pack with assorted range from which the desirable hardware could be selected to manage

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the fractures in the same operative session as the emergency fasciotomy. This obviates delay in the fracture treatment and thus reduces the length of hospitalization.

Case Report

A 15-year-old male who lives with his parents and his siblings in a convivial home fell from the balcony of the 5th floor of a five-storey building and landed on a concreted ground. There was a momentary loss of consciousness and pain and the inability to stand with the left leg. He presented to us 2 h after the fall. Resuscitation was commenced and Foley catheter drained 110 ml of clear urine. Examination showed a conscious patient with Glasgow consciousness score of 15/15, blood pressure of 90/62 mmHg, pulse of 98/min, and respiratory rate of 30/min. The left thigh and the left leg were swollen and there were no open wounds. The calf was tense and tender and passive dorsiflexion of the toes increased the pain. The dorsalis pedis and tibial arteries' pulsations were weak and the pulse oximetry showed oxygen saturation of 82% while the contralateral side was 98%. Urgent radiographs showed comminuted fractures of the distal metaphysis of the left femur and segmental fractures of the left tibia involving the mid shaft and proximal metaphysis [Figure 1]. Hemoglobin concentration was 9 g/dl and hemoglobin electrophoresis was AA. Serum electrolyte, urea, and creatinine as well as urinalysis were normal. He was transfused one unit of blood. During the period of workup, the limb was placed in a plaster of Paris back slab and wedged between pillows and elevated to the patient's heart level. The state of the compartment pressure was monitored and the pain was worsening despite adequate analgesia. The plan was emergency fasciotomy and plating of the fractures. These procedures were carried out within 5 h of admission under general anesthesia, adequate preoxygenation, and without a proximal tourniquet. Adequate care was taken to close the leg wound without tension. The postoperative radiographs showed satisfactory alignment [Figure 2]. The recovery was uneventful except for occasional complaints of headache without any feature that suggested raised intracranial pressure. He was discharged on the 10th postoperative day, nonweight bearing with crutches, and in a protective cast. Short-term follow-up at 6 months showed progressive union and ambulation without support [Figures 3 and 4].

Discussion

Multiple long bone fractures could follow high-energy transfers, usually encountered in falls from storey buildings.[1] Other body systems may be injured as well and so these call for thorough assessment by following the advanced trauma life support protocol. Furthermore, the surgeon should have a high index of suspicion and conduct clinical and radiological assessments to rule out child abuse in young patients.[3] The high-energy transfer in addition to causing fractures sometimes damages the vascular structures either directly or indirectly resulting in bleeding into the tight osseofascial compartment of the limb and raises the intracompartmental pressure. In our patient, the combination of thin build and close segmental tibial fractures was the risks factor for the accumulation of blood in the tight unyielding osseofascial space of the leg, with an attendant rise in compartment pressure. The incidence of compartment syndrome ranges from 5% to 36% in some series of segmental tibial fractures and this risk is also increased by intramedullary reaming.[4] Early recognition of compartment syndrome is important to forestall a possible progression to gangrene.[5]

Healing of many fractures in children by conservative treatment is the standard practice, but our index case was managed surgically because of the multiple fractures with a floating knee. When all the conditions are met to enable the surgeons to fix the fractures internally, it would be expedient to combine it with fasciotomy in one theater session to ensure early mobilization and rehabilitation. However, if it is not possible to have a ready implant pack which is a very important condition, within the time frame for emergency fasciotomy, an alternative surgical option is a delayed internal fixation within a few days, provided there is no postfasciotomy wound infection.[5] Another option is to use external fixator and manage it as an open fracture having made an incision into the fracture hematoma. However, the external fixator is better used as a temporary splint when the patient's hemodynamic status is unstable.[6] These alternative options will invariably prolong the hospital stay.[5]

In a poor resource setting, the financial incapacity in procuring an assorted range of implants and the nonguarantee for their early use if procured as well as the poor sustenance of an implant-revolving fund are some of the banes of orthopedic trauma care.[5] Budgeting for such implants where there are other pressing needs becomes secondary. Therefore, a common scenario is to arrange for such implant from the company's vendors and this could take up to 2 days. Consequently, it would not be possible to fix the fractures at the same theater session as the fasciotomy leading to the overall delay in mobilization and rehabilitation. Therefore, it is important that centers which provide orthopedic trauma care should have a policy of ensuring the availability of basic resources, especially a ready-to-use implant pack, so that a one-time holistic treatment is provided to the patients with complex injuries like in this index patient. In addition, health insurance coverage for a wider range of orthopedic trauma care is advocated so that financial burden would not be a factor in the use of such implants when they are available. In situations where this coverage is not applicable, the health facility usually would ensure that the patient makes reasonable financial commitment for the procedure within the short time frame and often times, this may not be possible, therefore making the plan for single-session intervention unrealizable.

The adequate resuscitation as well as the early operative treatment of this patient in one theater session also ensured that his metabolic response to trauma was kept to a minimum and avoided the chances of second-hit phenomenon[7] which could

Figure 1: Radiographs showing left ipsilateral femoral and tibial fractures

Figure 3: Six-month postoperative radiographs showing union

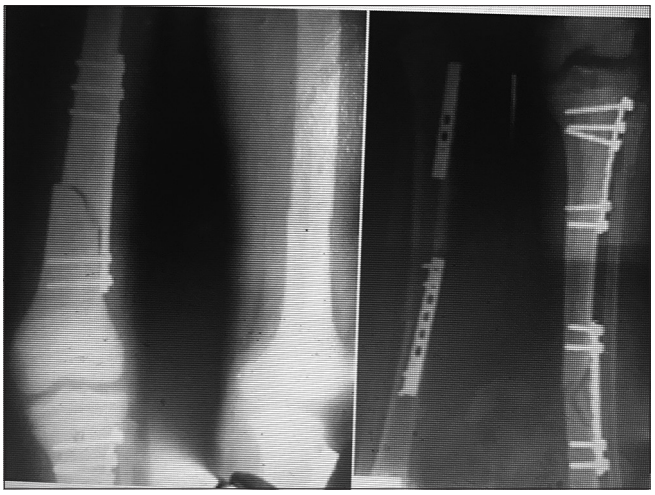

Figure 2: Immediate postoperative radiographs showing well-reduced fractures with internal fixations

Figure 4: Six-month postoperation (patient standing and ambulating without support)

be associated with more aggressive response and possibly tilted the patient into severe systemic inflammatory response and multiple organ dysfunction.[7] The immature skeleton has a high osteogenic potential and so union and remodeling are usually satisfactory.[6] However, malunion due to shortening and rotational deformities often complicates floating knee that is managed conservatively. For this reason, many authors prefer surgical treatment for floating knees in all age groups.[8] There is a current preference for TENS for the femur and the tibia through anterior knee incisions in childhood floating knees,[2] but reports of excellent results from dynamic compression plating are also abound in the literature.[9] The aim of surgical treatment is to obtain an early stable fixation of the fractures to enable early mobilization. However, this operative timing should be considered with respect to the stabilization of the patient, especially with regard to the injury severity score. Associated ligament or meniscal tear in the knee prolongs the healing process and rehabilitation,[10] and recovery is also determined by the extent of soft-tissue injury in the leg or thigh.[10] Furthermore, appropriate care should be taken like in our patient to avoid complication of infection, especially on the background of compartment pressure-induced local ischemia. The comminution of the fractures necessitated our choice for bridge plating and the union progressed as expected. However, a temporal protective cast was applied on the day of discharge when the compartment syndrome had resolved completely.

Conclusion

When multiple long bone fractures are associated with floating knee and compartment syndrome, the need for emergency surgical intervention cannot be overemphasized even in an immature skeleton. The internal fixations of the fractures at the time of emergency fasciotomy ensure early mobilization of the patient and early discharge from the hospital.

Consent

The patient and parents gave unconditional approval for this publication.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given

his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal patient identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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